1-12-1893

The WPI Volume 8 Issue 15, January 12 1893

Students of Worcester Technical Institute

Follow this and additional works at: http://digitalcommons.wpi.edu/wpi

Recommended Citation


This Book is brought to you for free and open access by the WPI Student Publications at DigitalCommons@WPI. It has been accepted for inclusion in The WPI All Issues by an authorized administrator of DigitalCommons@WPI.
## CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Editorials</td>
<td>173</td>
</tr>
<tr>
<td>W. M. E. S.</td>
<td>179</td>
</tr>
<tr>
<td>The Calendar</td>
<td>174</td>
</tr>
<tr>
<td>Nails and Tacks</td>
<td>181</td>
</tr>
<tr>
<td>Other Techs and Ours</td>
<td>175</td>
</tr>
<tr>
<td>Examinations</td>
<td>182</td>
</tr>
<tr>
<td>Something about Chapel</td>
<td>177</td>
</tr>
<tr>
<td>Alumni Notes</td>
<td>182</td>
</tr>
<tr>
<td>Notes by Entropy</td>
<td>178</td>
</tr>
<tr>
<td>Technicalities</td>
<td>183</td>
</tr>
</tbody>
</table>
W. H. JOURDAN,
ANTHRACITE AND BITUMINOUS
COAL,
WHOLESALE AND RETAIL.
Fire Sand, Clay and Brick.
Offices: 366 Main St., and at Yard,
Green Street,
WORCESTER, MASS.

CHAS. F. HANSON & CO.,
317 Main Street, Worcester, Mass.

THE HERCULES
TURBINE WATER WHEEL.
Best
Part-Gate
Efficiency of
Any Water
Wheel ever made.
Manufactured by

HOLYOKE MACHINE CO.,
WORCESTER, MASS.

S. I. HOWARD,
CARPENTER AND BUILDER,
Estimates furnished on all kinds of work. Store Fronts in Heavy Brick, Stone, or Iron Buildings a Specialty.

RESIDENCE 63 MAIN ST.,
WORCESTER, MASS.

FRANK H. RICE'S
PHOTOGRAPHIC STUDIO,
311 MAIN STREET.
Makes a specialty of Photographic Work of all kinds and sizes.

Having received the generous patronage of former students, I respectfully solicit the same in future from the Institute this sheet represents.

Twenty-five per cent. discount to Members of the Institute.

TECH STUDENTS SHOULD KNOW
THAT OUR STOCK OF
DRAFTING INSTRUMENTS
AND MATERIALS
IS THE LARGEST IN NEW ENGLAND.
THAT THE QUALITY OF OUR GOODS IS THE BEST THEY ADMIT
WHEN THEY SEE THEM.
ILLUSTRATED CATALOGUE MAILED FREE.

WADSWORTH, HOWLAND & CO.,
82 & 84 WASHINGTON ST., BOSTON.
THE WPI.

W. A. ENGLAND,

THE

JEWELLER

We make a SPECIALTY of REPAIRING FINE WATCHES, CLOCKS, and JEWELLERY. ALL WORK WARRANTED.

SIGN OF THE SIDEWALK CLOCK.

394 Main Street, Worcester.

THE NEW ENGLAND GROCERY AND TEA HOUSE,

234 to 238 MAIN STREET,

Make a Specialty of

IMPORTED and DOMESTIC GROCERIES.

Great Variety of Fruits and Candies. H. A. BROWN, Manager.

LUD C. HAVENER,

BICYCLES,

ATHLETIC GOODS,

CLOTHING, SHOES FOR SPRINTING, ETC., ETC.

Outfitters to W. P. I. CLUBS.

507 MAIN STREET.

IMPROVED

WHEELOCK ENGINE.

50 to 3000 Horse Power. Built in all Forms,

CONDENSING, COMPOUND, TRIPLE EXPANSION.

WHEELOCK ENGINE COMPANY,

WORCESTER, MASS.


CHAS. HAMILTON,

BOOK, JOB, CARD, POSTER AND NEWSPAPER PRINTER,

NO. 311 MAIN STREET, -- -- -- WORCESTER, MASS.
THE
STEAM
Pumps.

DEANE
Pumping
Machinery,
FOR EVERY DUTY.
The DEANE STEAM PUMP CO., HOLYOKE, MASS.
New York, Boston, Chicago, Philadelphia, St. Louis. Send for Catalogue.

DAVIS & CO.,
286 MAIN STREET, 286
—DEALERS IN—
Fine Ready-Made
CLOTHING.
Stylish Garments for Young Men a Specialty.
Those who prefer Garments Made to Measure will find us prepared, at all
times, to show seasonable goods of all grades and prices.
All Work Warranted Satisfactory.
Novelties in Furnishing Goods.
Prices Reasonable.

DAVIS & CO.,
Opposite Bay State House.
For the third successive year the WPI has undergone a change of management in the middle of the volume, hence it has now become unnecessary to state the obvious disadvantages of such a change.

The conduct of the paper by Mr. Comins is deserving of at least a word of commendation. He has set a standard which his successors will be honored even in equalling. He has accomplished a great amount of hard work in changing from a monthly to a semimonthly period of issue, with the changes in policy which this involved. It is a fortunate state of affairs that Mr. Comins will still remain on the board, and hence that his influence will not be wholly lost.

We wish to express our appreciation to the Amherst Student for the regard for our feelings which it showed in referring to the WPI by the correct name, that is,—without the periods. Those dots are our sensitive points.

To the students in general, the most important offices to be filled in class elections are those of athletic directors. Without reviewing any history of former boards, there is a word of advice to the different classes: Do not elect a man to this office, simply because he is an athlete. The main qualities required are judgment and energy, not ability to break records. We have selected as manager of the Inter-collegiate team, a progressive, energetic man, and he ought not to be handicapped by a board of weak, incapable directors.

In laying out the course in English Literature, Prof. Cutler seems to have overestimated the time which he may justly claim as preparation for his work, or the abilities of the students, or both. He requires the reading of twenty-five selections, taking an average of three hours each, and research on a special subject, in addition to preparation for one recitation each week, all in one hundred hours. It is evident that there must be slighting somewhere if this plan be carried out. But now that Prof. Cutler's attention has been called to the mistake it will undoubtedly be rectified.

But the question has another phase. Without any outside compulsion to do so, each man should feel within himself that it is his privilege and duty to make the most he can of the course in English Literature. There is none too much of a broadening element in our course at best, and none can afford to slight in any degree whatever may be offered in the line of the "humanities." The question is not whether a small or a large number of selections be read, but whether either be read well. The Senior is as a rule a busy man, but surely almost
every one may find time to devote to his recreation and improvement in the study of literature, not under compulsion through fear of an examination, but in the broad spirit of seeking after light.

Particular attention is directed to the communication on chapel exercises in another column. The suggestions therein contained are all worthy a fair trial, except that a return to a system of compulsory exercises is hardly to be desired. Such a system is of doubtful efficacy anywhere, and there seem to be specific local causes tending to its utter failure here.

The change of time is an important point, and more emphasis might be laid upon the value of the musical part of the exercises. Song has a power for unification and inspiration which is too well known to need any demonstration. Along this line great good may be accomplished.

And in addition to the suggestions offered by Senior is the one that the reading of short extracts from prose or poetry containing some great thought or high moral idea, would be a valuable aid to the students, and that a short talk by the professor conducting the exercises on some subject of the higher life would also be of interest and profit.

The question of the schedule for a four-year course will undoubtedly come before the Trustees for consideration at no very distant day, and the W P I offers here a few suggestions which it is hoped may lead to interesting and profitable discussion.

First, the devising of a plan whereby mechanical drawing may be taught in connection with shop practice. This does not mean a shortening of the total hours devoted to both, but cases have occurred which seem to show that the drawing as now taught is of little practical use even in the Washburn Shops, and if not of use there it may be wondered just where it will be. The two departments should be connected, even if they are not both put under one head.

Second, the introduction of a Course of Business Law which might include a variety of topics. This is given in some courses at the M. I. T. and would be an interesting and valuable feature of the course. It might be taught under the direction of the Professor in Economics, or possibly by lectures by outsiders. Such a course was hardly to be thought of under the three-year régime, but there can hardly be objections now on account of lack of time.

There is a strong feeling among the students who have taken both courses that it was a mistake to separate the mechanical and electrical departments. The W P I published some months ago an article asking for shop practice devoted to the building of dynamos and other electrical work. And if to this were added the testing of such machines as a part of mechanical laboratory practice the results might be better than under the present system. Final judgment must be suspended, however, for the present system has not had a chance to prove either its value or lack of it.

THE CALENDAR.

The Editors of the W P I have been greatly disappointed in getting out the Calendar. An amateur photographer took a photo of the Institute at our request. This turned out poorly, and another was taken. The second one was rather better and was sent away, that from it an engraving might be made. The engraving arrived the first of last week, but was unsatisfactory. The Editors, believing students would rather put up with the delay than with an inferior picture, had a third photo taken, this by the best professional out-door photographer in the city. The result this time was also poor. Three more photos have been taken, one by each of these artists, and one by another amateur, and unless No. 6 turns out well there is not a satisfactory one in the lot. The committee having started are going to have a first-class cut, if the calendar does not come out until 1894.
OTHER TECHS, AND OURS.

To the Editors of the W P I:—

In an article on "Other Techs, and Ours," in a recent number of the W P I, the author states that the figures "are taken from carefully arranged and corrected tables which, of course, are made up without prejudice, and are statistics pure and simple."

A few weeks ago, I endeavored to make some use of the figures given in the table that we are informed was carefully arranged and corrected, but soon came to the conclusion that the figures have but little, if any, value, when comparing the work done at different institutions; for it is very evident that a common standard was not employed in making the table, and, in many cases, the standards must have skipped around as lively as a lot of Juniors in the basement of Boynton Hall, and confused the compiler as completely as our friends sometimes disturb the meditations of the Civils while endeavoring to carry on their work and keep out of mind the pandemonium directly under them.

I can find no other explanation for some of the figures in that carefully arranged and corrected table.

The author of "Other Techs, and Ours," gives the following:—Thermo., 98; Draw., 636.

On noticing those figures, I hastened to consult the latest W. P. I. catalogue to ascertain if any member of our Faculty is hard-hearted enough to force the students to work more than sixty hours per week.

I am very happy to be able to state that I can find no evidence in the catalogue that any member of the Faculty believes in studying more than six days during a week, upon subjects that are connected with the work of our institute.

If the Civils have 98 hours or 98 minutes of thermodynamics in their course at this school, I wish we could ascertain something about it, from the information given in our catalogue. For the want of any better evidence than the Engineering News table, I shall continue to believe that the W. P. I. Civils do not take thermodynamics as a part of their school work. I have also examined the Mass. Inst. catalogue, with considerable care, without finding any evidence that Thermo. is included in the Civil Engineering course at that institution. Drawing, 636,—so says the carefully arranged and corrected table, which appears so faultless to our friend, that any conclusion drawn from a W. P. I. catalogue may be valueless to him.

I can manipulate figures to some extent, but am not expert enough to check the 636 hours of drawing time, which can include no part of the drawing during practice time, because that is all included in the Engineering News table, under the head of surveying.

The work of a term at the W. P. I. is now due in about 16 weeks, and we have about 352 hours for free-hand and mechanical drawing, and about 160 hours for stereotomy; or the time given to drawing and stereotomy is 124 hours less than that given in the Engineering News' incorrect table. Looking for a few more figures, I find that my friend, if a Civil, is looking forward to 312 exercises in French and German and 210 exercises in English literature and rhetoric.

I wonder whose work he intends to cut, and pardon me for wondering where I can find any evidence that French is now taught at the W. P. I.!

The present arrangement of the Civil Engineering course, as given in the catalogue, provides for about 432 exercises in English, German, Political Economy and Political Science, or 90 exercises less than the number given in the W P I article for English literature, Rhetoric, French and German.

It certainly does not appear that the tables were prepared with any great amount of care, when such errors can be so readily detected. I have not exhausted the evidence of the unreliability of the Engineering News table, when compared with the W. P. I. catalogue, but, as this is getting somewhat monotonous, let us turn our attention to some other school. I have selected the Rose Polytechnic Institute, because I find that its last catalogue is prepared in such a manner that one can determine the amount of time given to different subjects, without making any very wild guesses.

Under the head of astronomy, in the Engineering News table, I find the somewhat suspicious looking figures 296, for the Rose P. I.; but the Rose P. I. catalogue gives about 176 hours for lectures on astronomy, applications of the method of least squares and stresses in framed structures, during the second term of the Junior year, and I can find no other reference to astronomy in the course of civil engineering studies given in that catalogue.

According to the Engineering News table, the Civils at the Rose P. I. have only 114 hours of surveying; but when compared with the figures in the same column of the table, opposite Worcester P. I., I think the number should be increased to about 600.

It is probable that under the head of French or S., the Engineering News table also includes German, for I find figures in that column opposite Worcester P. I.
Now look at page 16 of a Rose P. I., 1891-2 catalogue, and, with pencil and paper, determine, as closely as you can, the number of French and German exercises in the course given on that page, and while you have your pencil ready for work, just make a few notes about the exercises in English and political economy. If you are a tolerably fair calculator, I think you will obtain about 315 French and German exercises, and about 100 exercises in English, &c. How does this compare with the 114 and 41 in the Engineering News table?

I think we have made comparisons enough to show that the table is unreliable, and as I look at the grand totals given in the table, I lose all confidence in their value, when comparing the work of different institutions.

It is probable that, in many cases, no discrimination was made between prepared and unprepared exercises. The figures may include all the time allowed for preparation for recitations, in some cases, while in other cases they may include no part of the preparation time; but in no case can I find the information that is needed to make comparisons that do not misrepresent the work of the institutions. Sufficent information can readily be obtained from the catalogues of the Boston Tech. and other schools, to show that, in many cases, the figures in the table do not represent the work of those schools, when compared with the figures opposite Worcester P. I. Then the statement that "they prove that in the Civil as well as the Mechanical Department, the work required here is as much and even more than in other technical schools with four-year courses instead of three," was undoubtedly made without any careful investigation, and was based upon the assumption that figures can never be made to misrepresent facts.

I am inclined to suspect that the fact that there is a difference between the kinds of work done at different schools, received no consideration. Suppose, for the sake of an argument, that the Engineering News table is correct; how does the 387 hours for engineering technicalities at the Worcester P. I. compare with the 2070 at Cornell, or the 1270 at M. I. T., or the 1240 at Washington University? Look through the list and observe that there are only eight schools out of fifty-one that have as small number of hours for engineering technicalities as are given in that column of the table, opposite Worcester P. I., and then tell me what is the argument that is to be drawn from such comparisons, if you think the figures represent the work of the institutions.

The part of the article which deserves the most criticism, is the portion in which the author apparently endeavored to present an argument against a change to a four-years course.

Such figures as are given in the Engineering News table form no basis for an argument for or against any proposed change in our course of studies.

A table giving the exact number of hours of prepared and unprepared work, without combining a lot of subjects under one head, would give sufficient information to enable one to make much fairer comparisons than can now be made; but to draw conclusions from such figures as have been presented to us, appears to me to be as unjust. In many cases, as to require the W. P. I. students to count ten hours of practice as equivalent to ten prepared exercises.

The arguments in favor of a change to a four-years course in civil engineering, are many, and are not based upon the author's understanding of the figures in the Engineering News table.

Although I apprehend that you are getting tired and wish I would stop, I hope your patience is sufficiently elastic to allow me to present one or two arguments in favor of the change:

1st. Civil Engineering students are not prepared to begin the study of mechanics till the beginning of the senior year, and the lack of knowledge of mechanics forces them to carry on the engineering work of that year, under very unfavorable conditions. As no one has yet presented a satisfactory scheme which crowds all the pure mathematics of our course into the Junior and the first term of the Middle year, it is probable that the Civils must continue to have considerable patience with their instructor, until a more satisfactory arrangement of the work can be made.

2d. All the time that we have for engineering technicalities is about 368 hours during the Senior year; 320 hours of this amount is called practice time and, according to the catalogue, we have about 48 hours for engineering laboratory work.

The practice time during the Junior and Middle years cannot be used for the kind of work that we endeavor to do during the Senior year. The students are now forced along just as fast as they can be prepared for advanced work.

If any one thinks that it is possible to cover in 320 or 368 hours what the leading schools give under the head of engineering technicalities, my opinion of his opinion about civil engineering matters is not represented by "A+," according to the scale employed in making out semi-annual reports.

Perhaps a comparison of some of the work done here with the same kind of work at the
Rose P. I., will reveal some of the points where I think our present civil engineering course is weak, when compared with the time allowed in the courses of a large number of the engineering schools of this country.

I have prepared the following table from data given in catalogues, and, although one more familiar with the Rose P. I. work may be able to detect errors of a few hours in some or all of the items, I have considerable confidence in the figures and have endeavored to have them represent facts and not opinions.

<table>
<thead>
<tr>
<th>Subjects</th>
<th>W. P. I.</th>
<th>Rose P. I.</th>
<th>Excess</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pure Mathematics</td>
<td>400</td>
<td>50</td>
<td>144 E.</td>
</tr>
<tr>
<td>Elementary Mechanics</td>
<td>66</td>
<td>66</td>
<td>144 E.</td>
</tr>
<tr>
<td>Applied</td>
<td>132</td>
<td>132</td>
<td>264</td>
</tr>
<tr>
<td>Physical Laboratory</td>
<td>156</td>
<td>156</td>
<td>134 H.</td>
</tr>
<tr>
<td>Engineering Laboratory</td>
<td>156</td>
<td>156</td>
<td>150 H.</td>
</tr>
<tr>
<td>Thesis Work</td>
<td>96</td>
<td>96</td>
<td>5 Weeks.</td>
</tr>
</tbody>
</table>

**Work During Practice Time.**

| Stressors in Structures       | 160 Hours | 516 Hours | 356 H. |
| Least Squares & Astronomy     | 96        | 220       | 124 H. |
| Design of Structures          | 874       | 1208      | 334 H. |
| Other work during practice    | 1350 H.   | 1944 H.   | 814 H. |

I will not trouble you by calling your attention to pure mathematics and mechanics, but just glance over those figures that follow, and if you do not think that the Rose P. I. course gives to students the better opportunity to secure some elementary knowledge of engineering work, provided that the work is not forced upon an insufficient number of instructors, then what are the grounds for your disbelieve?

Another argument can be derived from the fact that our time for hydraulics is very limited and not sufficient for even what we endeavor to cover, while no time can be found for making applications to such problems as are of common occurrence in engineering practice; and so I can continue to call your attention to such matters, but when once started, it seems to be down grade all the way, and I imagine I hear the whistle for brakes.

The main object in view, when I commenced, was to show that the Engineering News table does not give reliable information, and that arguments based upon figures given in that table, lead to erroneous conclusions.

As I made a more thorough examination of the W P I article, the evident attempt to present an argument against a change in the course of studies, caught my attention, and I have endeavored to demonstrate that there are two sides to the question, viz.: My side, and the other fellow's.

Q. E. D.

"Q. E. D." has certainly advanced strong arguments for a change from a three years course to a four, and the W P I is gratified that the change has taken place.

We are inclined to take somewhat of credit in causing the falsity of the Engineering News table to be brought to light, even while we must admit that the article evinces a lack of care in verification of its figures.—Ed.]

**SOMETHING ABOUT CHAPEL.**

**Editor W P I:**

It is now nearly a year since compulsory chapel attendance was abolished, and all students, except those who entered school last Fall, have had an opportunity to compare the old system with the new. For many reasons the latter is found to be decidedly unsatisfactory. Not unsatisfactory as compared with the old system as it was, for even the most disorderly inclined students would hesitate before returning to the uproarious scenes of a year ago, but as compared with the old system as it should have been. The students never demanded the change within the last three years at least. They only asked that the service be not made a farce; and there is little doubt that if to-day a vote were taken a majority would favor a return to compulsory chapel, provided it be properly conducted. Under the present arrangement, there is not a single exercise from one end of the term to the other at which we all meet together. Except for an occasional class meeting or a chance nod in front of the bulletin boards, we might just as well be in a college of scarcely twenty members, for we get but little acquainted outside of our divisions. A fifteen-minutes chapel exercise at a quarter to ten, no matter how irreligious a student is or what his creed, makes a cheerful break in the morning's series of recitations, and gives him an opportunity to meet and speak with men in other divisions and classes.

There is something extremely pleasant in the pushing up the stairways; in the crowding about the door-way, and the exchange of greetings; in the strolling to one's own seat and sitting with one's fellows. The presence of two hundred and fifty young men all bent on the same purpose and sharing in common the difficulties and pleasures of school life, the stirring words of a hymn from so many throats, these all combine to arouse a man's enthusiasm and make him go back to his studies with a renewed zest and an awakened interest in his fellow-students. It may be said that these advantages might all be enjoyed at present. This is hardly true. In the first place chapel occurs at such an hour that it requires an effort for a student to attend. He may be ever so willing to go, but when no penalty follows absence, it is a little easier to let chapel go by for just once, than it is to pack up books and hurry to Boynton Hall fifteen minutes
NOTES BY ENTROPY.

Mr. Editor:— In the last letter I wrote you, I tried to tell something about Brown & Sharpe's shop. When I received the W P I, I found that I didn't say much about it. I will try to keep myself to my subject this time.

On stating the object of our visit and that we were W P I men, we were immediately given over to the care of a very gentlemanly guide. We were very much pleased at having somebody to accompany us who knew something about machinery, instead of being allowed to wander at our own risk, or being accompanied by the office boy or "ink slinger." He first took us to the wash room. We were not bright enough to see the insinuation though, if there was any. By the way, we did not need a bath after leaving the shop which is more than I can say of most places I have visited. The washroom is modelled after that of the W. M. S. or vice versa. That is, the wash tubs are, the rest isn't, decidedly not. Every man is assigned his place, and the majority use a variety of soap that is slightly soluble in water. I believe this does not accord with Tech practice. This room, which is also a coat room, is presided over by a man who also acts as a sort of watchman, being responsible for anything the men may leave there while at work.

In the machine shop machinery of different kinds is grouped together. One large room is filed with grinding machinery. We were told that most of this machinery was designed by them for their own use in manufacturing. There is seemingly every possible variety. They use emery wheels for grinding to accurate sizes and where true cylindrical surfaces are desired, also where it is merely desired to polish. We understood that all flat wearing surfaces of cast iron or brass were scraped by hand to surface plates, there being danger that in these softer and more open grain metals, that particles of emery would adhere to the surfaces and cut their way out when the bearing was used. Grinding planers are used, however, for polishing.

How many times have I polished hours and hours in the W. M. S. with a greasy rag, nominally emery cloth, to wear out imperceptible scratches in handles, etc., only to see it scratched up in successive operations and no notice taken of it. This polishing by machinery as seen here and at the Deane Steam Pump Co., at Holyoke, seemed to be the only thing needed to secure happiness, unless the abolition of Dutch was counted in.

In another room are the gear-cutters. We noticed especially the planers or shapers for cutting the teeth of bevel-gears theoretically correct. We had always supposed that the operation of planing gear-teeth was confined to large gears, but we saw a little gear, hardly over two inches in diameter, being cut on one of these machines. For large gears and quick running, these planed gears are necessary in order to get quiet action, unless wooden cogs are used, which are in some ways objectionable. Another thing which is often overlooked by users of these gears is that the axis of a pair of bevel gears must intersect. Not somewhere near but actually. The failure to place gears correctly has probably caused quite as many failures as incorrect cutting.

In going through the pattern storehouse we noticed that some of the patterns were painted with clear shellac. No black paint on them. I wondered how many pattern-makers' work would look well under such a coat. Perhaps they black over those that they don't have good luck with. I also suspect that a moulder will handle a pattern with a little more care if he knows that any bruise on it will show more plainly than on the black patterns.

We glanced into the draughting room only long enough to note the small number of men that it seems to need to keep so large a company up to the times.

Yours, "Entropy."
W. M. E. S. MEETING.

The Washburn Mechanical Engineering Society held its regular meeting last Monday evening in the chapel at Boynton Hall. There were about a hundred members and visitors present. Pres. Paul called the meeting to order and after the reading and acceptance of the minutes of the previous meeting, the following names were submitted by the Board of Managers for admittance to membership, and were unanimously voted in: S. S. Jennison, '71; W. P. Dallett, '81; B. A. Gibson, '91; L. P. Strong, '93; A. D. Butterfield, '93; H. B. McFarland, '94.

Prof. Alden then introduced the speaker of the evening, Mr. Geo. H. Babcock, president of the Babcock and Wilcox Boiler Company of New York, and past president of the A. S. M. E.' He spoke of him as having made friends in every civilized quarter of the globe.

The subject of Mr. Babcock's address was, "The Genesis and Exodus of Steam." He spoke somewhat as follows:

"Probably the first thing made was Hydrogen, considered by many as the basal element from which all others come, and possessing in the greatest degree the property of conservation of energy in the form of light, heat, electricity and force. Oxygen was also one of the first elements created. It was these two elements which the All-wise chose to unite, to form that which was to become the greatest physical blessing to the being whom he purposed to create in His own image, and place upon the earth in the future ages. And so Oxygen and Hydrogen were married, and in their union brought forth steam in its highest state of energy, ready for its mission in the world, and when, in fulfilling that mission, it had imparted very much of its energy to the things around it, it condensed and became water, and when this had further given off its heat to things colder than itself, it became ice." Steam is a mineral, for, if science is to be believed, Hydrogen is a metal, and steam and water are merely metallic oxides and as truly minerals as oxide of iron in iron ore.

"If 1/2 lb. of H. be mingled with 1/2 lb. of O, and ignited by a spark of electricity, enough heat is liberated to melt 20 lbs. of steel or 350 lbs. of lead, or to have exerted 2 1/2 H. P. for an hour. When heat enough has been subtracted from the pound of steam to have raised 37 pounds of water from freezing to boiling point, it will itself become water, and when it has given off enough more heat to raise 320 lbs. of water one degree, it will have become solid itself.

"We have, say, one lb. of water, and we put it in the bottom of a vessel in which we have fitted a perfectly tight and frictionless piston. To the bottom of this vessel we apply our heat, assuming that the vessel itself has neither specific heat nor power of radiation whereby we are enabled to apply our heat to the water without interference or losses. We start with the water at the temperature of 32° F. As heat is added its temperature rises at the rate of one degree for each thermal unit, but, for a time, this produces no expansion. ** At about 40° the water is at its greatest density, and from that time on, it will be found to expand gradually as it increases in temperature, until it has arrived at 212° by the addition of 180° H. U., when, if our piston be supposed to be without weight, and to be held down only by the pressure of the atmosphere at the level of the sea, it will have come to the boiling point. This boiling point varies with every variation of pressure. Its characteristic is that, when at this point the water is incapable of becoming any hotter, and every addition of heat thereafter, however small it may be, converts a portion into steam, in other words the water has all the heat it can hold—as water—at that pressure." The water has now increased in bulk about 4% and raised the piston. The heat added has been employed in three ways. About 1/399,000 in mechanical work; about 60% in overcoming the internal resistance of the water, and the remainder in raising the temperature, increasing the vibration of the molecules.

"Beyond this point, each addition of heat, instead of raising the temperature, converts a portion of the water into steam, having a bulk 1622 times greater. Here a unit of heat raises the piston 7800 times more than before, or does an amount of work equal to about 60 ft.-lbs. After 966 heat units have been added, the water is entirely evaporated, but there is no change in temperature, hence this added heat is called 'latent.' It is not lost any more than the force exerted in winding up a watch spring is lost. It is simply stored.

"The action just described is what takes place in an open vessel, but the action in a steam-boiler is different.

"If we had placed our pound of water in a close vessel of infinite resistance to rupture, and just large enough to hold it, we could have heated it to any extent without making steam. If we suppose the envelope to have the same co-efficient of expansion as the water, and the water to retain the same specific heat at low temperatures, it will be found that when there has been added the same quantity of heat as was required before to make it all into steam,
instead of indicating 212° in the thermometer as before, it will now show nearly 1200°, or be red-hot, at which high temperature it would exert a pressure of about 20,000 lbs. per square inch.

"What we call a steam boiler, which does not boil steam, but generates steam by boiling water, is a closed vessel of ample strength to stand a desired pressure and capacity greater than is required by the water. Suppose one of 1 cubic foot capacity, containing 1 lb. water at 32°. Up to the point of saturation there is no difference from former conditions, but then another set of conditions come into play. Adding heat vaporizes part of the water, but the envelope prevents it from expanding; it crowds the available space, and the pressure upon the surface of the water is increased, raising the point of saturation gradually, so that not all the heat added now is employed to vaporize the water, a part going to increase the temperature of the fluid up to the new point of saturation. But as the steam is not allowed to expand as much, a less amount of heat is expanded in this work, and none at all is required for external work, so that the proportion of water evaporated for each unit of heat is decreased only very slightly. When, therefore, we have added the 1,146 heat units which before, under one atmospheric pressure, were sufficient to heat the fluid and evaporate the whole of the pound, the pressure in one vessel will have risen to nearly 30 atmospheres, and, say, 10% of the water will remain as water at a temperature of 450°. Eighty units more heat convert the whole pound of water into steam at a pressure of 475 lbs. absolute.

"If we had added only sufficient heat to raise the pressure to 100 lbs. absolute, only one-fourth of the water would have been evaporated, and the remainder would have a temperature of 3271/2°, which corresponds to that pressure. And if now we draw off the steam and add heat enough to keep up the pressure, we have the entire principles of every steam boiler. Questions as to the most advantageous application of these principles are here out of place.

"Having made the steam, what becomes of it? Steam is not permanent, it is a thing of the moment. Whither, and how does it go?

"There are three ways in which it may cease to exist. It may do external work, it may give off heat itself, becoming water, and it may mingle itself into the air, becoming 'general humidity.'

"We have only begun, as yet, to understand the conservation of energy. For ages it was known that a blow of the flint or steel produced heat, but only recently was it known that the heat was the equivalent of the blow. For every amount of work done, an equivalent amount dis-

appears. We transfer heat energy of the coal to the steam, with the engine drive a dynamo, convert the electricity into light through heat by means of the glow lamp, or into power with the motor.

"Water saturated contains all the heat it can at the given pressure. Saturated steam, on the contrary, holds the least heat it can; if it gives up any, part of it condenses. If the water which we had at 120,000 lbs. pressure had been allowed to expand to atmospheric pressure, 690 H. U. would have been necessary to make up for the external work.

"Had we also allowed the pound of steam at 475 lbs. pressure to expand, the work done would be 220,000 foot lbs., and about one quarter of the steam would be condensed.

"When steam does work pushing a piston in a cylinder, it is robbed of its heat, and in this way 21/2 lbs. of steam must condense per horse-power hour. If this were all, power would be cheap; but machinery is so imperfect that from 5 to 25 times this amount must pass through our cylinder in order to secure this amount of work, the balance going into the condenser or into the air, and is of little further use.

"Steam which goes into the cylinder of an engine may be divided into three portions, one of which is condensed in doing work; another, and generally a large portion, makes up for heat wasted through cylinder walls and evaporation at exhaust surfaces. The third, much larger than either of the others, serves as a backing for them. Thus, of one pound of steam at 20,000 lbs. pressure, only half of it would be condensed in doing external work. Theoretically, 60% could thus be utilized in a perfect engine. The best quadruple expansive engines to-day utilize less than 20 per cent., best non-condensing engines 10 per cent., and the most wasteful 21/2 per cent. Every time a great steamer crosses the ocean, 3,500 tons of steam send it ahead, while 17 or 18,000 tons give up their heat to the ocean.

"The estimated average for stationary, locomotive, and marine engines, is, in this country, 120,000,000 H. P. per hour, requiring the condensation of 150,000 tons of steam per day, and at least eleven times as much more goes out of existence without being utilized. This calls for the burning of 100,000,000 tons of coal for its equivalent per year.

"Much steam is used for heating because it will carry a great amount of heat for a given weight, and because after this has been given up, it instantly drops out of the way. Air and gases hold but 1/50 of additional heat, and do not part with this readily. The New York Steam Co. is the largest provider of steam for
house heating, and it supplies in winter about 8,000 tons of steam per day or about 1,600,000 tons per year. The city of New York uses, roughly, 18,000,000 tons per year, and the whole United States, 150,000,000 tons. Add to this that used in boiling and heating in various processes and it gives a safe total of 200,000,000 tons. This will add 30,000,000 tons to the coal account, or a total of 180,000,000 tons per year. Natural gas and other fuel would reduce this amount to about one-half that mined, which in 1891 was 150,000,000 tons.

"The third way in which steam makes its exodus is by dissipation. Air at normal temperature absorbs about 1% of its weight. The higher the temperature, the greater the absorption and vice versa. At 120° it will hold 10% and at 38° but 1 1/2%. The Carnegie Steel Co. throws into the air every hour not less than 1,500 tons of steam. In all processes, not less than 600,000,000 tons are annually absorbed by the air. Does this enormous quantity affect the amount of rain-fall? The annual rain-fall east of the Rocky Mountains averages about 36 inches. This amounts to about 9,000,000,000,-000 tons, so if all the steam made in the whole country were confined east of the Rocky Mountains, it could not add over 1/120 of 1% to the total rainfall, or 4 1/20 of an inch—not enough to furnish one evening dew."

"It is said that electricity will supersede steam. At present electricity is made by steam-power. In the future some way may be discovered by which it may be obtained directly from heat of combustion without the intervention of the steam-engine. However, no more efficient means of conveying heat will probably be found than by steam, the cargo capacity of which excels all other available substances."

Among these present were Mr. C. H. Morgan, Dr. Fuller, Mr. Mitchell, Mr. Scudder, Mr. Carl Beede, and among the alumni, Messrs. E. F. Tolman, '71; Wm. L. Chase, '77; C. D. Parker, '79; L. F. Gordon, '81; H. W. Wyman, '82; W. F. Cole, '83; V. N. Edwards, '83; A. A. Gordon, '86; E. F. Miner, '87; J. O. Phelon, '87; G. W. Booth, '91; B. A. Gibson, '91; A. L. Rice, '91; F. W. Collier, '92; T. E. Brayton, '92; G. H. Day, '92; J. F. Bartlett, '92; A. L. Smith, '90.

A vote of thanks was extended to Mr. Babcock and the meeting adjourned.

**NAILS AND TACKS.**

These useful articles were made by hand up to 1604. One great seat of the industry was at Birmingham, Eng. Here were tack makers so expert that they wrought tacks 1200 of which would go into an ordinary goose quill. The nails and tacks were forged from rods, the workmen using a hammer with a particular degree of obliquity, so that when he left an old job for a new one, he must needs take his hammer with him.

In 1606, Sir Davis Bulwer took out patents for a nail-making machine; but no record of any English patent prior to 1416 is extant, so no description of this machine can be given.

In 1617, Clement Dawbeny built a nail machine, but the first one in England of practical use was that of Thos. Clifford of Bristol, invented about 1790.

Meanwhile America had not been idle, for in 1775, Jeremiah Wilkinson invented a machine for cutting nails, the heads being made in a vice. Josiah Pearson, 1794, Jacob Perkins, 1795, and Ezekiel and Jesse Reed were instrumental in the development of the nail machine, that of Jesse Reed being in use at the present day with little modification.

The tack machine is due to Thos. Blanchard who was born in Sutton in 1786, and who is better known as the inventor of the lathe for regular forms. He conceived the idea of the tack-making machine while making tacks by hand in his brother's shop. He was then eighteen years of age, and it was six years before he fully developed it.

The Reed nail-machine consists of a substantial bed supporting two uprights or posts as they are called. Into the tops of these boxes are fitted in which runs the spindle; a fly-wheel gives steadiness of motion.

There are three heavy moving parts. The "cutting jaw" is driven by an eccentric pin driven into the "head" at one end of the spindle. The cutting jaw carries a "knife" which together with one fixed in the bed shears off the plate, the width of the "blank" being regulated by a gauge carried behind the knife. The blank is caught between a moving bar and a fixed piece and is held until "gripped" between two dies ground with "scores" the size and shape of the nail, one of which is fixed beneath the bed knife, the other being moved by means of a lever actuated by a cam on the spindle.

The heading is done by a tool carried in a lever driven by means of a "toggle" from the cutting jaw. After the heading, the dies slacken and a "clearer" knocks the nail out of the score.

The plate is fed in by a weight through a "barrel" or tube, having a reciprocating rotary motion, and is fed in at an angle designed to give a wedge form to the point of the nail.
The Blanchard machine is similar except that there are two moving knives carried in two separate jaws, the jaws being moved by cams while the eccentric pin is used to move the heading mechanism.

The two moving knives offer one continuous face to the bed knife, and when the blank is cut off it is caught between one knife and a spring called the "bearer" and is carried down and gripped by the dies. The bearer is moved out of the way and the heading and clearning accomplished. The Blanchard machine is thus adapted for smaller work.

The grinding and adjustment of the "tools" in one of these machines is a matter of great skill and the care of 16 or 20 is a great strain on the nerves. It requires from 100 to 200 bolts and set screws to fasten one of these machines together and furnish a means of adjustment.

The Blanchard machine may be run at the rate of 325 revolutions per minute giving a tack at each revolution. Machines are now being built which are an improvement on the Blanchard, although similar in principle, which cut from 380 to 400 per minute.

The making of wire nails is an industry which has grown up in this country within 25 years. The machines first used were imitations of those invented by the French and were very complicated. Wire nail machines consist of a fixed die, a moving die carried by a gripping lever, two cutters carried in levers, a heading and a feeding arrangement. The wire is gripped, headed, fed ahead, cut off, leaving enough for the head of the next and so on.

There was a "consolidation" of most of the tack and nail companies in the U. S., which came to an end in '86 or '87. In April, 1891, the principal tack companies of the U. S., if not of the world, all of which are in Massachusetts, formed a corporation known as the Atlas. Besides nails and tacks they manufacture rivets, buttons of various kinds, staples, hooks for peach crates, ears for pails, eyelets for shoes and a variety of other things. In all counting each size as one unit they must manufacture at a conservative estimate, 10,000 varieties of products.

Nails are rated as 3 penny, 4 penny, etc., the term meaning pounds per M. (originally 1200). Tacks are rated as so many ounces per M. They vary from the long sharp shoe tack of which 1000 weigh only one quarter of an ounce, to the stout, short, 24 ounce roofing tack.

Tacks are finished by galvanizing, tinning or bluing. The best tinning is, of course, a process by heat, but a light wash of tin may be given by a cold process.

A great many tacks were formerly packed in various sized papers, but the amount is decreasing, and cut pasteboard boxes have almost entirely superseded the papers in containing what are now packed.

In conclusion we wish to observe that tacks are all right in their place, but their place is hardly in the seat of an easy chair.

**EXAMINATIONS.**

The mid-year semi-annual examinations begin the last part of next week and continue to the 25th of the month.

The schedule, as obtained from the office, is as follows, for the several classes:

**SENIORS.**

Thurs., Jan. 19th, Physics.
Fri., Jan. 20th, Political Economy.
Sat., Jan. 21st, Thermo-Dynamics, Chemical Philosophy, Physics, [For Political Science Course] Hydraulics.
Mon., Jan. 23d, English Literature.

**MIDDLES.**

Thurs., German.
Fri., Analytical Geometry.
Sat., Mineralogy and Mechanical Drawing.

**DRAWING.**

Mon., Descriptive Geometry.
Tues., Mineralogy and Mechanical Drawing.
Wed., Physics.

**JUNIORS.**

Thurs., Algebra and Geometry.
Fri., English.
Sat., German.
Mon., Physics.
Tues., Trigonometry.

Wed., Chemistry.

Electrical Engineering, Jan. 14th.

All examinations will begin at 8 A. M., unless special notice otherwise is given to the class.

**ALUMNI NOTES.**

76. Luther H. Bateman is assistant to the Engineer of Harbor and Land Commissioners, Bowdoin St., Boston.

Division Engineer Charles E. Alger of the Boston and Albany Railroad, whose territory extended from Springfield to this city, died at Springfield January 3. He took cold at the time of the big blizzard, four years ago, and the cold developed into bronchial consumption, from which he died. He was a son of Engineer James M. Alger of Auburn, and was born in Brookline thirty-four years ago. He
was at one time engineer of the Newton Water Works.


*84. Roseoe H. Aldrich, who has been with the Gould's Mfg. Co., Seneca Falls, N. Y., for over eight years, formerly as its superintendent and of late as chief engineer, has opened an engineering office in Buffalo, N. Y.

A. H. Allen spent Christmas at his old home at Northboro', and on the following Tuesday called on several members of the Faculty and looked over the Institute. It was his first visit to the Institute since his graduation. For six years he has been with the Westinghouse Company of Fitchburg, and is now stationed at Philadelphia with an office in the Girard Building.

*85. Samuel Green spent Christmas at his home on Green Hill in this city.

*87. Frederick L. Emory has recently resigned his position as Professor of Mechanical Engineering at the University of West Virginia, Morgantown. The following is clipped from a Morgantown paper:

PROF. E. MORY RESIGNS.

"Prof. Emory, who has been at the head of the department of Mechanic arts at the university ever since it was established, has resigned his position. The resignation was made yesterday and is to take effect Jan. 1."

"Some time since Mr. Emory was tendered the position of Principal of the Indianapolis Technical High School, to be established immediately at Indianapolis, Indiana. He has had the matter under consideration ever since, and finally decided to accept. His connection with the university will terminate practically to-day."

"That Prof. Emory leaves the university and Morgantown is a matter of regret. He is a man of ability, and was held in the highest esteem by fellow-instructors, students and citizens, and, in fact, was a most popular man. He has the kindest wishes for success in his new field of labor."

*88. Allerton S. Cushman is Assistant Professor of Chemistry in the Washington University, St. Louis, Mo.

P. J. McPadden is Manager of the Department of Meters and Transformers of the Western District of the General Electric Company. Address, 173 Adams St., Chicago, III.

*89. Harry V. Baldwin is managing editor of the Providence Evening and Sunday Telegram.


*92. F. W. Morse is Chemist of the New Hampshire Experiment Station, Durham, N. H.

George H. Miller is draughting with the Merrick Thread Company of Holyoke.

TECHNICALITIES.

Quercus says that, as a general thing, he thinks judges combine fine language into sentences.

Dr. Fuller was recently elected an honorary member of the University Club of Boston.

A change in the seat of war—the removal of Prof. Gladwin's room.

The base ball manager can be happy in the thought that the WPI will not jump on his conduct at least until April.

An enterprising Senior remarked last vacation that he made up back work in the Iron Room and head work in the Draughting Room.

Techipubun wants to know if when '93 become "city fathers" as prophesied by Prof. Kimball, they will be eligible for the class cup.

We suggest that the windows of Boynton Hall and the Shop be protected by outside shutters before the snow-ball fights between '95 and '96.

If '92 had planted their tree in the middle of the walk leading up Tech Hill, it would be appreciated now that the cinders are covered with ice.

A large sign in the window of a Springfield hotel basement announces in letters which those who run may read, "Boots blacked inside."

1st Senior: "The wind must be getting lots of marks lately."

2d Do.: "Why?"

1st Do.: "Oh, because it's been cutting so much."

On Monday morning Prof. A. asked "What do we always do? A Senior with vivid recollections of the evening before blossomed out with "Take the arm."

The Juniors are about to purchase their drawing instruments. The committee to solicit bids is comprised of A. W. Clement, H. J. Fuller, R. L. Morgan and N. C. Thrasher.

Mac., '94, must have been out very late the night before he gave the following method of making a magnet: Pass a current of air through a coil of electricity.
A 6-hour test of a boiler burning petroleum was made at the Morgan Spring Co.'s works, Dec. 22. Prof. Alden and Mr. C. H. Morgan conducted the test. Results will be published later.

Tech No. 1 is using ether to clean a certain portion of his wearing apparel. Enter Tech No. 2 who says:

"What are you using on your trousers?"

"Ether."

"Are they so loud that you have to etherize them?"

A funny man in the Iron Room recently bought a stick of candy from the "canny" boy and directed him to deliver it to the "large whiskered gentleman in the office." The gentleman in question did not indulge in the professed delicacy but the students outside did in a hearty laugh.

The strange things one hears. Scene in English Literature Class. Prof. C.: "When did Sir John Mandeville live?"

D-rby. '93: "He dieder about 1360-er along in the latter part of his life."

A pleased expression is heard fitting over the class. Prof. C. to G-dr-ch: "How did the great plague affect the people, and consequently literature?"

G-dr-ch: "It scared the people so that they thought more about God and things of that kind."

1st Tech. "It's getting cold. Better put some coal on."

2d Tech (looking at the fire). "Oh, the fire is going fairly well."

1st Tech. "Well, put on half the usual amount."

2d Tech. "Oh, you mean put a semi-colon."

The announcement has been made of a course of five lectures on "Social Problems of Today," by Prof. MacDonald. They are to be delivered on consecutive Tuesday evenings, commencing Feb. 14th, and at the School of English Speech, on Front St.

As it did last year the Engineering News offers as prizes for the best theses written by graduates of technical schools in the class of 1893, the sums of $75, $50, $25, and the writers of such theses as receive honorable mention win two years' paid subscription to the magazine. The theses must be sent in by college authorities, not by writers, must be sent in under designating symbol or name, and accompanied by an envelope containing nom de plume or symbol, and real name. Those selected will be published in the Engineering News.

DANCING.

WINKS' ACADEMY,
38 Front Street.

The leading school and only Academy in WORCESTER opposite the City Hall. All horse-cars pass the door.

Ladies and Gentlemen that have neglected to learn to dance and wish to avoid the appearance of awkwardness in company can do so by taking Private or Class lessons. Instructions given every day and evening on the Waltz, Polka, Galop, Newport, Skater's and Five-step Schottische. Yorke, Spanish-Yorke, Oxford-Minuet, and many others including the latest steps.

Mr. Winks has the latest and best methods known to the dancing fraternity by which the Waltz can be taught in three private lessons.

Private Classes a Specialty.

OPEN FROM 8 A. M. TO 11 P. M.

For Terms apply at the Academy,

W. CHARLES WINKS, Principal.
MRS. W. CHARLES WINKS,
Musician and Assistant Teacher.

WHEN YOU

Want another pair of Rubber Shoes remember and get a pair of the "Gold Seal" ones. They will outwear three pairs of any other rubber on the market.

Every shoe bears the above Trade-Mark. For sale at

P. L. RIDER'S Rubber Store,
370 MAIN ST., WORCESTER.

Also the largest and best line of Mackintoshes in the city.

LOUIS W. SOUTHGATE,

Late Examiner U. S. Patent Office, formerly head Draftsman Pond Machine Tool Co.,
COUNSELLOR-AT-LAW AND SOLICITOR OF
PATENTS,

W. P. I. Class, '85.

Room 18, Burnside Building,
339 Main St., Worcester, Mass.
The Richmond Straight Cut No. 1

CIGARETTES

are made from the brightest, most delicately flavored, and highest cost
GOLD LEAF grown in Virginia.

This is the OLD AND ORIGINAL
BRAND OF STRAIGHT CUT CIGARETTES, and was brought out by us in the year 1876.

Beware of Imitations, and observe that the FIRM NAME is on every package.

ALLEN & GINTER, Manufs.,
RICHMOND, VIRGINIA.

C. C. LOWELL,
(Founder of J. C. WHITE)
HEADQUARTERS FOR
Mathematical • Instruments
And ARTIST MATERIALS.
ALSO, FULL LINE OF
PAINTS, OILS, GLASS, and VARNISHES.
12 PEARL ST., opp. Post-Office.

H. F. A. LANGE.
Floral Decorator,
294 Main St. Worcester, Mass.,
Keeps constantly in Stock
FANCY ROSES AND FINEST ASSORTMENT
OF CUT FLOWERS,
Which he will arrange in Designs of any kind.
Decorating Parlors and Halls a Specialty.

OUTING SHIRTS
AND CAPS.
FINE QUALITY.
LOW PRICES.
New York Hat House,
14 FRONT STREET.

THE F. E. YOUNG CO.,
WHOLESALE AND RETAIL
Confectionery & Cigars.
SALESROOM:
215 MAIN ST., WORCESTER.

The "C. A. B."
RAPID RECTILINEAR LENSE.
The Best Low Priced Lense in the Market.

Boyden Photographic Supplies,
47 PARK STREET.

L. W. PENNINGTON,
Designer, Manufacturing Jeweler, and
DIAMOND SETTER.
Badges and Emblems Made to Order.
Gilding, Acid Coloring and Oxidizing, Repairing, Etc.
Old Gold and Silver Purchased.
81 MECHANIC ST. WORCESTER, MASS.

WM. S. SMITH & CO.,
DEALERS IN
Hardware and
Building Materials,
Carpenters' and Machinists' Tools,
ALSO DRAWING INSTRUMENTS,
171 Main St., Worcester, Mass.

GO TO
WHITTIER'S
FOR
HOT AND EGG SODAS,
Drugs, Perfumes, Etc.
STEARN'S INSTANT HEADACHE CURE.
49 MAIN STREET.
FRED. W. WELLINGTON & CO.,
Wholesale and Retail Dealers in
COAL.
General Office,
416 MAIN ST., - WORCESTER, MASS.
Branch Office, 600 MAIN STREET.
Coal Pockets,
NORWICH, - CONN.
Retail Yard,

S. R. LELAND & SON,
Music House.
Pianos, Organs, and Band Instruments,
446 Main Street, 446
WORCESTER, MASS.

REBBOLI,
CONFECTIONER AND CATERER,
6 AND 8 PLEASANT STREET, WORCESTER, MASS.

MEN! wear the
STRONG & CARROLL SHOES.
Our $5.00 Russett Storm Bluchers, are just the thing for Winter.
Stylish Patent Leather Shoes for $5.00.
Our $3.00 Line of Goodyear Welts can not be duplicated for the money; we have them in all the latest styles. Foot-Ball Shoes and all kinds of Winter foot-ware for Men.
Best assortment of Blacking Brushes in the city.
436 MAIN STREET, Opposite Front.
W. N. BROOKS, Manager.

A. F. BRAGG,
HOT AND COLD DRINKS,
Lunch, Confectionery,
AND CIGARS.
Always open after the Theatre.
322 MAIN STREET.

L. M. ALEXANDER,
Formerly with HILL & TOLMAN,
Dealer in
Bicycles & Safeties.
Repairs of all kinds a specialty.
Machines Remodeled with Pneumatic or Cushion Tires.
Brazing, Enameling & Nickeling Done in the best manner at short notice.
Agency for the Hickory.
191 Front Street, ground floor, Worcester, Mass.
WM. H. LARKIN & CO., No. 395 Main Street,
Dealers in HATS, CAPS, TRUNKS, BAGS, SHAWL-STRAPS, BAG-STRAPS, EXTENSION-CASES,
Canes, Umbrellas, Fine Neckwear, etc. AGENTS TROY LAUNDRY.

LEWIS & EMERSON,
Successors to C. B. EATON & Co.,
Wholesale and Retail STATIONERS, BLANK BOOK AND PAPER Dealers. All kinds of PRINTING, BLANK BOOKS, made to order, also complete line of TEACHERS' and SCHOOL SUPPLIES.
No. 505 MAIN STREET, WORCESTER, MASS. Telephone 278-4.
DRAWING PAPER IN SHEETS AND ROLLS.

BAY STATE HOUSE.

Ranking with best of First-Class Hotels of New England, reorganized and will be conducted on a

First-Class Basis
In every particular. Passenger Elevator, Well-Furnished Rooms and all heated by Steam.

FRANK P. DOUGLASS,
Proprietor.

Barnard, Sumner & Putnam Co.,

D RY GOODS AND CARPETS.

The largest house devoted to legitimate Dry Goods in New England. It grows with the growth of Worcester County, because it is the acknowledged Shopping Home of the Ladies, and because all things are here that ought to be here, and at the Fairest Prices.

Barnard, Sumner & Putnam Co.

JOHN A. SNOW,
Is Prepared to do all kinds of

BOOT AND SHOE REPAIRING,

326 MAIN STREET,
Opposite Mechanics Hall, up one flight of Stairs, Room 2.
LADIES' and GENTS' SEWED WORK a Specialty.
Back and Front Stays and Toe Tips.
“DISCOUNT TO TECHS!”

Ladies and Gentlemen Looking for Fun and a Good Healthful Exercise, CAN FIND IT AT

J. P. WHITE'S
TEN PIN, BILLIARD AND POOL ROOM.
87 Pearl Street, Worcester, Mass. Hours for Ladies: 9 A.M. to 4 P.M.

SEND FIVE 2-CENT STAMPS FOR MY CATALOGUE.

THEO. ALTENEDER & SONS,
PHILADELPHIA.

PATENT ADJUSTABLE STAND.

BARNARD, SUMNER & PUTNAM, Proprietors.

WASHBURN MACHINE SHOP,
WORCESTER, MASS. M. P. HIGGINS, Superintendent.
DON'T Buy Ready-Made Clothing

WHEN YOU CAN BUY

CUSTOM MADE at the Same Price.

We will make you an Elegant Business Suit from $20 to $25 and up.

Suits for Students a Specialty.

First-Class Style, Fit, and Make.

MATSON & GUSTAFSON,

Custom Tailors,

203 Main Street, - - Worcester.

CRAYON PORTRAITS AND PASTEL PORTRAITS AT HIGH GRADE PHOTOS ONLY.

Groups and Large Work a Specialty.

Engage your sittings.

25 PER CENT. DISCOUNT . . .

TO TECH . . . STUDENTS.

326 Main Street;

Opp. Mechanics Hall.