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THE W P I

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After much labor and anxious waiting the Board of Editors of the "'Ninety-three Aftermath" saw the product of their work on the Tuesday of Commencement week. Whether it fully satisfies them or not we cannot say, but we were led by numerous remarks by different members of the Board to place our expectations so high that the book does not fulfil them. We do not mean by this that the "Aftermath" is not well gotten up and interesting, for it is, but it surely does not out-class 'Eighty-eight's, or 'Ninety-one's book as we were led to expect.

The idea of having the picture of each man opposite the short sketch of his career is a very good one, and adds greatly to the value of the book. The illustrations in general are very good. The copy of the W P I, published in 1923, was to us very interesting and there were some other rather bright parts, but to say of the book in general that it is the high-water mark of class-books at the W. P. I. is, to our mind, placing it too high.

One more class have received their diplomas and been added to the list of alumni. We will not say much about the class of 'Ninety-three. In some ways, their record has been one to be proud of. There has been an unsually large number of brilliant men in the class. It might not be entirely wrong to say some of them were too brilliant. The faculty will probably remember 'Ninety-three as an especially good class and one to be proud of. 'Ninety-four will not. The two things of most importance that 'Ninety-three did were to win the cross-country championships, and not to come up on Tech hill on the night of their Half-way supper. But to change our tune, really 'Ninety-three has done much during its course to aid the Institute in various ways. It has originated some very bright ideas and had push enough to carry them through. The Institute will be better from the presence of the class of 'Ninety-three here for three years. Most of the men have now started out in life for themselves, and the W P I wishes them all possible success, and let them be as much of an honor to the Worcester Polytechnic Institute as alumni as they have been as students.

COMMENCEMENT WEEK.

The exercises of the week opened with the baccalaureate sermon by the Rev. Daniel Merriman at Central Church, Sunday evening. The idea of a sermon to the graduating class here at the Institute has never been carried out before, but it surely is an idea that has met with much favor and should be made a custom. The complete sermon follows:

Twenty-five years ago next autumn the Worcester Polytechnic Institute was first opened for students. Twenty-two classes have since

been graduated with an aggregate of 533 members. The twenty-third class—much the largest in the history of the Institute—is to be graduated this week.

It is at the suggestion and request of this class that, for the first time in connection with the Institute, what is known as a Baccalaureate sermon is now to be preached—that is a sermon appropriate to those who are about to become Lauriate, about to take their first degree.

Such sermons have always been given in our colleges. Sometimes they are preached even in our academies when classes are graduated. Indeed, they are always so numerous just at this season of the year, and so crowd upon public attention with their masses of moral earnestness and good advice, that they provoke now and then a smile and the gently scoffing inquiry as to whether this preaching may not be a trifle overdone.

But in spite of this mild criticism, and in spite of the slight reproach contained in the saying, "as dull as a sermon," it is clear that the Baccalaureate discourse was never more in favor, never more reverently listened to. It is a good and hopeful sign. I would not argue too much from it, yet it seems to indicate that, notwithstanding the alleged materialism and unbelief of the times, people, and especially young people just on the threshold of active life, are disposed to take counsel of the preacher, of the "prophet of the soul," as Emerson calls him, of the man who, rightly or wrongly, is supposed to be conversant with spiritual things, and to give some heed to him, provided he has anything to say worth saying. To have the opportunity thus to speak is a very high dignity, worthy the loftiest powers.

I gratefully and humbly accept this office for these young men this evening, not with any assumption of superior wisdom, still less of authority, but as a sympathetic student and fellow keeper of the truth with them.

In the discharge of this most delightful and honorable duty let me quote as the key of my discourse the exhortation of St. Paul in

Philippians IV. 8. Last part.
"Think on these things."

In the early part of this long verse the apostle enumerates these objects of thought. They are, whatsoever things are true, honorable, just, pure, lovely, of good report—indeed whatever virtue, or whatever praiseworthy thing there be; and he urges us to think on, that is, to apprehend, to take into practical account or possession "these things." Observe that they are all moral entities, or attributes. They are not material substances. They cannot be measured or verified by the senses. Yet they are not the less realities.

Righteousness cannot be weighed except figuratively. The existence or quality of honor cannot be proved by the application of an acid. Virtue, as an ethical quality, cannot be grasped and put under strain in a testing machine, as one would try a bar of steel. Nevertheless these things of which St. Paul here speaks exist as the essential and indestructible elements of all higher life, the bond of all human relationships. They lie on the surface; they also hide themselves in the depths. They are involved in a child's purchase of a penny's worth of candy, and his sharing it with his mates; and it is their working that shakes a great nation with supreme cost and supreme valor to put down a great wrong.

They are in the ferment of every political and socialistic agitation. In the struggle to define them and set them in clearer and more authoritative light is to be found the secret of philosophical and theological debate, and of divisions in the school, and in the Church, and under their comprehensive sway and their infallible judgment the individual man must register his final destiny; the individual soul meet its God.

These ethical realities of which St. Paul here speaks are not, then, figments of the imagination; nor are they the arbitrary assumptions of religion, or of religious creeds or systems. Imagination may clothe them with power. Religion may define and vitalize them, sometimes, alas, may obscure or weaken them. But they inhere in the nature of things. They are essential to existence—divine and human.

As such they are to be apprehended and possessed in their fulness and force, by the individual and society, through constant attention to them. They are to be made regnant by thought upon, and experience of them, till they become part of the man himself and of society.

My plea, then, is for moral and spiritual thoughtfulness, for thinking upon the ethical side of things, as a habit, as an experience. And let me enforce this plea:

I. In the first place by pointing out, for a moment, the need and value of thoughtfulness in general, in our times. Hegel somewhere says that one thought of man is worth the whole world of nature.

Indeed, what significances has the earth with its forces and phenomena—its bulk of mountain, its waste of sea, its towering forests and snarling beasts, its perfume and color of flowers, its cataracts, or its volleyed lightnings; what meaning or worth have these, till frail man, "a reed, but still a thinking reed," as Pascal calls him, appears upon the scene? Instantly his

thought begins to measure and clothe everything with value. He reads in everything a divine interpretation. Where he runs his inquiring eye the divine utility, beauty and order emerge from previous chaos, and nature reflects his smile as well as ministers to his use.

This is the reward of thought which lays at our feet to-day the multitudinous garnering of ages of mental struggle from our earliest apelike ancestor who, to use a single illustration, in a happy moment, perceived that he could make advantageous use of a stick or stone to throw it at his enemy, down to Herr Krupp, who contrives and fabricates a steel rifled cannon of 120 tons that can project a sixteen-inch shot fourteen or fifteen miles.

But there is danger in our day that, by the very excess of our resources, the habit and power of thoughtfulness will be diminished. Too many objects thrust themselves upon the mind, which therefore tends to be over-occupied with the forms and surface of things.

There is the distracting glitter of phenomena, the fretting urgency of practical results. Knowledge is increased and its products, rather than its severe, disciplinary and exalting processes, are the possession of the many. What was once attained only by travel and laborious investigation at widely separated points and with long meditative intervals, is now, as at the World's Columbian Exhibition, brought into facile proximity, and a hundred interpreters stand by to explain in a moment how the lightning spells its syllables under the sea; to show when Columbus slept as guest of the abbot in the convent of La Rabida, and to point out how the cliff dwellers lived and wrought thousands of years ago.

Difficulty and mystery exist no longer. The nations and the centuries jostle elbows. The gaping crowds look on, eating their sandwiches or peanuts, comfortable in the assurance that their thinking has all been done for them. Yet to think one deep thought, be it respecting a natural or a moral law, is worth all this experience of sight-seeing.

It is not information, but insight which the world of to-day needs, but the information, the catalogue and showcase of facts, the formularies of thought, are so prodigious and insistent that the thinking power is overloaded.

Some who have carefully investigated our systems of public school education, affirm that there are thousands of children and youth who can read a page of English with mechanical correctness without having the slightest idea or grasp upon the thought expressed; and one keen-witted observer has declared, in connection with the recent startling disclosures of infinitely bad English in the entrance examinations of Harvard College, that the difficulty is not in the imperfect knowledge which the pupil has of the rules of grammar, but with his vacuity of mind, his inability to think.

But what can we expect in this epoch of the pictorial and kindergarten methods; when our daily papers are blossoming out with illustrations, as though their readers belonged to the prehistoric tribes of cave-dwellers who had no literature, but were obliged to express their ideas by rude drawings of man or beast on flat pieces of bone? What can we expect when not only distant lands, but the mysteries of science and even the doctrines of religion are advertised to be shown up by the stereopticon?

In the midst of this roaring and shallow stream of the visible, in the confusion of this multiplicity of objects, aims and knowledges, the real man is often seized with disgust and a passion for solitude in which to orient himself as it were. He murmurs to himself the lines of Faust:

> "When in the narrow chamber nightly,
> The friendly lamp begins to burn,
> Then in the bosom thought beams brightly,
> Homeward the heart will then return."

Out of this mood rises the specialist, who is forced to limit his field that he may intensify his vision. But the specialist though a thinker, and though having his uses, is yet apt to be an imperfect and ill-shaped man. He is hard and one-sided, seeing the reflection from one little facet of the universe, but seeing it so brightly as to blind his eyes to the others.

The extreme of specialization is a poor escape from the extreme of generalization. What the times need in the place of both is the *man*, mentally thoughtful, vital, elastic, originating, broad without being shallow, intense without being narrow, stocked with resource without being paralytic from the burden, creative without being visionary.

If you ask upon what meat must such a Cæsar feed that he may grow so great, I reply that to produce a *man* there is but one prescription followed by all from Aristotle to Darwin, from Plato to Spencer, from Moses to Gladstone; it is to *think*.

By thought man rose out of the lowest savagery. Let him cease thinking and, in the midst of his knowledge, he will become a savage again. There is no discharge in this warfare. Work your brain or you will lose it. Think, or in the midst of all the accumulations of thought, face to face with all the wealth which nature and society hold, your eyes will wander as the fool's eyes wander, and you will

not have even a baby's grasp upon the realities of man and God.

So much for the value of thoughtfulness in general. But I must get a little closer to the heart of my subject by pointing out.

II. In the second place the need and importance of ethical and spiritual thought—of apprehending and experiencing those virtues of which St. Paul here speaks.

In the different stages in the development of matter, in the different manifestations of mechanical and vital force, that which is lower prophesies that which is higher; and the higher always presupposes, includes and interprets the lower. The inorganic looks forward to the organic, and the organic in turn gives meaning to the inorganic. The rock foreshadows the plant, the plant the animal, and the lower forms of animal life, the higher forms. The forces with which the chemist deals take account of the primal energy of gravitation, and the biologist studies and seeks to comprehend the still more subtle forces which include and interpret the forces of chemistry.

The whole fabric of nature, as unfolded by science, is thus both prophetic and retrospective, in its diverse stages and categories. The latest discovery is not only made possible by the earliest, but it reflects back upon and gives significance to that earliest. And the latest discovery prophesies and indeed necessitates another still.

The same thing is true in the history of the development of the individual and of the race. The child is father of the man, and the man gives significance to the child. The age of the river-drift men, whose almost sole struggle was for food, foretells our own time, with all its seething and subtile competitions for the higher things.

The more complicated life evolves the loftier motive, and the loftier motive enriches the life. On the fore-front of the prodigious struggle which, for untold ages, man has made and is still making with the forces of nature and with himself, in his development, is written this mighty legend: "Man shall live by bread, but not by bread alone."

Before him always, sometimes flashing into clear vision, as in the Hebrew seers and poets, in the philosophies of Athens and most of all in the Founder of Christianity; and again almost whelmed in darkness and despair, as in the decay of the Roman empire or the succeeding ages, when only a comparatively few souls lighted the gloom, yet before him always, gleaming now with hope, and again dim with doubt, still never wholly lost, has been this image of the better man, the better world, this shining constellation of the virtues—the things that are just, honorable, pure, lovely and of good report, this moral and spiritual substance, divine and eternal.

Without this, life is a truncated cone, without apex or meaning. It is a bridge starting from the bank with promise, but ending in midstream, dishevelled and inconsequent. This realm of the ethical and spiritual, the existence and reality of which that which has been aptly called "the dirt philosophy," has undertaken to deny altogether, is exactly the realm to which everything below testifies, and without the interpretation of which everything lower, both in nature and in man, is meaningless.

The final problem of mankind must be spiritual. The body forces attention to the soul. Even a handful of earth has a voice affirming the spirit.

> "A spark disturbs one clod
> Nearer we hold of God
> Who gives, than of His tribes that take."

History illustrates this in every one of its most radiant epochs. Alike in the parliament and on the battlefield the ultimate question is "Whatsoever things are true, whatsoever things are just, whatsoever things are honorable, whatsoever things are pure." Out of the most unbelieving and earthly age, a few heroic souls are forever rising up to disturb easy, commonplace men and corrupt societies and governments, by insisting upon this inquiry; by demanding thought upon the unseen verities.

They interpret; they revolutionize; they bring in a new order, simply by thinking and making men think ethically, and realize their thought in experience and action. Socrates rouses the Athenians, and, though he perishes at their hands, compels a new moral era by insisting that they shall think upon virtue—upon the good. Peter the Hermit, with a moral thought and aspiration, sets the half of Europe in motion for the crusades, and introduces the age of chivalry.

Savonarola and Bruno in Italy, filled with the spirit of the rennaissance, die in the glorious attempt to make their countrymen think and see and realize moral and spiritual truth. Huss and Luther in Germany, Tyndall, Latimer and the rest, as well as Hampden, and later Wilberforce and Howard in England, and Garrison and his fellows in America—how did they all, with countless others of like temper, win for you and me and all men, the larger light and liberty and life, except by obeying this injunction of the Apostle, and thinking, and making their fellows think, upon whatsoever things are just, true, honorable, lovely and of good report, in relation to all the development of man, until plain men,

in utter contempt of ease and property and life itself, realized that these virtues are the only realities—the only things that give worth and meaning to existence. For if we put into the sacred word "freedom," as well we may, all that makes a man most himself, and that fits him to be truly a child of God then this question is forever compelling attention:

"For what avail
Or plow, or sail,
Or land, or life, if freedom fail?"

It is by the permeating energy of such ethical thinking that society is kept from hopeless putrefaction. This is the self-propagating force that hallows all the otherwise fearful earthliness of existence. Morever, when society soberly questions itself, it instinctively answers that it can have but one end, that is, the realization of virtue, or the kingdom of God on earth. That, and that only, can be the goal of man's long development.

Take for illustration a single fragment of human achievement with which we are familiar, consider the stupendous advance in the knowledge and applications of electricity during the past fifty years. For what ultimate end, by the infinite skill, patience and insight of hundreds of discoverers and inventors has this subtle energy been dragged out of the mystery in which it has been hidden since the morning stars sang together?

For what final object has it brought the force of the distant waterfall and poured it out in brilliant radiance in house and shop, and on the city's busy streets, or set it down in easily adjustable power by every hearthstone? Why is it, in the streams of cars, carrying the city swiftly out to the suburbs, and bringing the country swiftly to the city's heart—a movement, the effects of which are only beginning to be seen?

To what purpose has it made widely sundered Continents neighbors, and enabled merchants, a thousand miles apart, to chat together as easily as though they were sitting at the same desk? Does it satisfy to say that it is in order that men may see more plainly, move more swiftly and easily, throw their voices farther? Surely not. What of it? What is the use?

"To man propose this text:
Thy *body* at its best,
How far can that project thy soul on its lone way?"

The ultimate question respecting these applications of electricity is a moral and spiritual one. They are not apprehended—their meaning is not disclosed till we have traced out, first their political, economic, sociological, moral, and ultimately their spiritual effects upon the individual and upon the mass. Their secret is *there*. In themselves their discovery and applications solve nothing; they end nowhere. Their final cause must be spiritual. However thrilling they may be, man is above them; and the question how they are to touch *man* in his highest life, that is as a child of God, that is a thousand times more imperative, infinitely more thrilling than all else. So that I venture to say that no man can be regarded as a fully qualified electrical engineer till he is so to speak something of an ethical engineer also.

In other words—and this is here my point—the further science penetrates into nature and harnesses her forces, the more is she compelled to look beyond nature; the more she knows about the material, the more she must ultimately know about the spiritual; so that there can be but one goal for our progressive mastery of natural law, it must be to fulfil this injunction of the Apostle: "think on," that is apprehend, realize, experience, possess and grow into whatsoever things are true, just, lovely and of good report.

From this I pass, as a sequence.

III. In the third place, to observe that the scientific man—the man whose calling leads him to deal chiefly with material forces—should therefore be the first to appreciate, and indeed to emphasize the importance and reality of the moral and spiritual world. Without that world his own specialty is like a beautifully wrought and carefully laid ocean telegraph-cable which is cut at the shore end.

Of course I understand perfectly that it has almost everywhere been assumed that the investigator of the laws of nature—the chemist, the physicist, the biologist—must be the opponent of the supernatural, especially of revelation and revealed religion. I will not attempt to distribute the blame for this assumption and for the magnifying of the alleged differences between science and religion, and the scarcely less irritating attempts which have sometimes been made, as it is said, to reconcile them.

Doubtless both scientific men and theologians have much to answer for in this regard. Both have spent a good deal of breath and strength in useless disputes. But it is clear that a new era is dawning.

When men, who have each occupied one little particular square yard of God's earth and have assumed that it was the whole, come at length, humbly and together to "think on whatsoever things are true," they will be apt, in the end, and by the necessity of the case, to get on to wider and common ground.

I am not the least afraid of all that colossal investigation of the phenomena, and that wonderful application of the laws of physical and vital force which this age of ours is witnessing,

for I am sure that ultimately they will add distinctness and reality to the world of the spirit. The scientific thinker must come to God at last. His very training, as a truth-seeker, must take him there. He and the theologian must finally be found on the same road.

As thousands of years ago, Job said, speaking of the Almighty: "He stretcheth out the north over empty space, and hangeth the earth upon nothing. * * * So these are but the outskirts of His ways"; so I feel sure that to learn the truth about these "outskirts" must help us to learn that which is more interior. That in which physical and vital force finally inhere, must be that in which ethics and religion, in their simplest and most beautiful essence, inhere; in which man abides. It must be God.

Already theology and religion owe an immense debt to modern science. The great observer and thinker, Darwin, and his fellow-workers in the same field, in practically establishing the doctrine of the evolution of earth and man, have laid the foundation for a fresh revelation of the ethical and spiritual origin, development, and destiny of man, and have rendered what must ultimately prove an enormous service to religion.

True, as this great law is beginning to be applied, with wonderful enthusiasm and most brilliant results, in history, archæology, literature, anthropology and theology, there seems often to be some temporary loss. The superstitions and legendary are cleared away, and dogmas built upon them are losing their force, to the distress and confusion of many timid souls.

But, on the other hand, how immense is the relief at the discovery that God is in His world, and that the world is all of a piece? What a gain it is to have religion, together with religious experience, rid of that which is arbitrary, unreal, morbid and ghostly, and shown to be at their heart essential and of the nature of things; not a department of life, which one may enter or not as he pleases, but that which constitute the secret, the meaning, the essence, the loftiest end and outcome of all law, struggle, thought and life.

Here, again, let me record my profound belief that the scientific man—the thinker who deals with physical laws and carries his thought, as I have tried to show that logically he must, out into the realm of the ethical and spiritual, can, if he will, to-day become the prophet and priest of a new moral and religious dispensation; not in the faintest degree to supersede or dim Christianity; on the contrary, like the Protestant Reformation, to reveal and set in motion, hitherto, not unperceived, but only partially recognized and partially used forces within it; to emancipate them from the fictitious and arbitrary, and to clothe them with tremendous reasonableness and vitalizing power.

Would it be surprising if, in the immediate future, scientific men—of course, I use the term in its broadest meaning—should, in the Christian world, become the teachers of a new and more powerful conception of Christian faith, as Luther, in the 16th century, revolutionized the Church and Europe by asserting a new view of the same great doctrine?

Listen. We know the story of Jesus and the centurion; how the latter besought the Saviour to heal his servant, and when Jesus promised to go, answered, "I am not willing that thou shouldest come under my roof, but, Lord, speak the word only and my servant shall be healed"; and then gave as a reason for this request that he himself was a man set under authority, having soldiers under him, saying to this one go and he goeth, and to that one come and he cometh.

Here was a man, so far like the scientific man of to-day, that he was sensitive to his finger tips to the reign of law and trained to yield absolute obedience to it. Did this destroy his capacity for belief in a region that was invisible to him. Nay. Precisely the contrary. When he beheld the Great Physician, he believed that He, too, moved and wrought in a realm governed by law, like the realm with which he himself was familiar, and so in the simplest and most manly way he trusted the Saviour. Do you remember what Jesus said? "I have not found so great *faith*, no, not in Israel."

Is it too much to assume that *thinking*—in the large sense in which I have used the term in this discourse—thinking, reasoning, apprehending, the order, forces and principles of the universe—first in their physical, then vital, then social, then moral, and finally spiritual manifestations, that this shall yet give men a foundation for religious faith and religious obedience, which is the essence of faith, that shall make the generations just coming on, realize God and their oneness with Him in a way more vital, complete, reasonable and transfiguring than ever before?

I throw out the question, as a suggestion, as an inspiration, as a challenge for the largest responsibility to you who by training and profession are about to take your place among those who deal with physical forces and their applications. If what I have tried to say be true, you cannot fully deal with these, without also dealing with those that are higher.

He who thinks upon and obeys law in its lower ranges, must also think upon, obey and believe in law in its highest ranges, and in Him,

who, of both the lowest and the highest, is the centre and source. The scientific teacher and prophet of natural law, shall thus be yet the inspirer and exemplar of spiritual faith.

And lest in all this I shall seem to you to be a mere theorist, I wish to remind you, who propose to devote your lives to the study of material forces and relationships,—I wish to remind you of that great scientific investigator and thinker, Michael Faraday—one of the most brilliant men of this century—whose wonderful discovery of magneto-electricity Professor Tyndall declared to be "the greatest experimental result ever obtained by an investigator," and who was as much distinguished for his clear and humble faith as a Christian, as he was for his insight and ability as a man of science; in London to-day lecturing before a most cultivated audience as the most eloquent and gifted expounder of physical laws, and to-morrow preaching to a modest congregation as a most devout elder in the little Scandinavian chapel; as much at home in the New Testament and in the company of Christ and His Apostles, as in the great book of nature, and in the society of its most famous revealers.

Nor is Faraday a singular instance of this. Besides religious men of science like Gray and Dana, and many others, there was that ablest and most shining physicist of America—Joseph Henry—whose piety, faith and Christlikeness were as conspicuous as his power as a scientific thinker, and who just previous to his death, proposed as the subject for his next public address the reasonableness of the Christian doctrine of prayer.

These men and hundreds of others like them, though less distinguished, forever confound those who assert that thinking on material things must conflict with thinking upon spiritual things; that reason is opposed to faith. On the contrary they prove by their example, as well as their work, that the universe is one, that God is in it all, and that by thought developing into apprehension, experience, faith, man is to find both himself and his Father in heaven.

But in thus claiming, as I believe we must, that the highest laws and realities of the spiritual world are yet to be thought out, realized and experienced by man and society in their progressive struggle upwards; in insisting, as I believe we have a right to do, that the scientific man has and is to have a most important function, and an increasingly important function here, as a teacher and prophet of that which is above nature;—I am perfectly aware that the process is comparatively slow.

The glorious epoch of truth and freedom in which we move, rightly stirs every high-minded soul with enthusiasm, but this epoch is not the end. It is only a step. Meantime we are not left alone; not left guideless. That which is the goal of our thinking, yet beyond our thinking, reaches down to us, as it were, from the infinite heights. He to whom every quivering leaf, and shining star, and inexplicable reaction of the laboratory, and mysterious current of social life point, reveals Himself to our hearts as Him who was, and is, and is to come—Christ the Lord—the perfect perennial embodiment of whatsoever things are true, honorable, just, pure, lovely, of good report,—of whatever virtue and whatever praiseworthy thing there be.

It is the prerogative of practical Christian faith, not abandoning, still less contradicting a single foot or achievement won by science and reason, but rather accepting and interpreting them, to pass over, as it were, the spaces not yet wholly conquered by them, and to find in the Christ, *Immanuel*, God with us, at once the source and object of both reason and faith.

Gentlemen of the Graduating Class:—

Your work at the Institute is over, and you are about to enter upon the activities of life in the midst of a period of most thrilling interest. The end of the most extraordinary century of the Christian era is near, and your work is to lie mainly among the changes and possibilities of another century, which changes and possibilties as we contemplate them, even from this distance, amaze us by their probable effect upon the development of society.

My message to you to-night, as you face the tremendous responsibilities and opportunities of this immediate future, for which mankind has made so long and such costly preparation, is that you should be *thinkers*.

Be not mere puppets and lackeys. Think, not only upon the facts and laws with which your own calling has to do, but follow out the inquiries and suggestions which these facts and laws inevitably provoke, into moral and spiritual fields. By that thought, which means experience, possession, *faith*, feed your immortal souls in these fields, and so become, not disciples of "the dirt philosophy," but the believers, teachers, prophets and inspirers of your fellows in the beautiful life of the spirit.

Trust to the wholeness of God's universe. Be not only denizens of the natural, but also denizens of the moral and spiritual world. Sink your plummet deeply, extend your gage widely, but remember that this means that your are to reach your hands up on high where God dwells and whither man surely tends. Above all take for the object of your thought, for the text of your allegiance, for the end of your faith, the Saviour, Christ the Lord, who is above all

things and by whom and in whom all things, all these glorious virtues of which St. Paul speaks, consist.

So shall you be citizens, not only of this world, but of heaven; not only of this life, but of the life spiritual and eternal.

Class Day Exercises.

The weather clerk was particularly kind to '93 on the 20th in giving the class a warm, sunny day, which brought out their friends in large numbers. The exercises were held on the slope near the electrical laboratory, where a temporary platform and rows of seats had been constructed. In front of the platform, which was decorated with palms and ferns, was an arch entwined with the class colors, blue and white, and surmounted by the head of the class mascot, the famous goat. The platform was also draped with the class colors, and at the rear were the three banners won by the class in the spring of 1891 and the spring and fall of 1892. Stretched between two trees in front of the platform was the crimson banner of the Institute with W. P. I. on it in steel gray. The seats were filled early in the afternoon by the friends of the class, a large proportion of whom were ladies. A large number of undergraduates graced the occasion with their presence and occupied the slope in the rear of the seats.

The ushers were George W. Heald, '94, chief; George A. Denny, '95, Alba H. Warren, '95, Fred S. Parks, '95, Hiram R. Willson, '96, Geo. W. Eddy, '96, M. Percival Whittall, '96, and Percival Moore, '96.

Shortly after 1.30 o'clock, the procession started from the Salisbury Laboratories headed by George W. Heald, '94, chief usher. He was followed by Battery B band and the class of '93. There was a brief halt at the class tree, situated between the laboratories and the shops, and President William H. Parker solemnized the planting of the tree by throwing a handful of earth upon its roots. The class then proceeded to the platform where the speakers of the day and the class officers, William H. Parker, president; Louis W. Rawson, vice-president; Arthur D. Butterfield, secretary; and Norman M. Paull, treasurer, took seats. The class was seated directly in front of the platform.

After a selection by the band, President Parker opened the exercises with an address of welcome:

In the name of the class I welcome you, our friends, relatives and well-wishers, to these, the class-day exercises of the graduating class of 1893. To us, at this time, when our connection with this institution is nearly ended, your appreciative presence at these exercises, which the class regards as its own particular celebration, is especially gratifying. We are glad to see the familiar faces of our friends who have come to enjoy with us a day to be given to enjoyment. When looking backward we can see each duty performed, our work well done and we can feel that we have earned the right to devote this day, to us memorable, to unqualified pleasure.

I shall leave to certain of my classmates, duly delegated and chosen, the exposition of the history and achievements of the class in the line of duty, in our hours of leisure and in the classroom and laboratory, on the athletic field and oval.

It is my duty only to greet and welcome you. And this in the name of the class of 1893, as its representative, I most heartily do.

Pres. Parker next introduced the tree orator, Everett E. Kent, who spoke as follows:

Friends and Classmates:—

Ages have passed since Adam was placed in that garden "eastward in Eden." Trees, according to the sacred record, were an important element in the beauty of the landscape; and ever since, to the reverent mind they have stood as symbols of that which is beautiful, strong and enduring. Our heathen ancestors often regarded the venerable trees of their German forests with no little awe; and something of their spirit has descended to later priests and prophets. The great Bacon has declared the planting of gardens to be the purest of human pleasures; and our modern gardeners find delight in striving to secure artistic effect with trees and shrubs for paint brushes, and for pigments, flowers and foliage.

The people of Worcester have done much to beautify their city. These bright June days remind us especially of the attractions of their public parks. Elm Park is a rare jewel, in which the gems have been shaped and set by the hand of a genuine artist. Institute Park, through the generous outlay of money, thought, and taste, will become a source of inestimable delight. These Institute grounds, also, originally laid out and cared for with such wisdom and appreciation, are choicer than we have often had leisure to realize during the three busy years of our stay here. It is the massing and grouping, the combining and contrasting, of the different elements that gives character and beauty to the landscape. Here is a group of oaks, slow-growing and sturdy; there, a clump of hemlocks, green the year round; yonder a graceful spruce, set off by the green slope behind; and just beyond a bit of lawn, bordered with the various low, flowering shrubs; each doing its part, in high or low position, by

slow or rapid growth, in making up the whole complexity of the world of nature.

In this process of developing the beauty of these grounds we, as a class, have a part to-day. Yonder is our tree. Central in the northern quadrangle, in a spot become familiar by these years of constant passing, it stands in the very current of Institute life. The tree is small and slender now. I like to think of it rather as we hope it will be, tall and stately, majestic in its grandeur, casting down its grateful shade, and drooping with a quiet grace as it offers shelter and protection. But for the present the tree must grow. The warm sun and gentle rain must slowly build it up. But it is an *elm*, and in it lie all the possibilities of that noble tree for gracefulness, for strength, and for endurance.

And so I hope it may be typical of this class and of its members. Its hard, close grain may well represent the firm fibre of character this Institute seeks to produce,—such sinew as is fitted to endure, to struggle and to win. The Institute provides a discipline for its students, based upon the physical sciences and their application, that is well calculated to fit them for the requirements of life as it is to-day. We have not been taught to translate Greek; but our faculties have been trained to do our bidding. We have not been taught philosophy; but we have been taught to think, and to search out a matter for ourselves. Other colleges may plant their clinging ivy if they will; we plant a *tree*, sturdy, self-dependent, standing up alone. And so we go forth, not as parasites on society, nor yet as clinging vines, but rather as self-sustaining trees; not to be drags upon the world, but to build it up. And who shall limit the possibilities of the strong, earnest, cultured manhood that knows how to help the human race.

Our tree now takes its place among many others; among some that were living when this region was still the hunting ground of former generations, among others that are the careful plantings of the landscape gardener, and of a score or more of graduating classes. So we now go forth into society. So we hope to hold our places in the world, as this elm, quietly, sturdily, constantly growing on, to offer broader shade to the weary, a more gracefully rounded outline to the lover of the beautiful; and to yield our individuality more and more to the common good as our roots and branches intermingle more and more with the lives of those who precede, and those who follow us.

After another selection by the band, Charles O. Rogers delivered the class history, which, as it is given in full by the Aftermath, needs no mention here. The next address was the banner oration by Harry L. Phillips. He said:

The success of the class of '93 in the cross-country runs is known to you all. The story of these triumphs has just been told in the Class History, and I need not review it. I might refer you also to a chapter in the class book, entitled, "A History of the Cross-Country Runs," which is written, I am assured, in a very interesting manner. So, undertaking no narrative, I propose only to dwell for a moment upon the causes of the success of the class of '93 in these popular contests.

It must be admitted that the victories were ours, not because many of our number were fine athletes, for, if such were the fact, would the class not also have come to the front in general athletics, during the field days. Why, then, were we the winners in these runs? Was the success not due, for one thing, to the determination with which the class entered them, to the unanimity which the class manifested, and to the perseverance which was displayed and which brought '93 to the front? As soon as the cross-country runs of the last two years were spoken of, the members of the class said, "We have won the banner once or twice, now we must exert ourselves to the utmost to win it again, and thus make a clean record. We cannot lose it, gain it we must." This was the beginning. Then every man was determined to do his best to aid in winning the banner. In any line of activity, cannot a man accomplish more when he knows that he must bring about a certain result, than when he enters into anything in a half-hearted way and without resolution? Surely he can. The will to win entered therefore as an important factor into our achievements. Every member of the class helped in some manner. Some ran just for the success of the class, well knowing that they would get no glory as individuals. Those that couldn't run took care of the runners, "rubbed them down"—to use the technical term—and cheered them on to victory. In this way success was due to the work of the whole class. What would have been the result had only a part of the class been interested instead of the whole? Would it not have been defeat instead of victory?

The perseverance also which was shown entered prominently in determining the results. At the defeat in the first of a series the men were not discouraged but entered into the next run with renewed vigor and persevered until finally they had won. But for perseverance defeat would have been certain. Unflagging perseverance and undaunted will on the part of the contestant; the cordial unanimity and the enthusiastic support of all in any way interested, these

all had their influence in gaining the victories we now celebrate. And in the contests of another sort which we are already beginning to contemplate we shall need the same spirit of harmony and helpful interest, the same sympathy for one another; this we can, I am sure, count upon.

The same perseverance and the same determination we are eager to apply to sterner conflicts for greater rewards to which ambition and conscience call us, with no less imperative command, with no less confident assurance of success. Sure still of the helpful support of classmates and of the interest of you, our friends, we feel strong for the larger obligations. Determined to persevere, and promptly, reverently and absolutely to follow the dictates of duty, "Stern daughter of the voice of God," we press still and ever toward the mark—

> "So nigh is grandeur to our dust
> So near is God to man,
> When duty whispers low Thou must,
> The youth replies—I can."

The class oration by Nathan Heard was perhaps the best of the day. His oration was as follows:

Ladies and Gentlemen, Friends of the Institute, and Fellow Classmates:—

To-day is a bright and happy one for us in every way. After three long and yet all too short years, varied by all the joys and sorrows, the pleasure and toil of student life, we of '93 are gathered on this campus for the last time—gathered on ground which the past has made familiar and dear to us. The culminating point of our ambition as students is nearly attained and we have reached what is in one sense the turning point of our lives. Filled with all the vigor and hopefulness of our young manhood, we stand at the end of our college days on the brink of the future whose golden doors stand ajar before us and behind which we are longing to gaze, if perchance we may be able to see what awaits us.

We are essentially social beings, and history has shown among mankind a marked tendency toward organization. First, perhaps, for defence, then for co-operative industry, and then for social advantages, prominent among which we place education.

In all our organization and co-operation, the principle has held that a few are to command, while the great mass obeys. Realizing the necessity for this, we almost unconsciously find our places and render more or less willingly "tribute to whom tribute is due." Every privilege which is granted us by society brings with it a duty. Nothing of worth is ever granted to us without a corresponding obligation. It is in the fulfilling of these duties and obligations that our part in society consists. The more faithfully we perform our part, the more obedient and loyal each one is to proper authority, the more satisfactory will be our condition. There is something, even in the strictest discipline, that commands our respect. We admire a soldier who resolutely and firmly yields up his life in obedience to commands for which he may know no reason. There is within each one of us a certain feeling which recognizes and glories in the recognition of authority, even if not always wise and beneficent; this we call loyalty.

What is it that holds us to our country's flag? Did not we or our fathers pay even with life for all that we enjoy? But still we feel our indebtedness, and manifest it in steadfast loyalty to the red, white and blue. Some may ask, "Have we not paid for all we have received in the way of education?" Yes, in one poor way, but money only partially cancels our obligation. Dollars and cents are no measure of the services of a cultured mind. We still are indebted for that which is a priceless gift to man in this age and generation. The advance of modern civilization has placed a good education among the necessities of life, and made it almost as indispensable to our happiness as liberty and homes. It is no mere feeling of sentiment which causes one's heart to burn within him as

> "Home his footsteps he has turned
> From wandering on a foreign strand."

Neither is it mere sentiment which should animate us as we may return to our college-home.

Here it is that we have been preparing for our life work. Here it is that our untrained minds have been developed and directed along the paths of knowledge. Here it is that we have been taught some of the laws which govern the workings of the giant universe, and have learned how best to obey them. Here in some small way, we have learned to harness the mighty forces of nature and to send them forth to do our bidding. With it all has come the more important knowledge of ourselves and our own infinitesimal powers, which has made us ask more reverently, "What is man that thou art mindful of him, and the son of man, that thou visitest him?"

During our stay at the Institute we have been cognizant of many evils and grievances; some exist to-day; some, we are sorry to say, have been increased by us; some were fancied or unimportant, and will vanish from our recollections as time takes its flight; some we have, perhaps, been too much inclined to cherish and to dilate upon, until we have neglected our

duty. The future only will place us in a true light.

But in particular, day by day we have been brought face to face with the fact that there is a lack of feelings of loyalty, enthusiasm and devotion to their alma mater among both students and alumni. To point out specific or even general instances is unnecessary. We are but too well aware of the fact. To name the cause might be difficult, but it is to be feared that in the intense search after the practical, the finer and more delicate feelings have been blunted and obligations have been neglected. If evils do exist, it is our duty to do everything possible in our power to have them removed, but existing institutions must not be destroyed until better can be substituted. It should be the aim to construct rather than to destroy.

And now, fellow classmates, as we go forth to join the rapidly increasing ranks of the alumni, let it be with hearts full of enthusiasm for the old Institute. Let us remember our obligation to it and when riches and honor come to us, as God grant they may, let us more generously remember it, and let us resolve to do all in our power for the advancement of the Tech's fair fame.

We have prided ourselves, and I hope with reason, upon our class and its history, but may '93 be forgotten, and the memory of all its happy and glorious past be forever annihilated if it is not more loyal to its alma mater.

And now, one parting farewell to the Institute, to this campus and to old Boynton Hall. May year by year, larger, more enthusiastic and more loyal classes go forth from its doors. May it stand for many long years and meet the sun it its coming. Let the earliest light of the morning gild it and parting day linger and play on its summit.

The closing address of the afternoon was given by William H. Larkin, Jr. His address to undergraduates was one of the new features of the day and was listened to with interest.

Friends and Undergraduates:—

Last night many of us listened to an address delivered before those who soon will be graduates, and now the duty has devolved upon my hesitating shoulders to preach a little sermon to you, the undergraduates.

To us the change from one to the other seems a magic transformation. What a short time ago it seems that we first scaled the Heights of Learning, which we call "Tech Hill." How like yesterday seem the events which have been related by the historian.

Yet we have passed on and, in departing, would leave behind us some bits of advice, or better, a word of farewell to you who will fill our places. To be sure we have the feeling that we leave a vacancy that can never quite be filled, but that is only natural and a failing common to graduating classes.

In looking over our varied experience here, perhaps the thought which strikes us most forcibly is embodied in the one word, work. Whittier shows great insight into school-boy human nature in the words:

> The charcoal frescos on its walls,
> Its door's worn sill betraying
> The feet that creeping slow to school
> Went storming out to playing.

I do not know that we have any compromisingly worn sills, yet the sentiment is universally true, even in these days.

It is by labor that all difficulties are overcome, all long roads traversed, all worthy ends attained. This school has no place for those who resemble the farmer's lad who, when told to do some ploughing, replied, "Oh, I wish I were dead." "Yes," said his father, "that's jest like ye, ye want to be lying in yer grave and taking it easy all the rest of yer life."

There is a great responsibility in education, which we shall realize better, perhaps, when we assume our positions in the ranks of educators as junior professors and the like, or when we take charge of men in the shop or field. Education is a priceless jewel given into our keeping, we should realize the trust and act accordingly. May we realize it as thoroughly as did the man whose youthful son said, "Say, father, who was Shylock?" "What!" replied his father with a look of great surprise and horror, "great goodness, boy, you attend church and Sunday-school every week, and don't know who Shylock was? Go and read your Bible sir."

Yet how cheaply these great truths and principles, so dearly purchased by others, are made our own. We sit comfortably at our desks and imbibe facts which possibly mean half an hour's study to us, but which may be the fruit of a lifetime of labor on the part of some one else. We are living decades each single day of our school course.

Now that the time of parting comes, it seems that we have too little realized the enjoyment of each other's society, too little have we grasped the waiting opportunities, in fact it is human nature never to appreciate present joys. We take everything as a matter of course, perfectly natural seem to us the easy intercourse and absence of any considerable degree of restraint. How different would be our appreciation of these present joys had we been at Princeton under President Davis many years ago. Here are some of the regulations then daily observed:

"Every scholar in college shall keep his hat off about ten rods to the president and five to the tutors.

"Every scholar shall rise up and make obeisance when the president goes in or out of the hall.

"Every Freshman sent of an errand shall go and do it faithfully and make quick return."

And many others of equally interesting character.

School life is not all burning the traditionary midnight oil. There are many opportunities for social enjoyment, and he who misses them altogether has omitted a considerable portion of his education, for through them life-long friendships are made, and many a sharp angle in a man's character worn off.

As the little rivulets flowing together make the stream which is again diffused when it meets the ocean, so we who have joined our courses at this school are now destined to separate, and while some continue here, the majority will soon be spread over the whole world.

On departing, we leave you, undergraduates, who have been our rivals on the field, antagonists in many an exploit, yet comrades and associates in our work, with a feeling of respect and good fellowship. May you find the road to success a short one, and perhaps the best way to do so will be to follow in the footsteps of '93.

After the speaking, Gumpei Kuwada, the custodian of the mascot, took it down from its position and assembling his classmates led them in the class yell. The members of the lower classes replied, and a group of '94 men gave their yell with '93 at the end of it. The seniors responded with a burst of applause and a cheer for '94. The audience then dispersed, a large portion going to inspect the mechanical and thesis drawings, which were exhibited on the third floor of Boynton Hall.

The Annual Senior Reception.

On Monday evening, at Horticultural Hall, occurred the annual Senior reception. The hall was very tastefully decorated. The photographs of the class in a large frame on the platform attracted considerable attention. The ushers, in charge of George W. Heald, '94, presented the guests to Mrs. MacDonald, Mrs. Washburn, Mrs. Whitcomb and Mrs. Garver. Refreshments were served just before ten and at ten o'clock dancing commenced. Although the evening was very warm, a large company remained on the floor until the last number on the order was finished.

Tuesday was rather a quiet day, nothing of especial importance going on. The ball game which generally takes place between members of the class was this year omitted and Tuesday was improved by many in resting for the excitement to come Wednesday and Thursday.

The Aftermath, which was expected to be on sale Monday, did not arrive until Tuesday. Wednesday afternoon the June meeting of the Washburn Mechanical Engineering Society took place at the Board of Trade rooms on Foster street. By having it at this time many of the Alumni who were in the city for the Alumni Association meeting Wednesday evening were enabled to be present. After the necessary business had been transacted two papers were presented. These will be found in full in another column.

Course in Chemistry.

Phosphorus and Arsenic in Copper, Frank W. Cheney.

Investigation of Deposits in Sewage and Non-Sewage Bearing Streams, D. Howard Hodgkins, Charles D. Howard.

Analysis and Study of the Mineral Spring, Sand Springs, of Williamstown, Erastus Hopkins.

The Separation of Nickel and Cobalt (Hope's Method), Pelham W. Lincoln.

The Sanitary Condition of Lake Quinsigamond, William H. Parker.

Course in Civil Engineering.

Determination of Change in Volume of Cement by Hot Tests, Arthur D. Butterfield.

The Cippoletti Trapezodial Weir, Charles W. D. Dyer, Alfred D. Flinn.

Rapid Transit in Cities, Robert B. Farwell.

Design for a Riveted Iron Highway Bridge, Nathan Heard.

Course in Electrical Engineering.

Storage Batteries, Harry W. Bowen.

The Efficiency of Dynamos and Motors by Electrical Methods, Herbert G. Clark, Robert S. Parks.

The Static Capacity and Insulation Resistance of Cables, Howard A. Coombs.

The Efficiency of Transformers, Austin R. Dodge, Alfred McKay, Thomas S. Perkins, Robert M. Starbuck, Jr.

The Measurement of Self Induction, Everett E. Kent, Ernest W. Marshall.

Course in Mechanical Engineering.

Steam Traction on Common Highways, Clarence B. Blanchard.

Test and Duty of the Knowles Steam Pump at the Salisbury Laboratories, Josiah W. Buzzell, William H. Larkin, Jr.

Intermediate Speed Regulators, John P. Coghlin.

Power Tests of Woolen Machinery, Arthur C. Comins.

Engine and Boiler Test at the Norton Emery Wheel Co., Walter J. Deuny, Louis W. Rawson.

Test of the Steam Plant in the Washburn Shops, Joseph A. Derby, Edward W. Vaill, Jr.

Cable Railways, Edward A. Gage.

Effect of the Reciprocating Parts of a High Speed Engine, Charles E. Goodrich.

Design of a Sailing Yacht, Moses F. Goodrich.

Test of Tandem Compound Engine, Fred H. Greenwood, E. Stearns Wood.

A Valve Motion for a High Speed Compound Engine, Aldus C. Higgins.

Computations for a Steam Plant, Gumpei Kuwada.

Comparative Test of a Compound Engine, Condensing and Non-Condensing, Frederick H. Metcalf, Leslie P. Strong.

Report of Test on a Wheelock Compound Engine at Worcester Woolen Mill, Arthur F. Newton.

Effect of "Drop" in a Compound Engine, Harry L. Phillips.

Quarter Turns in Power Transmission, Nathan Rice.

Test of Morse Rotary Engine, Charles O. Rogers.

Marine Boilers, Harry Sinclair.

Economic Construction and Care of Shafting and its Supports, William D. Thompson.

Course in General Science.

Comparison of Photometric Standards, Calvin H. Andrews.

Military Customs of Early Massachusetts, Charles Baker, Jr.

The Latimer-Clark Standard Battery, Arthur R. Bingham.

Sprinkling of Worcester's Streets by the City, David I. Wright.

Thursday forenoon at half-past nine occurred the reading of abstracts from some of the theses. Professor George I. Alden presided. The examining committee consisted of J. M. Goodell of New York, H. W. Wyman of Worcester and Frank O. Whitney of Boston.

The following is a list of subjects of the theses of members of the class. Abstracts of those marked with a star were read:

The different buildings were open for inspection all day Thursday, and the opportunity was improved by a number of visitors. Thursday evening were the graduation exercises at Association Hall. At eight o'clock the class filed in and took seats in the first five rows in the centre section.

Judge P. Emory Aldrich presided and opened the exercises by a brief address. He mentioned the improvements during the last year, spoke of the present standing of the Institute and in conclusion told the needs of the Institute. He then introduced Professor Robert E. Thompson of Philadelphia, the speaker of the evening, whose subject was "Building of a Nation." The attention of all was closely held for nearly an hour, and the oration was full of valuable thoughts.

Charles Baker, Jr., delivered the valedictory address, which follows in full.

Valedictory.

Into the life of every nation, of every individual, there come critical moments, times when the fate of the future may depend upon a single decision, periods when the forces at work are exactly counterbalanced, and the slightest movement turns the scale this way or that. Such a day, ere long, may come to each one of us. We have been, till now, cared for and bountifully supplied by parents and friends; opportunities for advancement have been freely given us, and the splendid advantages of modern education have been ours. At length, a change has come, the long years of preparation are over, and we must stand now in our own strength to do battle in life. It is in entering this struggle, in finding our place in the world that, for us, the crisis will come. The choice of a moment may determine our whole career. We cannot always tell which decision of ours will most influence our future and we may even settle it all unconsciously. Every step will, then, be a momentous one for us, since we know not what may hang upon it. Perhaps a month, perhaps a year, perhaps a decade will pass before we have found our work and gotten it begun; perhaps—but may it not be—some will never discover their mission in life, but pitifully waste their strength in misdirected effort.

As we go out from the confinement and discipline of school life, one danger especially confronts us. Our intense longing to be skilful and proficient engineers may lead us to neglect every liberalizing study, and the years may see us growing narrower and shrinking into men who are little better than fine mechanism. But, though instruction is ended, education has only begun, as some one has put it. If we are being truly educated, we shall not become dwarfed and misshapen but broader, more sympathetic, more cultured. Like the progressive and liberal-minded man, though we are no longer taught by a selected faculty, we shall be under the tutelage of a thousand masters, whose tasks, difficult or easy, we shall do. A multitude of forces draw us on, the world of books is at our command, the world of travel lies open to us, the world of nature invites us, and the world of our own selves offers an inexhaustible field for research. Shall we say that, as the school doors close upon us, we will have no more of them? Let us rather aim to be complete men and determine to keep open house, all the year round, to every elevating influence and every form of truth.

Two paths are open for us, one leading to wider, more extensive fields of knowledge, to heights of culture where grand views of all human progress stretch out before us; the other turning down into the narrow lane of one pursuit, from which little outlook is to be had and whose walls grow ever higher and closer together. Sooner or later, each one of us must take one road or the other, and, when we step forward on the chosen way, a crisis of supreme import for the man will be over, a crisis whose outcome

will have the greatest effect on that individual's entire future.

Parting words are always hard to say. They seem to mean the tearing and breaking of so many ties of friendship, the rending asunder of so many bonds of union in a common pursuit. Yet we can say good-bye only to the outward forms, the buildings, the trees, the faces and figures of schoolmates, teachers and friends. Their images we shall carry in our minds and would not be parted from them if we could.

First, we must bid farewell to the city whose hospitality we have enjoyed these years together. Its rich libraries have been open for our use, its beautiful churches have cordially welcomed us and ministered to our deepest needs, and in its homes we have made acquaintanceships and friendships that will be sources of pleasure in coming years. Here, too, we have found our social life, and in the industrial activity of Worcester the alumni of the Institute are taking a more and more prominent part. So we leave this fair city, whose busy life will scarcely know that we are gone, to take our places in other centres amidst the great army of toilers.

It is harder to break the associations with the old school. Gentlemen of the Trustees, you have been for us the powers that silently and unseen act for the welfare of the Institute. Our contact with you has been necessarily slight. But you have directed the means and agencies for our education. We step to-night out from your guardianship, and bid you farewell.

Aside from that of parent and child, few human relations may be more helpful and stimulating than that of teacher and student. That relation we must sever now, and we would not do it with hasty or rough hand but only in a formal and dignified manner, trusting that your interest in us as our respect for you does not, at this time, come to an end. We cannot realize all that we owe to you until we have put in practice the help you have so lavishly given us. As the years go by, the details, the unpleasant features, the conflicts, the inevitable friction between governing and governed will sink into insignificance and we shall remember rather the spirit which has animated you in striving to make us more skilful and better fitted for life's struggle, than these. Nor are we now devoid of a sense of the deep debt of gratitude we owe you. We feel that a large part of our success in our chosen fields depends upon the faithfulness with which we have followed the paths into which you have led us. We would fain repay this debt in some way even to-night, but believe that by patience, perseverance and industry in our future work we shall best show our appreciation of the efforts you have made in our behalf. Gentlemen of the Faculty, we are soon to be officially cut off from you, but may that truer, higher intercourse of friend which these years have in some measure set up between us not now cease but rather take a more real, more vital beginning.

Schoolmates: we are gathered for the last time as members of the Institute, as one of your number. Next year our places, which we thought so large, are amply to be filled by some of you, our air of importance you will wear, it may be, with added self-assurance, our task you will do, we hope, better. During our stay the Institute has seen many improvements, and, we believe greater ones are coming. The honor of the dear old school now rests on your shoulders. Defend it, with might and main. Put new energy and skill into athletics; our eyes will be upon you, and we shall rejoice in your every victory. Let the move for a broader student life flow on, more and more vigorously. Maintain the student clubs, both special and general, and do not let the enlarging social life of the past year utterly die out. Finally, do your work better than we have done it, and may success attend you along all lines.

Classmates: many feelings crowd themselves upon us in these closing moments of our school life. No words of mine can half express them. Silence were a thousand times more befitting, a thousand times more eloquent. Few friendships we shall ever form will be more firm and lasting than those made at the Institute; few associations will be dearer than those which cluster around the old hill, and few memories more frequent and pleasant than those that go back to the Tech days. It is hard to believe that those days are indeed only recollections now, and we are at once sad and joyful. Sad, because we must leave all that these years have gathered about school intercourse; joyful, because we can now take our places in our chosen work. Farewell then to the past, welcome to the future. Farewell to each and every one, schoomates, teachers, trustees, city and dear old Institute, farewell, and may a prosperous and glorious career be yours. The class of '93 bids you a long farewell.

In the absence of President Fuller, Professor George I. Alden delivered the address to the class. He said:—

Gentlemen of the Graduating Class:—

Every noble mind cherishes a lively interest in the best aims and aspirations of young men.

The world is in need of men—of extraordinary men. Men with knowledge and skill, courage and strength, stability and patience;

men who love truth and practice virtue. Only such can successfully cope with the great and complex problems incident to our advancing civilization.

As you stand in the presence of this need, it is inevitable that every eye should be turned upon you. Pressing upon you from the past are the thronging memories of your college life, a life not wholly free from hardships, disappointments and trials, but a period which, in spite of every unfavorable feature and condition, has, when seen in its true perspective and from your present standpoint, a charm which is quite unlike that of any other picture which your memories will cherish. Before you is life, in greater fulness, with larger responsibilities, broader opportunities, higher possibilities. You cannot be insensible to such an environment.

You have as a class and as individuals won and retained the confidence of your instructors in a high degree, and I am sure they are glad to recognize your success and worth and to speak a last official word. But it is a time when words should be few and earnest.

I have said that the world is waiting for men. What may we expect from you?

We expect, first of all, that you will be earnestly devoted to your life work, and that in that work, whatever it may be and whenever it may begin, you will be always students. That you will remember that true scholarship ever leads to greater humility and that pride and pedantry are out of place in a real student of science.

Beyond this, our expectations regarding you are modest though far reaching. We expect you to be intelligent, progressive, cultured, and self-reliant. But I mean by these common expressions a little more, perhaps, than the words at first convey. The real innermost truths and facts of social and business life do not lie upon the surface or fall from the lips of the careless. You cannot be truly intelligent without intellectual activity and effort.

There must be mental perception of the relations of facts, an intellectual discernment of truth, an inner sifting sense, which pierces through the artifice and deception which selfishness uses for its baser purposes of gain and vain glory.

Intelligence of a high order loves the truth and has at least the power to turn its face always toward the light.

It is your fortune to graduate in Columbian year (put off a year, perhaps, for your benefit) and to have the opportunity of seeing at the Exposition the grandest example and illustration of the progressive tendencies of the age, that has ever been seen in one place. Let this be an incentive to you to hold your minds in readiness to receive truth from every quarter, but be careful to store new truths symmetrically around the centre of gravity of the old, thus gaining in breadth and height of knowledge without destroying equilibrium in what is already gained.

The broad, deep river has one essential quality which belongs to every part and particle of it. It is that which makes it a river—its onward motion. It never ceases from its great purpose to reach the ocean. But the banks of the river are beautiful with flowers and vineyards, with cottages and castles, and these are reflected from its surface. As you see it in the sunlight, you are hardly aware of its motion. That which impresses you is not its essential quality as a river, but its beauty.

Let your lives be like the river. The earnest and deep purpose of your life must be its chief characteristic. But if you cultivate within yourselves a serenity of soul, a grace and delicacy of feeling and action, and the profound sentiments of love to your fellow-men and to God, the rugged forces of the great current of your active professional life will be harmonized and lost sight of in your social life, just as the current of the river is forgotten while we enjoy the splendor of the valley through which it flows. The wonderful ideality displayed in the physical universe, whose laws you have begun to study, will, if rightly viewed and lovingly and reverently contemplated, yield in your lives the fruits of the soul-life, which make men truly cultured.

But are we not looking to your class for a Gladstone, a Humboldt, a Watt or an Edison? No, gentlemen. The world needs but one Edison, and will have but one. To look for another would be as unwise as it is unnatural. It is new men we want for new conditions. No copies, imitations or duplicates will answer the purpose. Every self-reliant soul may have within itself, as yet all undiscovered, a latent power just suited to some new necessity, and which working spontaneously at the right moment, may reveal itself in deeds which all men shall recognize as worthy of the highest honor. Ponder then this power that comes to the self-reliant man. Study your own present limitation but do not allow yourselves to be too often on the brink of these limitations. You can enlarge the area upon which you may firmly stand. Do this continually, and you will secure your own growth, and will retain the confidence of men, because they will not too often find you outside yourselves. If you cultivate true self-reliance, avoiding its counterfeits and dangerous extremes, you will all live as those whom

the world stamps with greatness. You will say with Emerson, "Why all this deference to a few great names? What if they were virtuous? Did they wear out virtue? As great a stake depends on your private act to-day as followed their public and renowned steps. When private men will act with original views, the lustre will be transferred from the actions of kings to those of gentlemen."

If you are characterized by intelligence and culture, if you are progressive and self-reliant and if you practice all the simple and cardinal virtues, not for what you can get from them, but for what you can make of them, so that honesty, integrity, truthfulness, shall have a new and higher meaning as seen in your lives, you will cultivate the best qualities for professional success; you will also deserve the gratitude of mankind, and will receive the approval of God, and the eternal rewards of heaven.

That you may treasure up the central thought I would impress I will give it in the words of a favorite author, "In deiner Brust sind deines Schicksals Sterne."

The diplomas were then presented by Judge Aldrich to the following men:—John D. Curtis, class of 1871; Charles W. Sanders, class of 1876; William F. Burleigh, class of 1892, and of the class of 1893.

Chemistry: Frank Weston Cheney, Worcester; David Harwood Hodgkins, East Brookfield; Erastus Hopkins, Worcester; Charles Danforth Howard, Westford; Pelham Winslow Lincoln, Worcester; William Huntington Parker, Worcester.

Civil Engineering: Arthur Dexter Butterfield, Dunstable; Charles William Duff Dyer, Holyoke; Robert Bennison Farwell, Hubbardston; Alfred Douglas Flinn, Worcester; Nathan Heard, Worcester.

Electrical Engineering: HarryWallace Bowen, Adams; Herbert Guild Clark, Derry, N. H.; Howard Addison Coombs, England; Austin Richardson Dodge, Shelburne; Everett Edward Kent, Worcester; Alfred Mackay, Clinton; Ernest Woods Marshall, Worcester; Robert Sampson Parks, Fitchburg; Thomas Steel Perkins, Idlewood, Penn.; Robert Macy Starbuck, Jr., Worcester.

Mechanical Engineering: Clarence Bradford Blanchard, North Uxbridge; Josiah William Buzzell, Worcester; John Patrick Coghlin, Ashland; Arthur Clark Comins, Worcester; Walter Josephus Denny, Leicester; Joseph Augustus Derby, Fitchburg; Edward Anson Gage, Worcester; Charles Edward Goodrich, Spencer; Moses Foster Goodrich, Portsmouth, N. H.; Fred Henry Greenwood, Clinton; Aldus Chapin Higgins, Worcester; Gumpei Kuwada, Tokio, Japan; William Harrison Larkin, Jr., Worcester; Frederick Holbrook Metcalf, West Upton; Arthur Freeman Newton, Worcester; Norman M. Paull, Fairhaven; Henry Lucian Phillips, Holden; Louis Windsor Rawson, Worcester; Nathan Rice, Worcester; Charles Owen Rogers, Worcester; Harry Sinclair, Worcester; Leslie Parsons Strong, Springfield; William Dexter Thompson, Worcester; Edward Warren Vaill, Jr., Worcester; Elijah Stearns Wood, West Upton.

General Science: Calvin Henry Andrews, Boylston Centre; Charles Baker, Jr., Worcester; Arthur Robbinson Bingham, Worcester; David Isaac Wright, Tatnuck.

Graduate Electrical Engineering: Evin Wright Howard, Worcester; Wm. Nelson, Worcester; Arthur Louis Rice, Barre; Clayton Oliver Smith, Worcester; Hugh McClellan Southgate, Worcester.

The prizes of $75 to each of the six men who have stood highest in the class during the course were awarded to Charles Baker, Jr., Robert B. Farwell, Nathan Heard, Alfred D. Flinn, Henry L. Phillips, and Charles O. Rogers.

At twelve o'clock the class assembled at the Commonwealth Hotel for the "Clear Way Thro'" supper. A very amusing list of toasts had been prepared, but as there was considerable business to be done and the time was short the entire list was omitted.

Among other matters of business was the election of officers for two years. Charles O. Rogers was elected President, Edward W. Vaill, Jr., Vice-President, and Harry Sinclair, Secretary and Treasurer. It was voted to hold a reunion in two years. After the business meeting Henry L. Phillips was appointed auctioneer and the property belonging to the class was auctioned off. The cuts used in the aftermath were all sold with the exception of the one of Prof. Sinclair's room which was donated to him, and the cuts relating to the Ninety-four Half Way Thro' supper which were donated to Thomas S. Perkins.

The last cross-country championship banner was sold to Dyer for $10.50 after lively bidding by Parker and Coombs.

The auction netted about $40. The meeting broke up at about five o'clock.

BORN.

Born at Galesburg, Illinois, April 26th, a daughter to Charles E. Wells, class of '80.

PAPERS READ BEFORE THE W. M. E. S.

Recent Advances in Municipal Engineering.

The growth of an American city, from a hamlet of a few board houses to a railway and industrial centre, is generally so rapid that it is not just to expect the perfection in detail which characterizes the older cities of Europe; and the municipal engineers who are supposed to keep these rapidly-developed places paved, drained, and provided with abundant water, certainly deserve lasting credit for the work they have done. Persons not directly connected with municipal affairs little comprehend their magnitude. As an illustration, take the matter of granite-paving in New York City. What that amounted to in twelve months, in 1891 and 1892, can be best understood from the fact that if the blocks used for the new pavements were made into a pile 4ft. high and 4ft. wide, the pile would be nearly 19 miles long. This instance of a single branch of work in a single city is enough to show that, although you gentlemen of gears and emery wheels may regard municipal engineering as a combination of a little guesswork and considerable bluffing, it is nevertheless a matter of much moment.

The few things I wish to mention this afternoon have nothing to do with pavements, however, but concern water supply and sewerage. The great influence which a water supply has on a city has only been realized by the great mass of the people within the last year. The importance of a good water supply was never more forcibly, although terribly, emphasized than at Hamburg a year ago. That city drew all its water directly from the Elbe river; the supply was forced from the stream by pumps through the mains and service pipes directly into the houses of the people. The population of Hamburg is 623,000; there were 18,000 cases of cholera and 7,600 deaths. Adjoining Hamburg on the north is Altona, whose population of 143,000 is supplied with water drawn from the same river, but below the point where all the sewage of Hamburg's 623,000 people is discharged. The spread of cholera is brought about by the germs of the disease introduced into drinking water by the sewage from those places afflicted with the scourge; consequently, one would naturally expect more cases of cholera in Altona than in Hamburg, but there were actually only 562 and 328 deaths, many of which were traced to the use of Hamburg water. What was the reason for this? Simply, that the water used in Altona, instead of passing from the river directly to the city, was filtered through sand. Now, here is an instance where the municipal engineer is plainly shown to have the health of a community in his charge. It is of interest to note that the frightful mortality, caused indirectly by bad water in Hamburg, has led the authorities of that place to construct filtration works that are of the best type except in one regard. In these works the water is pumped first into four settling basins, holding over 8,000,000 gallons. After it has clarified by settling for twenty-one hours it flows to the sixteen filter beds, each having an area of over 80,000 square feet, where it is filtered at the rate of 2½ inches an hour. The filter material is sand, placed in a sheet from 2 to 3¼ feet thick. From the filters, the pure water flows to a covered distributing reservoir. The construction of these works marks the latest and most complete surrender of the engineer to the biologist, and the advances in municipal engineering which are most noticeable in the last two years are largely in the line of biology. Formerly, if an engineer wished to know if a water was fit for drinking, he sent a sample to a chemist and asked for an analysis. Now, it is as foolish to decide if a water is safe to drink from a chemical test alone, as it is to decide how large a sewer is necessary to drain an area of 1,600 acres without other data being given,—a question that a city engineer asked me last week. It has been said by Dr. Thomas M. Drown of the Massachusetts State Board of Health that there is not a more mistaken notion than that the chemist tests for definite harmful impurities in water as if searching for poisons, when the fact really is that the value of the results of a chemical analysis depends entirely on the correctness of their interpretation.

Now, the great source of pollution of water is of course sewage, in which, when fresh, there are two characteristic substances, free ammonia and chlorine. By free ammonia the evil-smelling ammonia water is not meant, but rather the carbonate or chloride; the use of the word free is rather unfortunate. If one or both these substances are detected in unusual amounts in water there may be disease germs in it brought by sewage. But, unfortunately, there may be a great amount of pollution, even a dangerous amount, in a water which is not revealed by the amount of free ammonia shown by analysis. For it is easily shown that living algæ absorb this free ammonia. The plant life in turn appears in an analysis as albuminoid ammonia, but as this albuminoid form may be due to algæ which have never been nourished on sewage, it is evident that ammonia is a very uncertain guide as to the character of a water supply. But, fortunately, the presence of much chlorine in water is a pretty safe indication of contamination. The amount of chlorine occurring naturally in water varies widely, but as soon as this normal account can be determined then the question of pollution can be pretty quickly settled. The value of an analysis depends very largely on the knowledge of the normal or natural amount of chlorine found in an unpolluted water supply. In this State this amount of chlorine ranges from 0.06 parts per 100,000 in North Adams to 2.4 parts in Provincetown.

If a chemical analysis leads to the suspicion that a water supply is polluted, a careful examination of the water-shed will generally reveal the source of contamination, while a microscopical examination of the water will show its actual contamination. It is not the chemicals which are dissolved in water that are harmful, but the micro-organisms.

Now, these micro-organisms can be divided into two classes—microscopical and bacterial organisms. The first class are the bacteria, which require to be brought up carefully on cold soup, ancient potatoes, and similar tid-bits; they are all plants, and are so very small that they can be studied only with very powerful microscopes. The microscopical organisms, on the other hand, do not require to be carefully nursed; they can be easily studied with a microscope, and include plants and animals.

The microscopic organisms are those which engineers in charge of water works establishments are supposed to understand. The bacteria are so small, their characteristics are so hard to determine, and their importance so great that their study is turned over to professional biologists. Still, the method of investigation of these bacteria is interesting and is quite simple in theory, although very delicate in practice.

In making a biological analysis of water, a small quantity of the sample is well shaken in a test-tube filled with melted gelatin, the mixture poured out on

a plate and allowed to stand for two or three days. The plate is covered with a bell-glass to prevent bacteria from gaining access to the inoculated gelatin. Soon after the mass has solidified minute white clots appear which grow for two or three days. Each of these growths is due to the rapid development of a single bacterium into a colony, and as it is an easy matter to count the number of colonies in a definite portion of the gelatin, an idea of the number of bacteria in the sample of water can thus be found. It is a much more difficult matter to determine the species of the bacteria. To do this, a small part of one of the colonies is transferred to a test-tube and thoroughly shaken up with distilled water. A test-tube of melted glycerin is then inoculated with a small quantity of this water and the glycerin allowed to cool in ice-water, the test-tube being revolved continually in order that the solidification may be uniform and the bacteria may be kept well apart. When a colony makes its appearance, tubes of beef bouillon, blood serum, and other substances are inoculated from it and the growth in these mediums watched through powerful microscopes.

The microscopical organisms, as compared with the bacteria, at least those of any importance, can be determined in a much more simple manner, however, which is fortunate, because some of them have been found to be a source of considerable uneasiness at times to water works superintendents. The investigation of water supply for the purpose of ascertaining the number of these organisms is generally made by a method worked out jointly by a biologist, Professor W. T. Sedgwick, and a civil engineer, Mr. George W. Rafter. An ordinary six-inch glass filter is partly filled with perfectly clean, sharp sand, through which 500 cubic centimeters of the water under examination is allowed to filter slowly. After all the water has filtered through, the sand is washed into a test-tube by 5 centimeters of distilled water. The sand has probably separated out all the organisms in the sample, so, when it is washed into the test-tube and thoroughly shaken, nearly all of them will be suspended in the 5 cubic centimeters of water, which is immediately decanted into a second test-tube.

The examination of this class of organisms can be made with a comparatively inexpensive microscope, and a number of water works officials now make regular examinations of the quality of the supplies under their control. A little box, having brass sides, mounted on a glass microscopic slide, and a glass cover is filled with a cubic centimeter of the decanted water from the little sand filter just mentioned. The bottom of the box has an area of just 1,000 square millimeters. By means of a micrometer device, it is an easy matter to count the number of organisms in twenty of these square millimetres, and from these results calculate the number in the original 500 cubic centimeters.

The importance of this simple method of determining in part the organic impurities in a water supply was early recognized in New England, and for a very new thing its adoption has been quite rapid. Down at Brookline, Mr. F. F. Forbes, superintendent of the local water works, makes a microscopical examination of its water in the reservoir every week, and by carefully studying the organic growths is able to guard against some of the sources of bad tastes and odors, the causes of which were unknown a few years ago. The Boston water board conducts weekly investigations of all of the Boston waters, making 2,310 microscopical and 2,160 bacteriological examinations during the past year. The practical use of these examinations in that city is shown by an occurrence in January and February, 1892, when the reservoirs were all covered with ice. The water drawn from the taps was slightly bitter or spicy, especially near dead-ends. Microscopical investigation showed that wherever the taste was strongest, there existed in the water comparatively large numbers of infusoria, which were traced back through the mains and conduits to the northern division of Lake Cochituate. Hence, to stop the taste, it was only necessary to shut off this supply until the infusoria became reduced to their normal number.

Another instance of the value of these examinations is found in recent experiences at Meriden, Middletown and Wallingford, Conn., and Norwood and Plymouth, Mass. At one time or another the water drawn from the service pipes in all these places had a very disagreeable, fishy odor, while the water in the reservoir was without such a drawback. After careful examination the trouble was in each case traced to little organisms of the genus Uroglena, and the Massachusetts State Board of Health has promised us a report on these organisms which will enable us to look out for them and prevent their injurious effects as much as possible. Another organism that can create a great amount of trouble for so small a thing is Crenothrix, and places using a ground water supply are always on the look-out for it, if the water contains certain iron salts. When it does occur, the microscope has shown that the best cure is often absolute exclusion of the light from the storage tanks or reservoir.

The value of bacteriological and microscopical examinations in connection with the filtration of water and the disposal of sewage is very great, and while the municipal engineer is not expected, nor has he the time, to make such investigations himself, nevertheless the progress of sanitary science makes it necessary for him to understand the methods adopted and to interpret the results obtained. This branch of engineering, or rather this allied branch of scientific work, is so recent, its works are of such little interest to the great mass of engineers, and its value so little appreciated, save in Germany and New England, that it offers a very attractive field of investigation, and certainly promises valuable and practical results.

The Commercial Side of Engineering.

Not very long ago I received from Prof. Alden an invitation to address this gathering, and as I read the letter it seemed almost as though he was saying to me, Come, sir,—it is now more than twenty years since you left the school on the hill and entered the larger school of active life,—have you not something to tell of what these twenty years have taught you? As compared with the few years of school life these years of active work are many,—tell us in what way the lessons of the many have confirmed or modified the lessons of the few. Accepting the invitation in this spirit I have chosen for my subject, the Commercial side of Engineering.

Have you ever heard some one say, in explanation of a failure, "Well, what else could happen? that was a very pretty plan in theory but it had no value in practice." In a technical railway journal of recent date, in a letter from a so-called "working man" you may find this sentence,—"Theory is the god of destruction on railroads and causes untold loss of life and property." This too common talk about something as being good in theory and bad in practice is evidence, as it seems to me, of confusion in thought. We may with equal propriety speak of harmonious discords, or of the enjoyment of ill health.

What is this "theory" which is so jauntily brushed aside as one of the infirmities of noble minds? Before this audience the words of Rankine ought to count for something, and he says, "Sound theory in physical science consists simply of facts and the deductions of common sense from them, reduced to a systematic form." Another simple definition is that which declares theory to be "the knowledge of the principles by which practice gains its ends."

By all means, let us admit that all theories are not equally true, all theories are not equally sound, all theories are not equally valuable; but let us not forget that "men do not gather figs of thorns, neither of a bramble bush gather they grapes." In short, there is no real conflict between theory and practice, and the want of harmony which seems to exist is not between the two departments but only between unfortunate individuals who cannot see that the two lines of effort are not parallel but are converging and are always striving to flow together into the broad stream of human endeavor.

The confusion of thought, to which I have referred, leads to a belief that theory and theorists are things to be tolerated, as well enough in their way, but that the world's real benefactors are the practical men. "Theory," says the practical man, "is mere knowledge." Yes — if you will — but like "mere morality" it lies very close to the root of things. Was it a practical man who established the fact that celestial and terrestrial mechanics are of one science, and showed that the motion and stability of bodies on the earth are controlled by the same laws which also guide the stars? Galileo was sufficiently practical to invent the convenient proportional dividers, but his fame rests less on that, I imagine, than upon his enunciation of the first principles of dynamics. Rude telescopes were in use before his time but it is said that Galileo, in one night of profound meditation upon the principles of refraction, succeeded in formulating a theory which led to the making of the first telescope of substantial power and value.

Knowledge is a mere jumble of unrelated facts until theory brings order out of the confusion. Theory consists of systematic thinking on the results of experiment and when Newton formulated the theory of the different refrangibility of light of different colors, he opened the way to the invention of the reflecting telescope. Newton was, if ever there was one, a pure theorist, but it was owing largely to his masterly elucidation of the principles involved, that the inventors of his day finally produced the navigator's sextant and the methods for finding longitude on board ships at sea, and when at the age of 52 he was appointed warden of the mint he proved himself to be also a practical man "summa cum laude." Was it the severely practical man who believed Cyrus W. Field when he said that the Atlantic Ocean could be bridged with a wire rope? No, but it was your practical man who said that it would be time enough to build a railroad from Boston to Albany when a road was needed from Boston to the moon, and it was your practical man who laughed the loudest when the theory that the earth is round was first put forth.

I do not forget that many theories that have been well fathered have deserved the laughter which they provoked,—but theorizing is like every other high art,—the bungler would better let it alone for he does but bring both the art and himself into discredit; while for the man with true inspiration, it affords splendid opportunities. Someone has well said,—"A person who uses an imperfect theory with the confidence due only to a perfect one, will naturally fall into abundance of mistakes; his predictions will be crossed by disturbing circumstances of which his theory is not able to take account.

"A great quantity of mistake has been made by those who do not understand the true use of an imperfect theory; hence much discredit has been brought upon theory in general and the schism of theoretical and practical men has arisen."

More than thirty years ago, John Tyndall wrote in the preface of his book on "Heat as a Mode of Motion,"—"We observe a fact and seek to refer it to its laws,—we apprehend the law, and seek to make it good in fact. The one is theory, the other is experiment."

It would seem, however, as though there must be at least some half truth which may account for the persistence of this pestilent misconception. Rankine points out that the very words "theory" and "practice" are of Greek origin and that they serve now to show how old is this exasperating confusion of ideas. The brilliant Macaulay falls into the old trap and gives some of his sparkling wit to the furnishing of one more illustration of the truth of the saying that it is better not to know so much than to know so many things which are not so. The heresy raises its head to-day in our very midst, for did we not read a few days ago, in a joint special report from a committee of the city council of Boston, that certain recommendations as to the reorganization of the Boston fire department were wholly impracticable and must have proceeded from mere theorists.

Against this, and every other careless, fling at systematic thinking, I do most solemnly protest. The Boston recommendations may have been wise or otherwise, but whether they were good or bad, the earnest efforts which men are constantly making to observe facts and then to refer these facts to their God-given laws must not be brought into disrepute. I ask you, men of the Washburn Mechanical Engineering Society, to do what in you lies to put an end to this unfortunate misunderstanding of the real value of theoretical investigation. Is there any excuse for this misunderstanding? So persistent a misconception must have some reason for being. If minds as brilliant as that of Macaulay and as wise as those of the members of the city council of Boston are befogged, there must be some sort of reason for it.

There have been two eminent English engineers the contrast in whose lives and deeds, has, I think, helped to keep alive this delusion. I refer to George Stephenson and Isambard Kingdom Brunel.

Brunel, you will remember, died at the age of 53, two years before our civil war. He was an only son, of good family, was born with a good intellectual inheritance, and "displayed in childhood singular powers of mental calculation, great skill and rapidity as a draughtsman, and a true feeling for art." At the age of seventeen he entered his father's office as assistant engineer, and at the age of 22 he was a resident engineer of the Thames Tunnel. For two years he employed himself in scientific researches, and enjoyed intercourse with Babbage, Faraday and others. In November, 1829, at the age of 23, he sent in competitive plans for a Suspension Bridge; these first plans were rejected but two years later in a second competition he was successful. Want of funds with other causes produced delay and the bridge was not finished during the lifetime of its designer. At the age of 27, he was made engineer of the proposed Great Western Railway, and for solidity of construction and skill and beauty of design this road holds a high place. He built the Hanwell Viaduct, Maidenhead Bridge, the Box Tunnel and the great bridges at

Chepstow and Saltash. He made the great mistake of introducing the broad gauge and precipitated the "battle of the gauges." At 40 he resigned as engineer of the Great Western Railway. At 38 he recommended the adoption of the Atmospheric System on the South Devon Railway, but after a year's trial the system was abandoned. Before he was 30 he suggested to the directors of the Great Western Railway that they should make their road longer and have a steamboat go from Bristol to New York. This steamship was built and was called "The Great Western." While the vessel was building, Dr. Lardner asserted that the ship would not be a success and presented an imposing array of figures to prove that the craft could not carry coal enough to get it across the ocean. He built other ships,—"The Great Britain," and finally "The Great Eastern," and this last was his swan song, for he did not live to see the vessel sail. He built docks and piers, large guns, a floating gun carriage, and hospital buildings. At 24 he was elected F. R. S.; he was afterwards a member of many scientific societies, and Oxford gave him the honorary degree of D. C. L. at the age of 51.

The early life of Stephenson was as unlike that of Brunel as it well could be.

George Stephenson's father was a fireman of a colliery engine and was too poor to send his children to school. At fourteen the youngster was his father's assistant fireman, earning a shilling a day; and at seventeen he had secured a position as an engineman. He was eighteen years old when he learned to read, and began to attend a night school, but by this time he had begun to show that he was possessed of more than the ability of the average man. He worked hard and with a persistent industry that was sure to bring good results, and it is no wonder that at thirty-one he was made engine-wright of Killingworth Colliery at $500 a year, and was employing his leisure moments in solving problems in specific gravity and the elements of mechanics.

At the age of forty-one he had been working for ten years upon the problem of a travelling engine, and at that time he succeeded in convincing the projectors of the Stockton and Darlington Railway that his travelling engine could be made to outdo either horses or fixed engines with cables, and he was made engineer of the road. Then came the Liverpool and Manchester Railway and his victory over Chat Moss.

His position as a successful engineer was assured at the age of fifty, and from that time until his death, in 1848, at the age of sixty-seven, he had but to choose his work and the rewards of it.

A man who is possessed with the idea that the theorist is almost sure to be found a failure when compared with the successful practical man will find, in a superficial examination of these two lives, apparent confirmation of his misconception.

Such a man will point to the fact that experience has shown the broad, seven-foot gauge, so vigorously advocated by Brunel, to be a practical failure. He will argue in some such way as this: "Of course a broad base gives greater stability, because of a lower position for the centre of gravity, more comfort for passengers, more room for goods and machinery, and an opportunity for increasing the weight and power of locomotives, with great steadiness in running—certainly a beautiful theory, but of no practical value." He will go on to say, perhaps, that Brunel was full of such beautiful theories and will call attention to his first suspension bridge, to his support of the atmospheric system of railways which was such a costly toy about the year 1848, and, finally, to that commercial failure, "The Great Eastern."

He will contrast the fine education and scholarly tastes of Brunel with the harsh training in the school of daily physical labor under which Stephenson was developed, and will point to the all but unbroken line of commercially successful ventures which were carried through by the practical Stephenson.

It seems to me, however, quite clear that a careful study of the lives of the two men will lead us to differentiate them upon other lines than those indicated by the words theoretical and practical.

Stephenson confined his efforts strictly to the field of railway and locomotive construction, but within his self-imposed limits he was as boldly theoretical as was ever Brunel. One has but to read the story of Stephenson's fight with prejudice, ignorance, and self-interest to realize that it is only after the fight was won that he was regarded as anything but an impractical visionary, and his whole scheme looked upon as only "the dream of a chimerical projector." He had no precedents to guide him, but he took certain facts that were established and reasoned his way to new conclusions.

Long before it was demonstrated by experiment, Stephenson had reached the conclusion that there is no need for rack-toothed rails or toothed-wheels in the operating of the locomotive, and practical men laughed at his beautiful theory. A writer in the able and dignified *Quarterly Review* for March, 1825, said: "We are not the advocates for visionary projects that interfere with useful establishments; we scout the idea of a general railroad as altogether impracticable, or as one, at least, which will be rendered nugatory in lines, where the traffic is so small that the receipts would scarcely pay for the consumption of coals. The gross exaggeration of the powers of the locomotive engine, or, to speak in plain English, the steam carriage, may delude for a time, but must end in the mortification of those concerned."

Nearly all the practical and scientific men of England united in pronouncing Stephenson's theory as well enough as a theory, but sure to lead to disappointment; and had they been familiar with the phrases of to-day they would have united in pronouncing Stephenson himself as an impractical crank.

A wise man of to-day gives judgment upon the two men in these words: "Brunel was progressive and advocated extensive undertakings, the success of which was questionable, while the Stephensons were conservative and devoted their energies to schemes which were sure to be profitable." Here, as it seems to me, we find the essential difference between the two men. Stephenson never lost sight of the commercial side of his projects, while Brunel was so absorbed in the work of creation that the full results of his labors were not always foreseen.

Stephenson's biographer says of Brunel: "He was ever looking forward to indefinite and continual improvement; he was restive under any restraint on invention, and could brook no limit to change. His railways were to be broader, his locomotives larger, and the speeds to be attained by them were to surpass those on all other railways."

The defect in the qualities of men like Brunel and Dr. Lardner comes to view in their constant efforts to be generalizing from new data to some still newer and grander results without waiting to work out in full detail the results of a theory. Here the complaint should lie, not against theory as theory, but against the impatient and unwise use that is made of a theory

which has not been well tested. Engineering progress was slow two centuries ago because the study of applied theory was confined to the few, and its triumphant march of to-day is closely related to the tendency of men not only to note facts, but to seek to refer these facts to their several laws.

Stephenson was as much of a theorist as Brunel, but his thought was sounder, more fitting to the time in which he worked, more sensible and so easily made actual that the *ultra* practical men are probably to-day claiming him as one of them.

May I venture to suggest that there is room for a new chapter in the text-books of applied science, which shall discuss the commercial factor in the various problems.

A form of construction and a kind of material which fits the special case in hand is the best for that case, and in establishing the test of fitness we must consider how far beyond bare necessity we can be justified in going, from a commercial point of view. The use of staff for the clothing of the iron framework of the buildings at the World's Fair is one of the happiest instances of fitness in the choice of material. The right commercial spirit never attempts to justify the taking of risks to life, but it may ask one to take certain risks as to material property. Then we have the question as to how much and in what way we will insure the risk. We may insure by spending money enough at the start to abolish the risk wholly, and in that case the insurance premium is paid in the interest on the extra outlay.

No one with any pretensions to sound engineering judgment would fail to see the error in putting an expensive high grade triple expansion engine, costing twice as much as the amount of a year's business, into a small factory; but it is in the less simple cases where the error is not obvious at first sight that the ambition to put in "the best" leads one astray.

The young engineer who is full of enthusiasm, who is honestly and earnestly trying to live up to high ideals, who is determined that he will do only the best work, is the one who is most likely to suffer from a failure to see the whole of his problems. He is so fearful of scrimping somewhere that he becomes extravagant. He has so little experience to guide him in determining questions of fitness that he uses material too valuable and therefore unfit for the case in hand. He has so little knowledge ef the limitations of different materials that his specifications bring a smile to the face of a more experienced man, and an impatient exclamation from some practical ignoramus against theoretical knowledge.

A certain manufacturing corporation decided to put in a plant for the making of fuel gas because a careful calculation showed that with it heat could be generated and used with greater economy than by the use of coal in the usual way. An engineer was engaged who made elaborate and accurate drawings, and whose specifications called for cut-stone foundations and work and materials throughout of the most expensive kind. The plant when set up was elegant in design, material and workmanship, it worked admirably and saved all that the preliminary calculations said it ought to save, so far as coal bills were concerned. The plant had cost $200,000, and represents therefore a new interest charge of at least $10,000, and though the saving on the coal bills was $10,000 a year, the actual net saving to the corporation is indeterminate.

Another corporation, profiting perhaps by its knowledge of this experience, put in a gas plant which saved $5,000 a year in coal bills and which cost $50,000. Here is a clear saving of $2,500 a year, and it is to be noted that the $50,000 plant was well and strongly built and differed from the first one only in size and in its lack of frills and finish.

If I have even partially succeeded in winning you to my way of thinking, you will not allow yourselves to say that the first plant was theoretically a perfect plant, though a practical failure, but you will assert with me that the fine cut-stone plan was built upon an imperfect, an incomplete theory inasmuch as the commercial factors in the problem were wholly overlooked.

Of course we can easily call to mind many cases wherein commercial considerations need have little weight with an engineer.

(1) Commercial considerations did not enter into the building of the pyramids, and it was of no consequence if it took a hundred men a month to raise a single stone into its place.

(2) If a man to-day is called upon to design a steam yacht for one of our multi-millionaires, he need concern himself only to get the best possible material, the most luxurious appointments, the most elaborate finish, and the most skilful artisans.

Public works offer full opportunity for expensive structures which are not to be regarded as wasteful. When a city enters upon the construction of waterworks it will put commercial considerations in the background. Men may come and men may go, this business enterprise may rise and fall, that manufacturing plant may be abandoned as unprofitable, this commercial venture may end in the minds of its projectors, but so long as men shall live in cities a pure, abundant and convenient supply of water must be given them. Structures of this sort are to stand indefinitely, for the accidents of trade, commerce and manufacturing do not affect the need for firm and generous highways, wide breathing-places, and efficient sewerage. The cities of New Bedford and Newton, Mass., are undoubtedly justified in putting into their pumping stations large boilers of the locomotive type at a cost of $30 to $40 per H. P., because these boilers are wonderfully efficient, durable and safe, and the corporations to whom they belong can never go out of business, but manufacturing corporations which can afford to do just what these cities have done are as scarce as snakes in Ireland.

Why is it that the most wasteful form of the steam engine keeps its place on the modern railway in spite of the fact that the modern railway is always looking for and is always ready to make use of "the best." The compound engine has long ago established itself as superior to the simple engine for stationary work, but it is only just beginning to receive attention from the modern railway manager. Railway engineers have again and again proclaimed that the compound locomotive is saving 15, 20, 25, or even 30 per cent. of fuel over the simple locomotive, and have proved these figures to be correct for a series of carefully conducted trials. The prudent railway managers are watching the coal pile and the bills for repairs, and as soon as these two points shall show a clear saving in favor of the compressed locomotive the success of this latest change in locomotive construction will be assured.

In the practice of the great majority of engineers the problems which present themselves for solution are rich in commercial factors. These opportunities for the engineer are largely the outcome of new enterprises in which capital seeks its reward, and obviously the certainty and amplitude of this reward is the controlling motive of the enterprise and must be reckoned with by the engineer.

Commercial considerations demand that every theory, however attractive at first sight, be thoroughly tested under every possible condition before large investments are made which depend upon the soundness of the theory. Foresight is wholly admirable and valuable, but we have not yet learned to do without the lessons of hindsight, and as an illustration of this we may turn to the experience of the electric street railway companies with the long car. It would seem at first sight that without question a street railway car of twice the usual length must be a more profitable appliance than a short car. The carrying capacity is doubled and the working force of men remains the same; but from a commercial point of view the long car is already a back number. I am told that the reason for this is found in the fact, that so much time is lost in getting passengers out of the long car that whole trips are lost, and the carrying value of the car per day is thereby greatly reduced. The designers of the long car gave full consideration to the questions of weight, power, first cost and operating cost, but who shall criticise them because they did not foresee that when a long car crammed full—with not even standing room remaining—is stopped to allow a passenger to get off that she will almost surely insist on working her way through the whole tedious length of the car to reach the rear door, when she might have used the front door next to which she was sitting.

In a country as rich and prosperous as ours there will always be a limited number of engineering opportunities of a commercial nature to which ordinary financial calculations do not apply, because of the exceptional and erroneous wealth from which such opportunities arise. These opportunities will fall to some fortunate indivldual and when they fall to one as able, as far seeing, and as skilful, as for example the engineer of the Calumet and Hecla Mining Co., we get some of the most notable achievements in mechanical engineering which the world has ever seen. Such opportunities enable the man who is equal to the occasion to venture upon valuable experiments which might be otherwise long delayed, and results are secured which make subsequent attempts both safe and profitable.

Teachers of ethics find it necessary frequently to remind us that man shall not live by bread alone and that utilitarian ends do not furnish the only prizes for which men should strive, and they do well in so doing. Far be it from me to oppose *this* theory, but in closing my very modest discourse let me recall the words of the Great Teacher who said, "Render unto Cæsar the things which are Cæsar's and unto God the things which are God's."

Taunton, June 20, 1893.

TWENTIETH ANNUAL MEETING W. P. I. ALUMNI ASSOCIATION.

The first session of the business meeting was called to order at 6.20, Wednesday evening, June 21, by President Chas. G. Washburn, in the Lecture-room over the main entrance, Y. M. C. A. Building, Elm st., Worcester.

After disposing of the reports of the Secretary and Treasurer, the class of 1892 were elected to membership in the Association, as was also Mr. John D. Curtis, of '71.

The following officers were elected for the ensuing year:—

Secretary—Wm. L. Chase, '77.
Treasurer—Edward K. Hill, '71.
Executive Committee:

Chas. G. Washburn, '75. Alden H. Wheeler, '84.
U. Waldo Cutler, '74. Harry E. Rice, '88.
H. Winfield Wyman, '82. Elmer H. Fish, '92.

The Alumni members of the 1894 Commencement Examining Board, and the Institute Visiting Committees are to be appointed by the Executive Committee.

The finances of the Association having received consideration, the business meeting was adjourned at 7.45 o'clock, and at about 8.30 a company of one hundred and fifteen sat down to dinner, served by caterer C. W. Parker, in Association Hall.

At the head table were His Honor Mayor Marsh, Messrs. Salisbury and Garver of the Trustees; Professors Alden, Gladwin, Sinclair, Higgins, and Conant of the Faculty; Pres. Washburn, and Messrs. Billings and Bateman, '71.

Among others present were:

E. K. Hill, '71.
E. F. Tolman, '71.
E. H. Whitney, '71.
F. O. Whitney, '71.
P. T. Denny, '72.
J. P. K. Otis, '73.
F. M. Clark, '73.
Wallace Metcalf, '73.
U. W. Cutler, '74.
E. H. Bigelow, '75.
J. C. Woodbury, '76.
G. H. White, '76.
J. F. Kyes, '76.
J. A. Ross, '76.
James Logan.
Wm. L. Chase, '77.
A. B. Upham, '78.
C. D. Parker, '79.
T. H. Clark, '80.
T. J. Howard, '80.
E. P. Sparrow, '80.
Dwight Goddard, '81.
F. F. Gordon, '81.
H. W. Wyman, '82.
H. F. Klingele, '82.
W. F. Cole, '83.
V. E. Edwards, '83.
J. H. Churchill, '84.
W. W. Estes, '84.
A. H. Wheeler, '84.
E. G. Watkins, '86.
A. A. Gordon, '86.
W. W. Bird, '87.
E. F. Miner, '87.
C. A. Bennett, '86.
H. E. Rice, '88.
G. I. Rockwood, '88.
Fred. Andrews, '89.
A. B. Kimball, '89.
W. E. Hartwell, '89.
W. S. Ball, '89.
E. G. Penniman, '89.
H. E. Austin, '90.
F. O. Gardner, '90.
C. H. Jenness, '90.
E. C. Rice, '90.
L. N. Farnum, 90.
G. E. Barton, 91.
H. B. Foster, 91.
H. P. Eddy, '91.
F. C. Hodgman, '91.
B. A. Gibson, '91.
W. H. Ramsdell, 91.
A. L. Rice, '91.
J. A. Whittaker, '91.
E. S. Phelps, '91.
E. H. Fish, '92.
E. W. Howard, '92.
H. N. Paige, '92.
A. B. Moulton, '92.
J. F. Bartlett, '92.
Geo. W. Day, '92.
E. L. Smith, '92; and a large representation from the Graduating Class.

Prayer was offered by Rev. Mr. Garver.

After dinner speeches had been enjoyed from Mayor Marsh, Mr. Salisbury, and Prof. Alden, when Mr. Billings, '71, tried to escape from the hall but was called back by Pres. Washburn. He was allowed to go after settling head table privileges by some sterling remarks.

Pres. Washburn then read a letter from Dr. Fuller from Portland, Oregon.

Wm. H. Parker, President of the class, was then asked what he could say for Ninety-three—and he was followed by Professors Gladwin, Higgins and Sinclair. Rev. Dr. Merriman of the Trustees telegraphed regrets and congratulations from Williamstown.

Business meeting was resumed at 11.07 P. M. The Visiting Committee, Department of Mech. Eng., Messrs. H. W. Wyman, '82, and G. I. Rockwood, '88, reported through Mr. Wyman an interesting paper, which precipitated a discussion as to the disposition of the Thompson Memorial Fund.

It was finally voted to turn the fund over to the Trustees, to be kept intact, and the income to be devoted to such objects as the Alumni Association may direct. For the present the income is to be applied to the development of the Institute Library. All lists of books to be purchased to be approved by the Executive Committee and reported to the Association, and all books when delivered to be supplied with a label giving the name of the Fund from which they are purchased.

The subject of the establishment of a general alumni fund was thoroughly discussed, and the Executive Committee was finally instructed to take such measures as may seem best to have all the classes canvassed with a view of securing subscriptions to a general alumni fund to be applied, under various restrictions, to forwarding the best interests of the Institute.

Reports were then listened to on the Departments of Civil Engineering, by F. O. Whitney, '71; Chemistry, by H. P. Eddy, '91; and in Design and Drawing, by C. A. Bennett, '86.

Votes of thanks were passed to the Visiting Committees and to Prof. Gladwin for his kind remembrance of the Alumni in presenting reproductions of pen and ink sketches of the new free drawing room and the grounds.

The meeting adjourned at 1.45 o'clock A. M., June 22.

W. P. I., 12; W. A., 9.

On June 7 the Academy team was defeated by the Tech boys for the first time in years. The game was not very skilfully played on either side; it is due to the Academy to say, however, that they were weakened by the two Hulls and Clark, who were to compete in the interscholastic games the next day. The Techs played well enough in the field, but better base running might have gained half a dozen more runs. The Academy scored in the first inning—Chase was given his base on balls, Webb was hit, Gordon sacrificed, and a two-base hit by Edwards sent the first two across the plate. In the third, two singles, two bases on balls and three errors netted five runs for Tech. Academy evened things up in their half of the inning. Two singles and Edmands's second two-base hit, two bases on balls and a sacrifice gave them five runs, thus putting them again in the lead. There was no more scoring till the seventh inning. Harris got his base on balls, Waite hit to Dana and Harris was out on second. Waite stole second, went to third on a passed ball, and scored on Abbott's single. For Academy, Leonard got first on an error by Perkins. Atkins got a hit, sending Leonard to second; the latter was caught napping at second, but made a break for third. Perkins threw the ball over Cullen's head into the crowd and both men scored. The score stood now 9 to 6, in Academy's favor, and Tech had only two chances more. But only one was needed. In the eighth, Gallagher got his base on balls and stole second. Philpot was given a similar present. Then Zaeder made a base hit, Gallagher scoring, and Philpot taking third. Philpot stole home, Gordon got his base on balls, and Harris struck out. Waite hit a hot one which Cutler could not handle, and Zaeder and Anderson scored. Waite stole second, and scored on Knowles's two-base hit. The score was now 11 to 9, in Tech's favor. Academy scored no more. Tech added another in the ninth—Philpot reached first on an error, stole second, and scored on Zaeder's long hit, which struck the dormitory and would have been a home run if there were no obstructions in the field.

TECH.

	A.B.	R.	1B.	T.B.	S.H.	P.O.	A.	E.
Gallagher, l.f.,	3	2	0	0	0	0	0	0
Philpot, c.,	3	3	0	0	0	8	1	0
Zaeder, 1b.,	5	1	2	3	0	13	1	0
Gordon, c.f.,	5	2	0	0	0	2	0	0
Harris, r.f.,	5	0	0	0	1	0	0	0
Perkins, 2b.,	4	2	1	1	0	3	3	3
Knowles, s.s.,	3	0	1	2	0	0	6	1
Waite, p., 2b.,	3	1	1	1	0	0	3	0
Abbott, p.,	2	0	1	1	0	0	7	0
Cullen, 3b.,	5	1	1	1	0	1	2	0
Totals,	38	12	7	9	1	27	23	4

ACADEMY.

	A.B.	R.	1B.	T.B.	S.H.	P.O.	A.	E.
Chase, l.f.,	3	1	1	1	0	0	0	0
Webb, p., 2b.,	5	2	1	1	0	3	4	1
Gordon, c., p.,	5	1	2	2	1	2	14	0
Edmands, 1b.,	5	1	3	6	0	7	2	1
Leonard, c.f.,	5	1	1	1	0	1	0	0
Atkins, r.f.,	5	2	2	2	0	0	0	0
Dana, s.s.,	5	0	1	1	0	0	2	2
Cutler, 3b.,	4	0	0	0	0	2	0	3
Vedetto, 3b.,	0	0	0	0	0	0	0	0
Chesbro, 2b., c.,	2	1	0	0	0	12	1	5
Totals,	39	9	11	14	1	27	23	12

Innings,	1	2	3	4	5	6	7	8	9	
Tech,	0	0	5	0	0	0	1	5	1	—12
Academy,	2	0	5	0	0	0	2	0	0	— 9

Earned runs, Academy 3. Two-base hits, Tech 2, Academy 2. Stolen bases, Tech 11, Academy 3. Double plays, Gordon to Edmands and Edmands to Chesbro, Gordon to Cutler, Gordon to Chesbro and Chesbro to Gordon and Gordon to Edmands, Webb to Edmands. Bases on balls, Tech 11, Academy 3. Hit by pitched ball, Chase. Struck out, by Waite 1, by Abbott 6, by Webb 1, by Gordon 7. Passed balls, Philpot 2, Gordon 1, Chesbro 1. Wild pitch, Gordon. Time of game, 2h. 10m. Umpire, W. J. McAleer,

ALMOST A SHUT-OUT.

On Thursday, the team evidently recovered from its spell and almost treated the Holy Cross Reserves with a coat of whitewash. For seven innings the reserves had not scored a run, and it was only through the merest chance that they scored in the eighth. Barnes reached first on an error by Harris; Cosgrove flied out to Gordon; Howard got his base on balls. Then, with two out, Mahoney batted a high one, unde which Zaeder, confident of his own ability, planted himself. But this was one of the cases where the surest man fails, and before the ball was put in play again, two men had crossed the plate.

Tech began scoring in the first inning. Gallagher reached first on balls, stole second, and scored on Zaeder's two-base hit. Gordon reached first on Igoe's error, and a single by Harris brought Zaeder home. In the second, Knowles made a hit and took second on a wild throw. Gallagher sacrificed, and Knowles scored on Cosgrove's error on Philpot's grounder. Philpot stole second and scored on Igoe's wild throw of Zaeder's grounder. Gordon then hit a slow one along the third base line and Zaeder scored from second on the hit. In the sixth inning Knowles reached first on an error, and Abbott was given first on balls. Gallagher then made a single and the bases were full. Crowley, in attempting to catch Knowles at third, threw wild, and Knowles scored. The other two men were left, as Philpot and Zaeder sent long flies to Barnes. The game was a very creditable one for the Techs and their playing was well praised by the Holy Cross boys. The Reserves, it should be stated, are composed of the substitutes of Holy Cross team, and is given much attention in order to develop players for the 'varsity team.

TECH.

	A.B.	R.	1B.	T.B.	S.H.	P.O.	A.	E.
Gallagher, l.f.,	2	1	1	1	1	2	0	0
Philpot, c.,	4	1	0	0	0	4	3	0
Zaeder, 1b.,	4	2	1	2	0	14	0	1
Gordon, c.f.,	4	0	1	1	0	1	0	0
Harris, r.f.,	4	0	1	1	0	1	0	1
Perkins, 2b.,	4	0	0	0	0	2	0	0
Warren, s.s.,	4	0	0	0	0	0	6	0
Knowles, 3b.,	4	2	1	1	0	2	1	1
Abbott, p.,	2	0	0	0	0	1	4	1
Totals,	32	6	5	6	1	27	14	4

HOLY CROSS RESERVES.

	A.B.	R.	1B.	T.B.	S.H.	P.O.	A.	E.
Igoe, 3b.,	4	0	0	0	0	1	1	4
Barnes, c.f.,	4	1	1	1	0	3	0	0
Cosgrove, 1b.,	4	0	1	2	0	7	0	1
Howard, s.s.,	3	1	2	2	0	1	1	0
Kerrigan, 2b.,	4	0	1	1	0	4	2	0
Mahoney, c.,	4	0	0	0	1	5	3	1
Shea, r.f.,	3	0	0	0	0	0	0	0
Bickford, l.f.,	4	0	0	0	0	2	0	0
O'Brien, p.,	2	0	0	0	0	0	4	2
Crowley, p.,	2	0	0	0	0	0	3	1
Totals,	34	2	5	6	1	24	14	9

Innings,	1	2	3	4	5	6	7	8	9	
Tech,	2	3	0	0	0	1	0	0	*	—6
Holy Cross,	0	0	0	0	0	0	0	2	0	—2

Earned run, Zaeder. Two-base hits, Zaeder, Cosgrove. Stolen bases, Tech 6, Holy Cross 3. Bases on balls, Tech 3, Holy Cross 2. Hit by pitched ball, Shea. Struck out, by Abbott 2, by O'Brien 2, by Crowley 1. Time of game, 1h. 45m. Scorer, Charles A. Burt. Umpires, Mr. McKone and Dadmun.

ACADEMY, 9; TECH, 7.

The second game with the Academy took place at the Oval, June 12. For the first five innings it looked as if the Tech was to have a walk-over. But at that time Perkins was obliged to leave, and the consequent mixing up of the infield was conducive of many errors. The score remained a tie till the ninth inning, when the Academy got in a few hits and the Techs a few errors, netting four runs. The Techs in their half, however, made a brace and scored two runs and had two men left on bases. It was hard to be defeated when victory seemed so easy and certain, and it can truthfully be said that Perkins's action was the cause of the defeat.

ACADEMY.

	A.B.	R.	1B.	T.B.	S.H.	P.O.	A.	E.
Webb, s.s.,	6	2	2	2	1	4	2	1
E. Hull, 2b.,	5	0	1	1	1	3	0	1
Clarke, c.,	5	1	2	2	0	6	2	0
C. Gordon, p.,	5	2	1	2	0	0	10	0
H. Hull, l.f.,	4	1	1	1	1	1	0	0
Chase, 1b.,	5	1	0	0	0	10	0	0
Leonard, c.f.,	5	1	0	0	1	0	1	0
Atkin, 3b.,	5	1	0	0	0	3	0	1
Cutter, r.f.,	5	0	1	1	0	0	0	0
Totals,	45	9	8	9	4	27	15	3

TECH.

	A.B.	R.	1B.	T.B.	S.H.	P.O.	A.	E.
Gallagher, l.f.,	3	1	1	1	0	1	0	2
Philpot, c.,	3	0	0	0	1	3	1	2
Zaeder, 1b.,	5	1	3	6	0	12	0	1
G. Gordon, c.f.,	5	0	0	0	0	1	0	0
Perkins, 2b.,	3	1	1	1	0	4	5	0
Cullen, 3b.,	2	0	1	1	0	0	1	2

Warren, s.s.,	5	1	0	0	0	2	4	2
Knowles,3b.,2b.	4	2	1	3	0	3	4	2
Waite, p.,	4	0	1	1	1	0	5	0
Harris, r.f.,	4	1	1	1	0	1	0	2
Totals,	38	7	9	14	2	27	20	13

Innings,	1	2	3	4	5	6	7	8	9	
W. A.,	0	0	2	0	0	2	1	0	4	—9
Tech.,	0	3	2	0	0	0	0	0	2	—7

Earned runs, W. A. 1, Tech 2. Two-base hits, C. Gordon, Zaeder. Three-base hits, Zaeder, Knowles. Stolen bases, Webb 2, E. Hull, Clarke, C. Gordon, Chase, Atkin 2, Zaeder, Warren. First base on balls, H. Hull, Gallagher 2, Philpot, Knowles. Struck out, E. Hull, Gallagher, Zaeder, Perkins, Cullen, Warren 2, Harris. Passed balls, Clarke 3, Philpot 4. Wild pitches, Gordon 3, Waite 1. Time of game, 2h. Umpire, McAleer.

FOOTBALL.

Games for most of the dates next fall have been arranged and plans have been made for a training table which is to be ready when the Institute opens. The matter of coach has been settled and very satisfactorily to those having the matter in charge. There is to be a man very well known by the students and very capable as a coach ready to begin work with the team the very first day that the Tech opens.

Several of last year's team will not be in Worcester next fall to be sure, but there is an abundance of good material and there is no reason why, if reasonable backing is given the team, the season will not be one of unqualified success. We cannot expect all victories with the schedule which has been arranged.

With very few exceptions no help has ever been received from the Alumni for the football team. It surely would be very gratifying to members of the team and others who are doing all they can for the good of football to have their labors recognized in some substantial way by members of the Alumni. At present the treasury is empty. Of course there will be a subscription paper circulated the first thing next fall among the students, but it would be very encouraging to receive subscriptions to the amount of seventy-five or a hundred dollars from the Alumni during the summer. If anyone is inclined to write his check for anything from 0 to $+\infty$ it will be carefully used. The address of the treasurer and manager for the summer will be: E. W. Davenport, Hopedale, Mass. Following is the schedule which has been arranged:

Sept. 23rd, Trinity at Worcester.
Sept. 30th, Amherst Aggie at Worcester.
Oct. 16th, Amherst 'Varsity at Amherst.
Oct. 21st, M. I. T. at Worcester.
Oct. 28th, Tufts at Worcester.
November 1st, Dartmouth 'Varsity at Hanover, N. H.

ENTRANCE EXAMINATIONS.

The fact that the examinations for entrance will henceforth be only in June and September and that the work of all departments will begin in September had, doubtless, much to do with the large number of candidates for admission, who presented themselves for examination on June 20th. The total number of men who tried their fate was sixty-three. The examinations were not unusually severe, but only thirty-eight were admitted, and of these twenty-four have conditions. Sixteen others were allowed marks in three or more studies, which will be credited to them when they take their final examinations. With the additional men who passed last January and others who will try the examination next fall, the class will be nearly, if not quite, the equal of preceding classes numerically. There are also many who have won reputations in athletics at the Worcester High School, Worcester Academy, and Williston Academy. The names and ages of those admitted are:—

H. W. Abbott,	19,	Winchendon.
R. A. Barnard,	17,	Worcester.
A. W. Beaman,	17,	Winchendon.
E. N. Benchley,	17,	Worcester.
F. C. Brown,	18,	Amesbury.
J. E. Brown,	18,	Worcester.
C. A. Burgess,	18,	Hopedale.
E. G. Beckwith,	20,	Great Barrington.
E. P. Chase,	19,	Adams.
R. N. Cundall,	18,	Worcester.
W. S. B. Dana,	20,	Santa Rosa, Cal.
H. L. Daniels,	19,	Fitchburg.
L. J. Davis,	17,	Fitchburg.
A. H. Durand,	23,	Princeton.
B. E. Eames,	18,	West Upton.
R. B. Earle,	17,	Worcester.
W. D. Edwards,	18,	Southbridge.
R. E. Fish,	19,	Brunswick, Me.
C. H. Greenwood,	18,	Gilbertville.
H. E. Gough,	17,	Fitchburg.
A. T. Hawksworth,	22,	West Peterboro, N. H.
N. W. Jencks,	23,	New London, Ct.
H. E. Kelley,	20,	Worcester.
H. S. Lancaster,	18,	Worcester.
S. B. Lombard,	21,	Springfield.
J. G. Keyes,	20,	North Worcester.
O. W. Lundgren,	17,	Worcester.
A. W. Merchant,	20,	Monson.
H. H. Morse,	19,	Southbridge.
T. L. Nelson, Jr.,	20,	Worcester.
A. E. Orrell,	18,	Ware.
E. B. Paine,	18,	North Woodstock, Ct.
A. N. Pond,	20,	Auburn.
C. F. Powers,	18,	Orange, N. J.
H. B. Prest,	18,	Whitinsville.
H. C. Smith,	19,	Worcester.
F. P. Tolman,	17,	Worcester.
C. N. Whitney,	19,	Worcester.

WESTERN ALUMNI.

The Northern Ohio Alumni Association of the W. P. I. held its semi-annual dinner and business meeting for the annual election of officers at the Hollenden, in Cleveland, on Saturday evening, June 17th. At eight o'clock the gathered alumni, headed by President Aborn, '71, marched to the banquet hall and proceeded to do full justice to an elaborate menu, beginning with little neck clams and winding its way through solids, punches and fluids to coffee, Plymouth-rock crackers and noisome cheese. After the removal of the *debris*, Pres. Aborn and Fuller lighted cigars, being the only smokers present, and reminiscences were indulged in of Tech days from '71 to '90. Election of officers for the ensuing year was then in order and, after the repeated refusal of the existing board to accept a re-election, resulted as follows: President, John G. Oliver, '82; Vice-President, Willard Fuller, '84; Secretary and Treasurer, Windsor T. White, '90; Advisory Committee, Frank Aborn, '71, and Francis W. Treadway, '90. President Oliver was greeted with cheers as he arose to acknowledge his election, and in a few graceful words thanked the association for the honor conferred upon him. He then called attention to the recent changes in the course at the Tech and heartily approved the extension to four years. After short addresses by each of the newly elected officers, the meeting adjourned to meet again at the banquet table in December.

Travelling alumni, passing through Cleveland to or from the World's Fair, are cordially invited to stop over, as all resident alumni will keep open house during the summer. The railroads have made arrangements to issue stop-over checks on all through tickets and Tech graduates are always welcome.

A NEW APPOINTMENT.

The trustees have elected George H. Haynes as professor of history and economics, to succeed Professor MacDonald, who has resigned to accept a similar position at Bowdoin. Mr. Haynes is an Amherst graduate, a member of the class of '87. Soon after graduating he came to Worcester and taught three years in the Institute in the department of modern languages. For the last three years he has been at Johns Hopkins University as a graduate student in history and political science. He is highly recommended by the University professors, and it is hoped that the high standard set in this department by Dr. Smith will be maintained.

PHELON-MASON.

Mr. J. O. Phelon, '87, instructor of Physics at the W. P. I., and Miss Blanche E. Mason were married June 12, at 8 Dix Street. The ceremony was performed by Rev. W. V. W. Davis of Union Church. The married couple will take a trip through New Hampshire, Vermont, Canada, and New York, and will endeavor to do part of it on bicycles.

PUTNAM-ANDERSON.

Willis S. Putnam, '89, formerly of Worcester and at present draughtsman for the Pennsylvania Bridge Company of Beaver Falls, Pa., was married at South Bend, Ind., to Miss Jeanie Anderson, daughter of Hon. A. Anderson of that city.

BIGELOW-MUNROE.

At 6.30 o'clock, on the evening of June 14, occurred a very pretty wedding, in which Miss Mary Helen Munroe was united to Myron J. Bigelow, '90. The wedding took place at the bride's home, 30 Hollywood Street, the ceremony being performed by Rev. A. Z. Conrad.

The bridal party stood in a floral alcove, constructed chiefly of laurel. The interior of the house was beautifully decorated with palms, ferns and potted plants. Roses, pinks, daisies, and laurel blossoms were in abundance.

While the wedding march was being played, the party descended the stairs. First came two pages, then the bridesmaids, followed by the groom with the best man, Dr. H. L. Houghton; then came the bride escorted by her father.

The bridal couple will take a short trip in the West, after which they will reside at Hopedale, where Mr. Bigelow is in the employ of Gen. Draper.

MORGAN-MAYNARD.

Miss Susie L. Maynard and Paul B. Morgan, '90, were united in marriage on the evening of June 15. The wedding took place at 87 Elm Street, Rev. Dr. Archibald McCullagh officiating. The rooms were decorated with flowers, daisies predominating. The bridal party stood in an alcove constructed of palms, ferns, and daisies. Miss Grace Maynard, a sister of the bride, was maid of honor, and Miss Gertrude Todd, of Concord, was bridesmaid. The wedding gifts were numerous, consisting chiefly of silverware and pictures. The married couple will reside at 37 Catherine Street after their wedding tour.

WALLACE-GUNDERSON.

Miss Clara H. Gunderson was married to J. H. Wallace, '92, on the evening of June 15, at the home of the bride, 20 Grand Street. At 5 o'clock, the bridegroom entered the parlor accompanied by the best man, Frank B. Knight, '92. Following them were the bride and her uncle, Carl G. Gunderson of Providence, who gave her away. The ceremony was performed by Rev. A. S. Garver. A reception and wedding breakfast took place after the marriage. The bride and groom will make a tour of the White Mountains, after which they will take up their residence in Boston, where Mr. Wallace's office is located.

KINSLEY—PIERCE.

On June 29, Sumner A. Kinsley, '91, and Maybelle C. Pierce were united in marriage by Rev. W. V. W. Davis, at the bride's home, corner of Laurel and Edward streets. Miss Nason of Boston was bridesmaid, and E. W. Kinsley, brother of the groom, officiated as best man. For the present, the married couple will remain in Worcester, but in August will make a trip to Chicago and Freeport, Ill. After October 1 they will reside in Lawrenceville, N. J., where Mr. Kinsley is master in drawing.

REVIEW OF BASE-BALL.

Probably the best base-ball team that has ever represented the Institute has been raised this last spring. It was, however, a rather unsteady team, for one day a very ragged game would be played, immediately followed on the next by an extraordinarily fine one. And so the supporters of the team were alternately praising and censuring it. The two Wesleyan games showed that this unsteadiness was greatly due to a lack of self-confidence, which was almost fear. The first game was played at Middletown and the Techs played a fine, steady game, which greatly astonished the natives. The Techs were beaten 8 to 4, but it was by a team that defeated Yale a week later. The game played in this city took place immediately after Wesleyan's grand successes with the larger colleges, and this had so great an effect on the Worcester boys that they played a miserable game, despite the fact that the pitching was good. Another instance—on June 7 a game was played with the Academy, which, although it was a victory, was one of the worst played during the season. The next day, the Holy Cross Reserves were played and all who saw it agree that it was the best the Techs ever played. The Reserves contained five men who, either before or since, have played on the Holy Cross team; and this team would have been shut out without a run except for an error which does not happen but once in a lifetime.

The team, as has always been the case, was weak at third base. Frequent attempts to strengthen this position has led to changes in other positions in the infield without much gain. Abbott's unfortunate accident in the class games seemed to leave the team without a pitcher but it served to bring out Waite who might not otherwise have been heard from. If both Waite and Abbott had been available for every game, more laurels might have been gained for the W. P. I. In fact, if Abbott had pitched the last Academy game, it would surely have resulted in a victory for Tech, for the Academy's method of batting is adapted only for use against a swift pitcher, and Abbott's slow deceptive curves would have sent many of them back to the bench on strikes. Abbott pitched two games and part of another during the season; Waite pitched five and a half, and Mr. Viles pitched one. The following table compares their work and that of opponents with regard to bases on balls, strike-outs, wild pitches, etc.

	S.O.	B.B.	HIT BY PITCHER.	W.P.
Waite,	20	21	6	3
Abbott,	7	8	1	0
Viles,	0	1	1	2
Opponents,	47	42	5	3

The table shows that our pitchers gave fewer bases on balls but failed to strike out as many men as the pitchers of our opponents.

Philpot, as catcher, has greatly exceeded all expectations, as his regular position is second base, nevertheless he caught every game and passed the season with but two errors—an excellent record. He had, however, 18 passed balls, compared with 25 by opposing catchers.

The following table will show the batting record of the team, as a whole, compared with that done by our opponents. It shows that although we have made more runs we have not made as many hits, but the batting averages are almost exactly equal, .247 and .249. The total batting averages are also practically the same.

	Games	A.B.	R.	1B.	T.B.	S.H.	Bat. ave.	Total Bat. ave.
W. P. I.	9	300	68	74	90	13	.247	.300
Opponents,	9	313	53	78	95	13	.249	.303

In fielding, the team, as a whole, has a very good average, .882, compared with .874 for opponents. As the table shows, 50 errors were made by Tech players in 9 games which is not a bad showing. In long hits, Tech leads slightly, and in stolen bases we have a good lead.

	P.O.	A.	E.	S.B.	2 B.H.	3 B.H.	H.R.	field'g ave.
W. P. I.	234	141	50	66	11	3	0	.882
Opponents,	222	147	53	52	8	2	1	.874

In batting, individually, the men have fallen off somewhat from their work early in the season. About the middle of the season, Gordon led the list with Perkins, Zaeder, Gallagher and Stone in the order named. At the end, however, all the leaders took a drop, except Zaeder, who did his best batting in the last few games. Knowles also improved toward the end, and a few hits by Waite brought him among the leaders. As run-getters, Gallagher and Philpot take the lead, as they should, being at the top of the batting order. In base-stealing, these two are tied, each having stolen thirteen bases. It will be seen, by examining the strike-out column, that Gordon has gone the entire season without having once suffered that humiliation. This is, indeed, a great achievement, and one of which he can justly be proud. Philpot has been especially unfortunate in the matter of base hits. He made several apparently good hits, only to have them stopped by the good playing of the opposing side. In his case the low average does not show that he is not a good batter.

	GAMES.	A.B.	R.	1B.	T.B.	S.B.	S.O.	BAT. AV.	TOTAL BAT. AV.
Zaeder,	8	32	8	12	18	8	2	.375	.564
Gordon,	8	34	6	11	11	8	0	.323	.323
Perkins,	9	33	6	10	12	1	5	.303	.363
Gallagher,	8	24	12	7	9	13	6	.292	.375
Waite,	6	21	3	6	7	4	2	.285	.333
Stone,	4	11	4	3	4	4	1	.272	.363
Knowles,	9	34	6	9	13	3	8	.265	.382
Cullen,	3	12	2	3	3	1	5	.250	.250
Lincoln,	4	13	1	3	3	2	2	.231	.231
Harris,	8	33	5	6	7	6	6	.181	.212
Abbott,	3	6	1	1	1	0	3	.167	.167
Philpot,	9	32	10	5	6	13	2	.156	.188
Warren,	4	14	2	2	2	3	5	.142	.142

In fielding, Zaeder again comes to the fore, with Philpot a close second. These two, with Perkins, have made their errors in the last few games, and, until then, they were playing wonderfully well. The fielders' averages are low, because of the few chances they have had; so that, even one error will bring their averages very low. In long hits, Zaeder again leads, having made four two-base hits and a triple.

	P.O.	A.	E.	S.H.	B.B.	F'L'D AVE.	2B.	3B.
Zaeder,	96	1	3	2	2	.970	4	1
Philpot,	47	12	2	1	8	.967	1	0
Waite,	1	33	2	2	2	.944	1	0
Abbott,	1	15	1	0	4	.941	0	0
Perkins,	31	21	5	1	3	.912	2	0
Gordon,	11	1	2	1	1	.857	0	0
Stone,	5	1	1	1	5	.857	1	0
Lincoln,	5	1	1	1	0	.857	0	0
Cullen,	2	5	2	0	1	.855	0	0
Gallagher,	7	1	2	1	13	.800	0	1
Knowles,	15	27	11	1	5	.792	1	1
Warren,	3	15	5	1	1	.782	0	0
Harris,	10	7	14	1	2	.549	1	0

Of this team all except Perkins will return next year. Thus the team will have had the advantage of having played together which is of much value. An effort will be made to find a new catcher and so make use of Philpot at second base, where he is more at home. If the new classes can contribute one or two good men, there is no reason why next year's team should not surpass by far any that has ever represented the institute.

Elmer C. Rice, '90, who, for the past three years, has been engaged on "The Telegram,"—the last year as telegraph editor,—severed his connection with that paper June 29, and has accepted a position on the reportorial staff of the "Boston Herald."