PROCEEDINGS

OF THE

EXERCISES INCIDENT TO THE

DEDICATION

OF THE

TRANSPORTATION BUILDING AND THE

LOCOMOTIVE LABORATORY

University of Illinois

Urbana, Illinois

May 8 and 9, 1913.

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* Read by the Chairman in Mr. Park's absence.

INTRODUCTION.

The exercises attendant upon the dedication of the Transportation Building, the Locomotive Laboratory, and the Mining Laboratory of the University of Illinois were held at Urbana on May 8, 9 and 10, 1913. Besides the formal dedicatory exercises and addresses which were directed toward the three buildings as a whole, a railway conference and a series of mining conferences were held at which some of the larger problems of each field were discussed by men prominent in the railway and mining worlds. In the ensuing pages are contained the proceedings of those exercises relating particularly to the Transportation Building and the Locomotive Laboratory, which were held on May 8 and 9. A separate volume records the proceedings of the Mining Conferences and other exercises which appertain to the Mining Laboratory and the work of the Mining Department.

The dedicatory exercises were inaugurated by an informal reception on Thursday, May 8, when from 3:00 to 5:00 o'clock p.m. members of the University and residents of Urbana and Champaign were given an opportunity of inspecting the Transportation Building and the Locomotive Laboratory and the Mining Laboratory. In addition to the large collection of framed pictures and relics which were permanently on exhibition in the corridors of the Transportation Building, there were also several collections of pictures and documents, mostly of an historic nature, that had been loaned by various

persons for the purposes of the dedication. The Locomotive Laboratory was in operation, with Illinois Central freight locomotive, #958, (Consolidation Type) mounted on the plant in the usual way and running at low speed. Outside the laboratory were the two railway test cars, which were open for inspection. Members of the railway staff acted as guides and conducted the visitors through the buildings and cars.

On Thursday evening at 6:45 o'clock, the University Band gave an open-air concert on the south campus, preceding the opening meeting of the dedicatory exercises which was held in the Auditorium at 8:00 o'clock. Dr. Edmund J. James, President of the University, presided. Addresses were delivered by Mr. Samuel Insull, President, Commonwealth Edison Company, Chicago, Illinois; Mr. J. G. Pangborn, Assistant to the President, Baltimore & Ohio Railroad, Baltimore, Maryland; and Mr. Robert W. Hunt, Past-President, American Institute of Mining Engineers.

A railway conference was held on Friday morning from 9:30 until noon, in the Physics Lecture Room, classes in the College of Engineering having been suspended for the day. The conference was presided over by Mr. Edward C. Schmidt, Professor of Railway Engineering, University of Illinois. The speakers were: Mr. B. A. Worthington, President, Chicago & Alton Railway Company, Chicago, Illinois; Mr. W. B. McKinley, President, Illinois Traction System, Champaign, Illinois; Mr. George R. Henderson, Consulting Engineer, the Baldwin Locomotive Works, Philadelphia, Pennsylvania; Mr. Albert Reichmann, President, Western Society of Engineers, Chicago, Illinois;

Mr. T. H. Goodnow, President, Western Railway Club, Chicago, Illinois; Mr. H. G. Hetzler, President, Chicago & Western Indiana Railway Company, Chicago, Illinois; Mr. Robert Quayle, General Superintendent Motive Power, Chicago & North-Western Railroad Company, Chicago, Illinois; and Mr. Samuel O. Dunn, Editor, Railway Age Gazette, Chicago, Illinois. The four following speakers were unable to be present; Mr. Charles B. Moore, Vice-President, Jacobs-Shupert United States Firebox Company, Chicago, Illinois; Mr. D. F. Crawford, President, American Railway Master Mechanics' Association, Pittsburgh, Pennsylvania; Mr. W. L. Park, Vice-President, Illinois Central Railroad Company, Chicago, Illinois; and Mr. H. E. Chubbuck, Vice-President and General Manager, Illinois Traction System, Peoria, Illinois. Mr. Park, however, sent his address, which was read by the chairman.

A buffet luncheon for guests in attendance at the exercises was given at the old Armory at 12:30 p.m. and was attended by 239 persons. Following the luncheon there was an inspection of the buildings of the College of Engineering, and especially of the Transportation Building and the Locomotive and Mining Laboratories, together with the auxiliary apparatus previously mentioned. A short respite was had in the Physics Lecture Room when Dr. W. F. M. Goss, Dean of the College of Engineering, thanked the out-of-town guests for the interest they had repeatedly shown in the work of the University, and particularly upon this occasion.

The formal exercises of dedication were held at a general University Convocation in the Auditorium at 4:00 p.m., presided over by Dr. W. F. M. Goss, Dean of the College of Engineering, University of Illinois. A musical number by the University Band was followed by the invocation by Rev. Charles Ryan Adams, Pastor of the First Presbyterian Church, Champaign. The address of dedication was delivered by Dr. E. J. James, President of the University. Hon. W. L. Abbott, President of the Board of Trustees, spoke on behalf of the University, and Mr. Willard A. Smith, President, Railway and Engineering Review, Chicago, Illinois, made an address of congratulation, taking the place of Mr. C. H. Markham, President, Illinois Central Railroad, who was unable to be present. Hon. Edward F. Dunne, Governor of the State of Illinois, who was to have spoken, also was prevented from appearing, and asked to be represented by Hon. W. L. Abbott, President of the Board of Trustees. The meeting was closed by the singing of "America" by the audience, after which a procession was formed, and, headed by the band, marched to the Transportation Building where the dedicatory exercises were concluded with a prayer of dedication by Rev, Charles Ryan Adams of Champaign.

Besides the list of 255 out-of-town guests shown at the end of the volume, containing many railway presidents, vice-presidents, managers, engineers, and others of note, the meetings were well attended by students and members of the faculty. Altogether a large and lively attendance was shown at all of the meetings, and favorable weather conditions combined to

assist in making the entire program a success from every viewpoint. The various addresses delivered at the three meetings above referred to are given in full in the following pages.

MEETING IN AUDITORIUM, MAY 8.

INFLUENCE OF ENGINEERING ON MODERN CIVILIZATION.

Address by Mr. Samuel Insull, President, Commonwealth Edison Company, Chicago, Ill.

Mr. President, Ladies and Gentlemen: I am not going to burden you on an occasion like this with a technical address. In coming here to assist in the dedication of the Transportation Building and the Locomotive and Mining Laboratories, it occurred to me that it might be suitable to speak for a few moments on the subject of the Influence of Engineering on Modern Civilization.

Francis Bacon, three centuries ago, said: "There are three things which make a nation great and prosperous,- a fertile soil, busy workshops, and easy conveyance for man and goods from place to place." Lord Macaulley, half a century ago, said: "The inventions which have bridged distance have done most for civilization". The work, or the inventions, of the engineers during the whole of the last or nineteenth century, and during the latter years of the eighteenth century, were in the direction of bridging distance. If we begin with the invention of the steam engine by James Watt in the latter part of the eighteenth century, we have one of the fundamental elements that led to such enormous mechanical developments during the whole of the nineteenth century. Another instance is the work of Robert Fulton in connection with the steamboat in the early part of the nineteenth century. Yet another instance is the work of George Stevenson, who engineered and

operated the first steam railroad ever constructed, the Stockton and Darlington Railroad, toward the end of the first quarter of the nineteenth century.

The introduction of gas, I think in 1816, was an important contribution by engineers to the development of modern civilization. Morse's work in connection with the electric telegraph in this country, and the work of Cooke and Wheatstone in Great Britain, toward the end of the third decade of the nineteenth century, have had probably, in conjunction with the development of the steam railroad, a greater effect on the development of civilization than almost any other contributions by engineers of the last century. These were followed about the middle of the last century by the coupling of the two great English-speaking peoples by means of the submarine Atlantic cable, which is probably one of the greatest factors in more recent years in bringing about a better understanding between those two great peoples. From the time of the successful commercial establishment of the submarine cable to the discovery by Alexander Graham Bell of the principles underlying the commercial telephone of today was but a short period - I think about a decade and a half. This was followed about the year 1879-1880 by the rapid development of the electric light and power industry and the general use of electric energy. My recollection - and it is but natural that I should dwell on this particular branch of engineering development on account of my connection with it - my

recollection of first seeing an electric lighted street goes back to London, when towards the end of 1878, the Thames embankment was first lighted by arc lamps, a Russian invention called Jablochkoff candles. While that exhibition was going on in Europe there were a number of very able engineers and inventors engaged in the development of the electrical industry here in this country. Brush, Elihu Thomson, Edwin J. Houston, George Weston, Frank J. Sprague, and many others, represented the engineering intellect which was devoted to the development of electrical industry in this country, headed, especially by the work and invention of Mr. Thomas A. Edison, who is entitled to the credit of devising the electrical distribution system as it is understood today.

I have mentioned just a few names connected with engineering development, but I might go on all evening in speaking of the personal work of various men; but time will not permit. There is just one man, however, whom it is fitting to refer ot - Mr. Marconi - and his marvelous invention of the wireless telegraph, which has practically annihilated space.

How have these accomplishments of the world's inventors and engineers benefited civilization? Great systems of transportation have been created ashore and great vessels afloat, connecting the several continents which border the great oceans of the globe. Surely an abridgement of distance, as Lord Macaulley put it, has been achieved

by the work of these men. If "conveyance for man and goods from place to place" is one of the great elements in developing a people, surely the engineers who have contributed so much to the industrial development of the last century may be crowned as empire builders. The work of the great transportation agencies has made possible the great manufacturing establishments of this state, whose products far exceed the combined product of the agricultural and mining industries of the state. Their work has developed the manufacturing industries of the east by transporting the raw materials of the west and south of this country. They have doubled in value the producing territory of the Mississippi Valley by bringing its farmers, and later its manufacturers, into touch with the markets of the world. The inhabitant, whether he be a trader or whether he be following any other occupation today, whether he lives in the occident or the orient - is alike under everlasting obligations to the engineers who have developed the great transportation systems ashore and afloat. Take the mere question of the abridgement of distance. London is today nearer to Urbana than Detroit was seventy-five or a hundred years ago. Pekin is today within easier reach of Champaign than New York was a comparatively short time ago.

If distance has been bridged by the transportation engineers; if with their assistance and the courage and valor of the pioneers the forests and prairies have been turned into great producing farm land, surely the telegraph and the

telephone have produced an abridgement of time that 75 to 100 years ago would have seemed the impossible hope of the dreamer. The telegraph and telephone - especially the telegraph - has made the world of nations next door neighbors. The civilizing influence of contact, the impossibility of isolation, the knowledge of what is going on the world over and the change that such knowledge must produce in one's point of view, the effect of such knowledge on the development of our race, are all matters that must be traced more or less to the work of the investigator and the engineer in the invention and development of our great schemes of communication either by telegraph or by telephone, local or international.

The development of the business of the generation and distribution of electric energy will probably have within the next quarter of a century more influence on the development of our local communities, not alone the large cities but our rural communities throughout our states wherever there is any considerable density of population. Heretofore the business of producing and distributing energy on an economical basis has been confined very largely to our large cities, but the marvelous work of our engineers during the last two decades, the great changes that have taken place in connection with the development of prime movers, the changes from the reciprocating engine to the steam turbine, the changes in use of units of 5000 horse-power to units of from 20,000 - 40,000 horse-power, are

producing changes in the cost of the energy which will lead to the centralization of production and distribution in the interests of economy to both producer and consumer, which must have a very great effect in the development of the industrial interests of such states as Illinois. It is today not only a possibility but an actuality that the same advantages that we enjoy in large communities can also be enjoyed by the farmer, by the rural community, by the people having large areas to drain; the same privileges of low cost of energy can be obtained for them as are obtained for the users of energy in the large centers of polulation. If you will trace back the development of the large manufacturing centers in this country, the early manufacturing centers, you will find that the workshop and the mill were established where cheap power could be obtained, and until the last few years the only places where cheap power could be obtained were on streams where hydraulic development was possible. The great manufacturing establishments of New England owed their foundation largely to this cause. Suppose any very small community anywhere in the thickly populated territory of the Mississippi Valley is able to obtain energy for manufacturing purposes at low cost. Assuming that in those communities the manufacturer can obtain the necessary labor, it stands to sense that one of the great troubles of modern life will be solved. At the present time large manufacturing interests as a rule

cluster around large centers of population. The reason for that is that power is relatively cheap where there is a large population to draw on for labor. But as this state and other surrounding states become studded with manufacturing establishments the necessity which compels the workman to dwell in large centers of population, where living conditions are most unfavorable, will cease. He will be able to establish himself under conditions where he can get healthful environment for his family. Instead of living in overheated, ill-ventilated, small tenements of the big city, he will have the opportunity to establish himself under the same desirable conditions as those who live in the country. Surely if this can be accomplished, if the living conditions of our people can be improved, if their children can be brought up under circumstances which will give them the foundation of fine health, which will give them the opportunity of association in our country schools with that portion of the population - the farming population - which is the very backbone of the country, it is reasonable to expect greater satisfaction on the part of the workmen with their conditions and better relationship with employers, because of a closer community of interests, and, in general, a better chance for the workman and his family.

It is natural in coming to the University of Illinois that I should want to address myself to the students of the Engineering College, and to speak to them

somewhat of the opportunities of their profession. The modern facilities for study in the engineering course as now known, whether it be civil engineering or mining engineering or electrical engineering, or whether it be a study of chemistry to be employed in the industrial arts - the modern facilities are unrivaled and are a blessing to the youth of this great state, and it often occurs to me to wonder whether they really appreciate the possibilities that are before them. It is not uncommon in this day, when big businesses and big combinations are receiving the attention of the politician and statesman, to decry the possibility of opportunity for the young man; but as a matter of fact there never was a time when opportunities were so great. The greater the business the greater the demand for trained men, and the greater the reward for capacity, and for executive ability and training in special knowledge. When manufacturing business or the great public service business of the country was run on a small scale, the item of overhead expense was one of the most serious items that the manager had to deal with. From forces of circumstances, the amount he could pay for trained brains was relatively small. But that condition does not exist with the modern methods of business development of large industrial establishments. Development of large transportation systems, development of large businesses of every sort call for so much special knowledge and special training that

the yonng men of our engineering colleges have today an opportunity that their predecessors never had. In addition to one's duty to one's self to provide for the future, to take care of one's own, the young man of the commonwealth owes a duty to the state in which he lives and to the community in which he resides. It is not necessary for him to enter public service in order to perform that duty. He can get not only the personal satisfaction of work well done and of receiving the remuneration for work well done, but there are a great many problems that the business man and the engineer will have to solve in connection with the development of the great businesses and the great industries of this country during the next two or three decades. Many of you young men, I suppose, think that there are no such opportunities in the transportation world as gave the chance for a James J. Hill or for a Harriman, but as the great transportation systems of this country develop there will be just as great an opportunity for the industrial empire builders as had the grand old empire builder who has done so much in connection with the development of the northwest, and the other great builder, now dead, who did so much in connection with transcontinental travel and the development of the Pacific Coast.

I have about spoken my alloted time. If there is one word more that I would like to say before taking my seat, it is to again appeal to the young men of this institution.

There is no royal road to success. Achievement is only possible by very hard work. Whether your career is to be made as an engineer or as an agriculturalist or as a doctor or along chemical lines, the only way that you can get to the top is by the most strenuous labor; by forgetting the hours of the day and practically the days of the week. Constant hard work has brought success to many in the past and there is no reason why the same task of constant and hard work should not bring success to all you young men and women who are attending this University.

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HISTORY OF THE LOCOMOTIVE

Address by Mr. J. G. Pangborn, Assistant to the President, Baltimore & Ohio Railroad, Baltimore, Maryland.

The stuff of which dreams are made. As old as the mysteries of the brain's action is the trend to initially so regard the broaching of such as is not already within human ken.

The member of the British Parliament who declared that when a locomotive was made that would remain on rails at a speed of ten miles an hour he would eat one of its driving wheels for his breakfast had antecedent as he has had trailing prototypes.

So, before Richard Trevithick, as well as after him, there have appeared others paralleling the pathos of his self rendered requiem: "I have been branded with folly and madness for attempting what the world calls impossibilities, even by the great engineer James Watt, who said I deserved hanging for bringing into use for the locomotive high pressure steam. This so far has been my reward from the public. However much I may be straightened in pecuniary circumstances the great honor of being a useful subject can never be taken from me, and which to me far exceeds riches".

Suggestive of a studied effect in light and shade not comporting with this presence may be the thought as to

this prelude, yet on second thought may come the realization that there are here dreamers of dreams. Men visioning the impalpable - the stuff of which dreams are made. So appearing to others but not to themselves. Inspiration - mayhap you will have it - leading up to the problem, as is the wont to term, and which in the solution to the point of demonstration of practicability, is the same actuating spirit voiced long ago by Trevithick - the being useful in the day and generation.

His day and generation were far different. To him and his contemporaries there was no blazed way. They blazed it for you.

Nevertheless there were gleams of light shed in the wilderness, as it were, before the locomotive was born. A dreamland in which steam was the atmosphere breathed by those visioning its subjection as the most potent of agencies for the world's advancement. As through a glass darkly was the mind's eye on the will-o'-the-wisp so elusive that on-lookers long viewed it a veritable wild goose chase.

Newton, the same Sir Isaac who primarily brought to our attention the fact that "what goes up must come down on your head or on the ground", was also the foremost to vision the governing of movement the reverse of the perpendicular, that is to say, the horizontal. He saw in the generation of steam what none other had to that time - the

possibility of its application for the purpose of propulsion.

The great philosopher's thought was the confining of steam under the highest pressure attainable and its employment as a propelling power by discharge against the atmosphere, the resistance of which would force forward the wheeled vehicle supporting the boiler.

Whimsical as this seems to us, it is, nevertheless, the first suggestion of steam power for locomotion recorded in history. And it wasn't until the world was thousands of years old that a man appeared upon the scene with even this much to suggest.

Sixteen hundred and eighty was when Sir Isaac evolved the idea, which at best was only such; a dream of what might be done, and never further extended by him. Not only is it the high pressure he proposed that is the essential of today, but the steam jet that he placed in the rear to push, we now have in front to pull; or what leads potentially to do so through the forced draft and consequent rapid combustion caused by the vacuum producing steam escapement.

Following Newton a French nobleman precipitated himself into a good deal more than the traditional peck of trouble; brought things to the pass that he not only was shut up in a mad house, but fastened into a straight jacket for projecting theories as to the development of steam as a force destined to entirely revolutionize existing conditions.

Poor De Caux! He was, by the way, a Marquis, as was, also, the English nobleman who having in some manner learned of the Frenchman's alleged aberration, crossed the British Channel to learn more about it at close range. He succeeded in, as we say now-a-days, getting next to De Caux; his influence securing him ingress to the place of the latter's confinement and an intercourse that eventuated in so confusing the record of it that what were really De Caux's ideas and what were Worcester's are past distinguishing. Whichever of the two should have the honor to his memory of foreseeing the possibilities of steam as applicable to locomotion must ever remain undetermined - the French continuing the meanwhile to claim it for De Caux and the English for Worcester.

At the time neither country took any stock in the utterances of either men; De Caux pining away and dying in his padded cell and Worcester appealing in vain for recognition as a prophet - the old, old story of being without honor where best known.

Not so much wonder, all this, pathetic as it may be from our view point. Papin did not hit upon the safety valve until 1681, and Moreland that year in an audience before the Queen of England grandiloquently phrased his discovery as "a new forde of fire." The condensing engine was then the acme of development and Papin's producing a vacuum by the condensation of steam in 1695 was naturally held to be a marvelous

thing. Three years later, Savary reached the zenith of his reputation in steam exploitation by largely improving upon Papin in the latter's especial field of effort. Next came Newcomen, in 1707, overcoming the condensation of steam in the lower end of the cylinder by freeing it and introducing atmospheric pressure to drive the piston head back. In other words, what we do with steam at both ends of the cylinder, he did at one end with compressed air.

Valve action wasn't automatic until 1713 when the boy Potter, to escape from a too close attention to the engine he was employed to care for, tied cords leading to the beam, which youthful dream of evasion of labor materialized into obviating a good deal of detail and was regarded as an important advance until Beighton five years afterward substituted the plug rod.

Leupold's high pressure engine of 1720 with its pair of single acting cylinders upon the boiler, each cylinder with a piston moved alternately by steam admitted through a four-way cock, was a very long step forward and made James Watt sit up and take notice.

This will appear a most irreverent manner of introducing our childhood's hero of the tea kettle, but it is without intentional disrespect of the name emblazoned in such shining letters upon historic rolls. There is no question of James Watt's right to place in the Hall of Fame for what he did with the steam engine in general but

there is no claim admitting of substantiation that he other than retarded the determining of the potency of steam as a means of locomotion. As with some big men of our own times an acknowledgment of a single authoritative source was with him the sine quo non for peace and harmony. He was the authority on the steam engine and his dictum was that high pressure was not only dangerous, a menace to life and limb, but fallacious in theory and practice. Everything that could be accomplished with high pressure he insisted could be better done with low pressure and all the strength of his tremendous influence was brought to bear to enforce this as a principle and establish it as the law of the land. The latter is no exaggeration as through Watt's activity and aggressiveness he brought about enactments of Parliament, which, while operating to deter those who otherwise might have made great names for themselves, at the same time so protected his own patents as to give him a practical monopoly. It was a Watt's Trust, so to speak. Those nearest to him, Dr. Robinson and Dr. Darwin, held progressive ideas of the utility of steam as a propelling power - for "wheel carriages" as the first named worthy put it; the other good man going farther and growing more expressive in dubbing - what he tried his best to induce Boulton, Watt's partner, to prevail upon the latter to build - "a fiery chariot." But the unapproachable and supremely stubborn James would have none of it, being then, 1769, oblivious to all things mechanical not relating to the perfection of his rotary engine.

Just at this time there transpired one of those materializations that now and then confound men prone to unbelief in anything not at the onset understandable.

The first vehicld to move by head of steam on earth was brought forth by a man never heard of in the circles where the evolution of the engine engrossed men's minds, or, as a matter of fact, was it known by anybody, apparently, that such construction had been conceived, let alone really perfected. Coming as a bolt from a clear sky there was no premonition of such a snorting, wheezy and altogether startling thing as one bright day in 1769 suddenly appeared upon the streets of Paris. With no source of impulsion the eye could discover and attended by noises and a vaporing utterly beyond the comprehension of the bewildered people, panic followed the strange course of the Satanic suggesting fabrication which, while evidencing a thrillingly mysterious ability to dash hither and thither of its own volition seemed to have no fixed will as to where it purposed going. From street to walk, butting corners here and knocking over what came in its way there, the infernal corporeality, as it was declared to be, ultimately came to a dead stop against the wall of the revered Church of the Madeleine. "Twas all over then with the avant-coureur of locomotion by steam. Not again would the offspring of his brain be permitted to shock the finer sensibilities of the populace; yet, strange to chronicle, the antipathy was

tempered to the point of tolerating the continued existence of the "wheeled devil", and its seclusion somewhere out of sight, hearing, or danger of further riotous doings. Thus eventuated the perservation, for most gratifying as it is to know, the original shaping through which steam was made to serve as the means of propulsion still remains intact. It could to-day be fired up and moved, and would now be in the Baltimore & Ohio's Historical Collection had the offer of 50,000 francs or $10,000 the late Robert Garrett authorized for it been accepted.

That this, the projenitor of the countless power propelled creations on wheels that link together the ends of the earth, should have been devised neither for goods or passenger carrying purposes, or for pleasure or any one of the objects of present use, is the unique feature of the conception. Nicholas Cugnot was a Captain in the French Army and the trance inspiring him to the devising looked to substituting the energy of steam for the horses attached to the guns in the battery of artillery which he commanded. This to prevent putting the guns out of commission by the enemy's shooting the animals, as, also, to facilitate rapidity of maneuvers on the field. So far as known, Cugnot had no mechanical training, having been led, doubtless, by what had come in his way to read up on steam experimentation and adapt the power as has been described. The machine in itself shows the artilleryman's natural tendency in construction, the supporting frame being indicative of the gun

carriage, and heavy throughout all its parts.

France, the leader of the countries of the world, in the actual movement by head of steam, was, within ten years, to take instruction - as were England and Germany likewise - from America in the augmenting of steam efficiency. Oliver Evans of Philadelphia was the teacher and his non-condensing engine of 1779 the object lesson.

Of his fellow dreamers in England was a timid, non- assertive but far-seeing and intelligent man - William Murdoch. Adding to the deterrents to a forceful progress, through the unfortunate traits specified, was the further misfortune of his association as an assistant to James Watt at the latter's Soho factory.

It was Murdoch's bread and butter to keep his job. He was an adherent of high pressure. Watt, his chief, was the upholder of the low pressure principle, the establisher of it to the point of practically making it a crime to construct and operate contrarily. Watt would have none other than abject servility to his views by those under him, and whatever Murdoch did had to be done surreptitiously. Night and its shades were the recourse, and, slipping out into the darkness one fateful evening with his half sized working model, Murdoch had the time of his life. Not exactly the sort of a time one of his exceptionally retiring disposition would voluntarily have chosen, for his machine got away from him and there was a made race for recovery

adown that lonely lane of Redruth that stirring Saturday night in 1784. Now it happened that at t'other end of the lane was the worthy Vicar of the Redruth Parish, out, in his imagined all-by-himself-ness, quietly conning over the notes of his next morning's sermon. Suddenly from behind him emanates spiteful, hissing, strenuously laboured breathing, as it were; a something so awesome in its effect upon the ear as to impel an affrightened turning to look, and one look caused the irresistible impelling sensation to run for life. There were three in the wild dash, the Vicar, the fire and smoke vomiting demon - as the reverend gentleman took it to be - and the hapless inventor who was simply after his own. It was the primogenial movement by steam on the soil of the British Kingdom, and with accessories rendering it memorable - for the time being certainly - in and about Redruth. The lamentable finish of Murdoch's aspirations. Watt saw to that.

Nathan Read of Salem, Massachusetts, thought steam too slow in the prevailing types of boilers of his day - the single and return flue varieties - so Yankee like he proceeded to give flight to his fancy in the way of getting more out of fuel combustion. Read was a natural born mechanic of the jack-of-all-trades-and-master-of-none stamp. With all his erratic tendencies there were streaks of real genius manifested and this was the case when he reasoned

it out that small fire tubes of brass or copper would insure the more rapid transmission of heat to the water. Thus the birth of the multitubular boiler in the year 1785.

It is well said that there is nothing new under the sun, and strikingly illustrated in the instance of the automobile. In conception it is older than the locomotive by a score of years.

The first dream of a power moving vehicle for passenger carrying was that of William Symington of England and in 1786 he fashioned a working model to demonstrate its practicability. Common roads were of course the contemplated arena as there were no rails those days save the rude iron capped wooden ways of the coal collieries.

Simultaneously with Symington's expression of this innovating idea abroad, Oliver Evans on our side of the Atlantic appealed to the Pennsylvania Legislature for permission to introduce the steam carriage in that State; but he was turned down without ceremony as a preposterously presuming individual to think of such a thing. Maryland, however, was more tolerant of him than was his native State, for her Legislature acquiesced in his wish for what was denied him at home. Money not being forthcoming for anything so crotchety as he proposed, Evans had to be content going on with the more humdrum things with which his name is connected; flour mill machinery, boat building, anything in fact

turning up that would keep his head above water financially. He did, however, succeed in 1787 in getting a patent in Pennsylvania on his high pressure engine and put one together in his Philadelphia shop.

By 1790 the Yankee Read had so far progressed with his plans for the adaptation of steam to road locomotion as to secure a patent - the original papers being still existent - and make a model as an exemplification of the proposed working. This, the harbinger of the steam carriage or automobile on the American Continent, was devised for the transport of freight and might, not at all inaptly, be spoken of as the parent of the heavy delivery trucks that now a century and a quarter later have become common on our streets. In the Read of 1780 was the primary introduction of copper and brass tubes - the multitubular boiler. It was the pioneer formulation, through an actually outlined plan, of steam propulsion on land in America. Read couldn't make a go of it in enlisting influence or capital in the steam wagon or, to any material extent, in other inventions, of which he was very prolific, and, becoming disgusted at the lack of appreciation of the emanations of his head piece, he turned as a by-play to politics. He was elected to Congress and never afterward heard from.

In England James Watt was still having everything

coming his way in the practical monopoly he was holding in steam engine building. Through his patents he exacted tribute from all essaying to become competitors and in the exertion of his masterful influence prevented high pressure from securing recognition as meriting development. He on one occasion did defer a bit to the growing sentiment that steam should be made to do duty other than in pumping water out of coal mines, by designing a locomotive, the drawing and specifications describing of which are of the records preserved in the British Patent Office. The outer boiler was to be of wooden staves bound with iron bands, the inner of wrought iron, and the steam pressure was to be seven pounds to the square inch.

Near Watt in Cornwall was a man who had vainly endeavored to evade his patents: tenaciously seeking to find a way to get around them and do something. Richard Trevithick was his name, and every thought of him is as of a giant physically and much so mentally. A Hercules in build and possessed of the strength of a Samson he was the idol of the miners to which class he originally belonged. The tales of his prowess with his bare hands in twisting horse shoes out of shape; of his bending iron bars over his forearm and of superhuman power of lifting and striking are yet traditional in Cornwall.

But infinitely more enduring is Richard Trevithick's fame as the Father of the Locomotive. For such he was -

story books to the contrary notwithstanding.

Watt's patents kept Trevithick restless and by no means voiceless until, happily in 1800 they expire and the brawny big miner's opportunity comes. Models follow models with kitchen table and floor as base of operation. Then Christmas time 1801 "Captain Dick's Puffer," as the townspeople call it, appears on the country road. His neighbors to the number of a half dozen are brave enough to accept his invitation and clamber to a foot or hand hold and off moves the uncouth contraption; slowly, and doggedly, but accomplishing the primary transport of passengers by steam in the world's annals. There was, as to be expected, much talk following these events; the whole neighborhood became agog, and the reports of the astonishing things Captain Dick had done spreading beyond the village confines cluminated in a wager that Trevithick could not construct a locomotive that, on the Methyr Tydvale colliery tramway in South Wales, would demonstrate an efficiency equal to pulling ten tons. Trevithick, despite the difficulties of movement of a locomotive on such as was the rough tramway, which was naturally not foreseen by the builder, promptly accepted the challenge, built his engine, attached the little cars to it, and not only drew the ten tons of metal as stipulated but two dozen or more people on top of it as well. Headway was slow, as trees had to be cut down where the width or height of the engine would not permit of its passage. Rocks and boulders

too, had to be shoved aside, and while a speed of five miles an hour was reached when obstructions did not intervene, the latter were so numerous that it required nearly four hours to cover the nine miles. Such was the first movement by steam on rails on all the earth. Richard Trevithick won his wager and became in truth the Father of the Locomotive. There was none before him to design and create one. Never before had there been an attempt at tractive power and never before had steam been made to propel on rails.

In the Baltimore & Ohio's Collection are two of the original cars drawn in 1803 by the Trevithick locomotive; several sections of the original rails, as, also, a number of the original stones to which the rails were fastened, and over which was the memorable movement as has been described.

Placing the rail sections in position on the stones, and then the cars, discloses that the gauge of the track over which the Trevithick train of 1803 passed was the standard width of today, viz: four feet eight and a half inches. Surprising, surely, this coincidence, or whatever may be the characterizing of the precedent.

A year after Trevithick's triumph, Oliver Evans encoumpassed what in its was was a parallel achievement; the passage by steam through the streets of Philadelphia of a great unwieldy dredging scow weighing forty thousand

pounds. Instead of the aligned tramway he had cobblestones to traverse, and this, the first locomotion by steam on the American Continent, was at last the practical demonstration of what this phenomenal man had for years been declaring achievable. He had built the steam dredge under contract for the municipality and it was provided that delivery should be in the Delaware at the foot of Market Street. His shop was on Broad Street, south of Walnut. Catching on to the opportunity to prove that what he had been claiming was not, as viewed, ridiculously chimerical, he rigged up a connection of the engine with the wheels, upon which he mounted the dredge and without mishap steamed merrily through Broad to Market Street and thence to the Delaware, where, taking the vessel from its carriage, the sliding into the river was a simple proceeding and the contract was fulfilled. Amazing, all things considered, as was this feat it made no lasting impression. Evolution is a slow process. A quarter of a century elapsed before steam turned carrying wheels a second time on this continent.

Meanwhile on British soil Watt was hot after Trevithick, who, in spite of the bitter warfare made upon him, appeared in London in 1808 with his "Catch Me Who Can", the first locomotive ever seen in the world's metropolis. It was indifferently operated for a time on a higglete-pigility excuse for a track which was the best that Trevithick's

meagre means could command. Watt, as has hitherto been stated, declared the Cornishman should be hung for persisting in bringing high pressure into use and in the end drove him into an unmarked grave in Potter's Field.

Evans, irrepressible, and unfortunately for him, living decades ahead of his time, proposed in 1809 a railway from Philadelphia to New York and in his advocacy of it foreshadowed all that has since come to pass. Not only as to the railroad itself, but its luxuries - sleeping and parlor cars, dining and cafe cars. The man had visions startling in their substantiality as we look back a hundred years to his period and its environment. He dreamed dreams which proved veritable prophecies. But he died unwept of the world; simply another visionary gone.

Adhesion, tractive power, the securing and maintaining of it so that the locomotive should be a practical proposition, was the most formidable obstacle encountered by the forerunners in its evolution. Steam formulation applicable of support upon wheels and so contrived as to make the wheels go round was proven other than the stuff of which dreams are made, but how to make the wheels take hold and pull anything - that was the rub. Trevithick had proposed making the tires rough and uneven by projecting heads of nails or bolts, or, to resort to cross grooves.

He also suggested fittings to the track that in cases of a hard tug "would cause a lever, bolt or claw to reach through the rim of one or both wheels so as to take hold of the ground." Stephenson fastened bolt heads on the tires of his earliest locomotive.

Blenkinsop in 1811 in the construction of a locomotive for every day use in hauling coal on a colliery tram attempted to solve the problem of adhesion by designing the rack rail and adjusting cogged wheel gearing on the engine to work in it; but the awkward machine wouldn't stay on the track.

William Hedley a coal mine superintendent was the first man to tackle the knottiest of the problems of the day with the correct principle as the incentive to his experiments. He found through his tests the most efficacious points of weight placing, and in 1813, built the "Puffing Billy" which creation settled for good and all the much vexed question of the adhesion of smooth wheels to smooth rails. The "Billy" was the Father Locomotive in that it was the first practical engine meeting operation demands through a vantage to propel other than itself. It is pleasant to record that it, the oldest of locomotives, and largely in its original form, is reverently preserved in the South Kensington Museum in London.

The year after the advent of the "Puffing Billy" signalized the entrance of George Stephenson, then a mine foreman, upon the scene of locomotive evolution with his "Blucher", his first engine and a failure. A bringing together, as continued to be so largely the practice in the Stephenson locomotives, of other men's dream children - so to speak - the commingling as a rule was so rudimentary as to eventuate in an early abandonment; or, as we would say, consignment to the scrap heap.

Hedley had established the essential of adhesion, and, in 1826, Marc Sequin a mining expert of France brought about another of equally great importance through the introduction of the multitubular boiler in locomotive construction. Securing from England a discarded Stephenson locomotive, Sequin replaced the single flue boiler with the multitubular, supplying the requisite increased draught through a fan operated by the revolution of the wheels of the tender.

The steam blast came a year later in the blacksmith foreman Timothy Hackworth's "Royal George" and the basic question of draught to extend the efficiency of the multitubular boiler was answered. It wasn't with this in view, however, that the exhaust was thrown into the smokestack. Parliamentary laws had compelled a cessation of

the practice of exhausting steam into the atmosphere, the moise so made scaring horses as well as putting the nerves of humankind in an unendurable tension. In this emergency, locomotive as well as steam carriage builders, the latter quite numerous at the time, diverted the escaping steam into the interior of the engine as the only way of muffling its disturbing racket.

Stephenson in the famous "Rocket" of twenty odd years later origin than the Trevithick, had the advantage of a comprehension of what Oliver Evans had done in the development of the high pressure non-condensing engine, and, of the adaptation by Sequin of France of the Read and Evans progression with the multitubular boiler. He was an exceptionally clever person in the appreciation of the accomplishments of other men; a clear headed pushing individual in applying them to his own ends. None of the locomotives built by him for the coal carrying trams of the Hetton, the Stockton & Darlington and other collieries, had proven successful; indeed, their imperfect application of principles, faulty construction and constant necessity for expensive repairs had well nigh produced the unanimous feeling that steam power on rails was an utter delusion.

The performance of the "Rocket" in the Rainhill trial of 1827 radically changed the aspect, however, and the personal honors of the victory were divided between

Stephenson and Booth. The latter the Secretary of the Liverpool & Manchester Road who had slipped over to Paris, seen there the "Sequin" with its multitubular boiler, come home and had the "Rocket" altered from the double flue to the multitubular; also making other radical changes. This is history, as, likewise, that Booth for his part in the remodeling of the engine was awarded half of the prize. The "Rocket's" subsequent career was not brilliant, it being soon relegated for more or less intermittent operation on a back-country colliery tramway.

George Stephenson was not the originator of any essential of the locomotive. A careful and painstaking research throughout the files of the British Patent Office failed to disclose one patent taken out by him in his own name alone; always with an associate. It was as the promoter of locomotive operation, not the Father of the Locomotive itself that he should have been placed in history. To him first and foremost will the honor ever be accorded of compelling recognition of the feasibility of the conduct of the railway by steam power. When skepticism and distrust, very largely predicated upon his own failures, were rife; when the pioneer of the English railways, the Liverpool & Manchester, had decided to abandon all thought of operation by locomotives and throughout the Kingdom the universal opinion was adverse to further experimenting at so ruinous a cost, Stephenson by his indomitable determination

to overcome every obstacle, succeeded, through the demonstrations at Rainhill, in transforming the situation into one marked ever thereafter by an unfailing optimism as to the ultimate outcome.

Hackworth, although the first to recognize what the vacuum creating meant with the draft, overdid it in the "Sans Pariel" his entry in the Railhill locomotive competition. The effect of the exhaust or blast into the towering stack of the engine was so strong for the single-flue boiler that the greater part of the fuel went through and out and into the air hardly half consumed. This being subsequently remedied, the engine proved an infinitely better one than Stephenson's "Rocket", the fate of which has already been alluded to. The "Sans Pariel" was in active railroad service for many years, and as the "Rocket", is of the historic treasures of the South Kensington Museum.

The chronicles of the world's railways embrace no more daring embodiment of nerve than that of the Baltimore bankers who early in 1827 calmly resolved to build a railroad from the Chesapeake to the Ohio. There was no railroad anywhere for commercial purposes. No completed line of rail existed on the globe other than the roughly conformed tramways for coal or stone carrying, which, until this time, had been the sole incentive to construction

and operation. The Liverpool & Manchester Railway had been projected in 1822, and it is true, that in 1825 Stephenson locomotives were introduced on the Stockton & Darlington road, at that time an exclusively coal transporting tramway, and afterward its improvised stage coach passenger-carrying was only such as not interfering with mine output.

Where there was the will the way would be found, was the courageous attitude of the virile Baltimoreans, and so assuming, they proceeded to get busy. Developments proved that in truth they hadn't the least idea of the way, its length, or in fact, any of such as would now be deemed adequate knowledge. They knew only in the abstract what they wanted and must have, and the concrete or actual, as it was demonstrated, would be met and overcome.

Not one of the principal movers in the enterprise had ever seen the Ohio, and, it is not known that any of them had ever beheld the Alleghenies or been farther West than Frederick or Hagerstown.

There wasn't a proposition extant in the world to surmount a mountain range with a railway, leaving out of question the promulgation of any theory of how it could be done. The Liverpool & Manchester, "The Grand British Experimental Railway", as the official circulars put it, was being built through a country as level as the proverbial barn floor, and as straight as the model housekeeper's clothes line.

It was all the same to George Brown and the other men of Baltimore associated with, and like him, dreamers of dreams. They would go to the moon if they liked, but just then preferring to elongate immediate connections on terra firma, they would be satisfied with the Ohio River.

They weren't, as it eventuated, but that is another story.

The pioneers of American Railway building with the impatience of boys not to be frustrated in what they had planned, brushed aside all queries, conundrums and the like as to how corners were to be turned, and hills climbed. Corners would be turned and hills climbed when they were reached, and literally this was the case. The way of the Baltimore & Ohio along river-side as up hill and down dale, over mountains and through forests, was blazed pretty much as the first settlers found and fixed their bearings. American brain and brawn got there, and the Company became kindergarten, primary school, high school, college and university of American railroading, all rolled into one.

Peter Cooper's production of the first American-designed and built locomotive was an example of the stimulus the gingery Baltimore men infused into things railroad. He didn't merely think that steam operation of the Baltimore & Ohio was practicable, he knew it.

To 1829 when Cooper, the merchant with a vision, proceeded to prove himself the man who knew, even if he couldn't explain why, there had not been seen on this continent anything pre-figuring a locomotive.

Pending the working out of his application of steam to rail transport, the "Stourbridge Lion", the first locomotive to turn a wheel on American soil, arrived from England by sailing vessel and was taken up the Hudson to the Honnesdale coal tramway for operation there. A seven ton, top heavy, grasshopper type construction on a hemlock way with but half inch thick iron plates between it and the wood, admitted of but one conclusion which was speedily arrived at. A single trial trip settled it, and the "America", a Stephenson locomotive ordered abroad at the same time as the "Lion", arriving in New York a few weeks later, was left there to be sold for what it might bring as a stationary engine.

This experience, transpiring when Cooper was in the very thick of his perplexities had no daunting effect whatever upon him. No tubes being available for his boiler, he bought a lot of shotgun barrels and made them do. So too with other prerequisites, if the thing he wanted was not procurable, he turned to some sort of a shift in the adaptation of some other thing. He made good, and the future of the American railroad with American methods of progression was established. The triumphant demonstration

of his little "Tom Thumb" of scarcely more than a ton's weight meant everything at a period in the country's advance when the situation was critical in the extreme.

Confidence supplanted doubt, for the American locomotive was born. A baby, to be sure, yet so lusty as to fulfill the dream of the certainty of steam operation where the way of the rail was through curvatures of four hundred feet radius and over gradients of twenty feet to the mile. Nowhere else had this been visioned, and nowhere was it so vital to the development of intercommunication as here. It was the beginning of an era the fecundity of which has had no parallel. Another merchant, Miller of Charleston, South Carolina, awoke, as had Cooper, to the realization of the trend of his imagination, and there came from him the first American locomotive constructed for real service. Davis a watchmaker of York, Pennsylvania, followed with the precursor of a distinctive American type, a the cheese or upright boiler that came to be known as the "Grasshopper". Competitors with him in locomotive trial were the two fellow watchmakers of Philadelphia, Costell and Childs. Soon after appeared upon the stage a third watchmaker in Philadelphia, Baldwin, the founder of the famous locomotive works that still bear his name. Meanwhile from his father's horse-breeding farm in New Jersey there had come Ross Winans to sell the power to the

Baltimore & Ohio on which it was expected to rely for the operation of its line when opened. Speedily followed the revelation to him that this was not to be animal but steam; and no man left deeper impress upon the locomotive of his time than this farm-formed dreamer of dreams.

Long, the Army Topographical engineer, Norris as Winans from the farm, Rogers the carpenter, Swinburne another carpenter, Clark the wool carding machine maker, Danforth who made spinning frames, and Masnn the producer of cotton machinery generally. These and the host of others who played great parts in the earlier stages of the American locomotives upbringing; not to overlook the landscape painter Morse who gave to the world the telegraphic alphabet by which the locomotive to this day is timed in its movement; all originally were men of foresight more less inexplicable from the strictly rational standpoint as is regarded that which restricts cause and effect to the influence of early environment.

Dreamers, men of imagination, men who have visions, men of initiative - term as you will - the earth would be a sorry place without them.

MINING AND TRANSPORTATION.

Address by Mr. Robert W. Hunt, President, Robert W. Hunt and Company, Engineers, Chicago, Illinois.

This is the second time that I have been honored by an opportunity of participating in the celebration of an important step in the constantly advancing progress of this University; and a very marked and satisfactory feature of its progress is that it is along lines so directly bearing upon the ever increasing material requirements of the times. Certainly there are no two features of our economic life greater in importance than those of Mining and Transportation; and no two which are more closely associated and interdependent.

The gentlemen who have preceded me this evening have ably and eloquently dealt with transportation problems and the power required by them; but without the products of the mine, we could not have either, unless perhaps in their crudest forms. Transportation itself, without mining, is not only inadequate to the needs of the present, but if we had been limited to it in the past, our present civilization would be an impossibility.

No doubt the direct consumption of coal for transportation power will be lessened, and in many districts water power will allow the practical abandonment of the use of mineral fuel. Indeed it is not at all certain that Mr. George

Westinghouse's prediction will not come true, and it will be demonstrated that it will be more economical to burn the coal at the mine and transmit the power electrically to the railroads, and thus both save the cost of transporting the non-heat producing portion of the fuel, but also burn the coal under conditions which will permit obtaining the greatest efficiency, as against the present most wasteful manner, that is, under locomotive boilers.

The requirements of city ordinances as well as other considerations have already caused the use of electric power for several important railway terminals, and we, who live in Chicago, are hopefully awaiting the application of such plans to the terminals of our own city. The abundant and constant water powers of our western mountain streams are being utilized by several railway systems to develop electric power for their mountain divisions, replacing both coal and oil; the latter a hidden wealth of the earth, which, so far as is known, is not now being created.

The successful use of electric power at various points will certainly be followed by the gradual extension of the electric zones until in time they will cover so much territory that it will be economy to apply that power to the whole of the railway systems, and then perhaps will come the general adoption of Mr. Westinghouse's plan. Such a system would reduce the traffic of many roads to the extent of the coal no longer required to be transported,

but if it should also proportionately reduce the cost of railway operation, will it not be desirable, and, as we know the development of the country is progressively making our railway capacity insufficient, will not the releasement of capacity through ceasing to transport so much non-producing freight, to that extent increase the efficiency of the existing transportation lines?

Advancement has always ultimately proven to the advantage of humanity. Labor saving machinery at first threatened the livelihood of many - its successful development has provided work for millions of increased population and given to the workers a manner of life whose conveniences were unknown and even undreamed of by the wealthiest families of those earlier days. If it is important that we should have increased economy in the use of the coal after it is mined, it is of equal moment that its mining should also be conducted in the most economical, and hence most scientific manner. I am giving prominence to coal because Illinois is a coal state, and in addition to the conservation of coal by intelligent and scientific mining, we must also remember the terrible sacrifice of human life which has resulted from ignorant and careless mining methods. But coal is not the only mineral of economic importance in the world's industrial and material life. Practically all of the others are dependent upon fuel to be made useful to man, and without iron, lead, tin, zinc, and copper, coal could do little but furnish heat to

the scantily clad barbarians crowding around the fire of the few burning lumps which they had succeeded in breaking from the outcroppings of the veins with pieces of stone bound to sticks by the sinews of dead animals.

In the Agricultural Department of this University are taught systems by which the productivity of the soil can be increased and its fertility retained. Thus the Agriculturist not only reaps, but he also sows. If he makes a mistake this season, he can correct it the next, with only the loss of time. The miner only reaps, he cannot sow. He takes out, he is powerless to replace. The waste attending his mistakes cannot be made good.

In the non-understandable scheme of life, we have been given this wonderful world with all its hidden treasures, and it is our bounden duty to conserve them. So far as we can understand we are to be followed by many generations of human beings just as much dependent as we upon the products of the soil and the mines. Is it honest to rob them by wasting their heritage?

In the past, the men of this country did not realize their responsibilities. The country was so rich in all its resources and the population was comparatively so small, that careless extravagance and waste were natural. But the alarm has been sounded, and it behooves us to awaken, and carefully prepare ourselves for the duties of the day. And it is through the establishment, generous

support, and careful administration of such Universities as this that our citizens who so soon must administer our estates can be properly prepared for their duties.

Each branch of our complex civilization is dependent upon the other. Even as are the various members of the human body, so are the members of the body politic.

Each department, each laboratory added to this University increases the moral, intellectual and material wealth, not only of the State of Illinois, but of the whole United States, - yea, of all Humanity.

RAILWAY CONFERENCE, MAY 9.

The Railway Conference was held in Lecture room "A", Physics Building, Friday Morning, May 9th, Mr. Edward C. Schmidt, Professor of Railway Engineering, presiding. The meeting was called to order at 9:30 A. M.

THE CHAIRMAN: Before beginning the exercises, I wish, on behalf of the University, to thank our guests from outside for their presence here today. We are glad to have you here, not only for our own sake, but we appreciate your presence as an evidence, a renewed evidence of the interest that railway men have always shown in the work of the University.

We wish to thank also the members of the student body of the University community who have availed themselves of this opportunity to hear so distinguished a company of railway speakers.

It may be worth while to present in a few words something of the history which preceded the event which we are celebrating here in the exercises of yesterday and today. It is about seven years ago since the University first offered its forces for training for railway service. Since then these forces have grown and established themselves. In the College of Engineering during the first

five years we were able to add to our equipment the two test cars which you will see on exhibition later, and such other railway apparatus as a brake-shoe testing machine, and a drop testing machine. Of course in the meantime we have had available the facilities of the other university laboratories.

Two years ago it seemed to the University administration that the growth of the work had warranted some comprehensive extension of our facilities and as a first step toward getting an increase in our organization, our staff, and our equipment, the University invited here in the fall of 1910, about two and a half years ago, the railway officials of Chicago and St. Louis. We had upon that occasion a company of some forty railway men, representing fifteen of the big railways centering in Chicago, who came to the University to look over what we had been doing, to acquaint themselves with our facilities, and our plans for development. They came to us, and after looking over the ground, we had in this very room a conference in which finally this resolution was passed, on motion of Mr. Clark, of the Illinois Central:

"Resolved, That it is the sense of this meeting that the railways of the state of Illinois co-operate with the President and Trustees of the University of Illinois in their efforts to secure from the State Legislature at its next session an appropriation for suitable transportation

and engineering buildings, to be erected for the purpose of furthering and promoting the work now being conducted for the study and development of the business of transportation and the education of men to enter the service of the railroad industry." *

With that approval and with that encouragement, the University asked the Legislature at the session preceding this one for an appropriation for this purpose. In presenting the matter to the Legislature we had at that time the very active and loyal support of all the railroad men whom we had here at that time and many others whom they enlisted. It is a great pleasure to acknowledge the large share that the railroad men of Chicago and the vicinity in general have had in bringing to so successful an issue the process which was entered into two years ago.

On our program for the morning we have several topics, the first of which concerns the modern problems of the steam railroad, the electric railroad and of the manufacturers. We are to have the pleasure of hearing in the first topic, "Modern Problems of the Steam Railroad," Mr. B. A. Worthington, President of the Chicago & Alton Railroad.

MR. WORTHINGTON: Mr. Chairman and Guests and Students of the University, - Aside from the pleasure which it gives me to come down here and say a few words to you upon the subject which has been assigned to me, I want to say that

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* For Proceedings of Conference of Nov. 9, 1910, see University of Illinois Bulletin, Vol. 8, No. 13, dated Nov. 28, 1910.

it was an extreme pleasure this morning to meet for the first time three men whom I have known for, I might say, somewhat longer than a quarter of a century, your Dean, Dr. Goss, Professor Schmidt, and Mr. G. R. Henderson, who, I understand, is also a guest here. In passing I want to say, Gentlemen, -- I ought not to say it in his presence -- but there is no man in the United States today who has a higher standing on technical railroad problems than your Dean, Dr. Goss. (Applause).

In celebrating the inauguration of these splendid educational edifices it is well to remember that a thing need not be great even in appearance to be worthily celebrated. It was the birth of a babe in a Jewish manger which opened the era of Christianity. It is by such apparently inconsidered instrumentalities that that babe, now the sovereign Lord of Life, is carrying forward his shining banners to the ends of the world, and we should celebrate such, not for their splendor, but for the immense consequences which have ever since flowed from them, and for the future promise which they present to posterity. In that light I think your buildings should be considered.

No one can appreciate more than the man who has had to struggle to get a technical knowledge, as I have, the advantages which you young gentlemen have in being able, right at the start, to have unfolded to your minds many problems that we had to spend months and years to get a knowledge of. While I have not seen very much of your

University here, I did go through a portion of the Transportation Building this morning. The first thing I noticed was a valve motion. I saw one of those valve motions which I made many years ago, and I cannot tell you how hard it was for me before we had anything of that kind, to understand the intricacies of valve motion. You can, through your teachings over there and the sectional views which you have, and the working of the valve motion, acquire as much knowledge in three minutes as we could get in a month. And these are advantages that tend to improve the entire morale of the railroad service. Men now graduating from a college of this kind can go into railroad service with a ground work that is an immense advantage over men that have not had any such opportunity. But this is not the purpose of my talk this morning.

(See next page for address).

MODERN PROBLEMS OF THE STEAM RAILROAD.

By Mr. B. A. Worthington, President,
Chicago & Alton Railway Company, Chicago, Illinois.

In many of the great problems before the people of America today, there is no basis of established and accepted fact upon which to construct a framework of logic. They concern matters which are so thoroughly interwoven into the very texture of our national existence, that the greatest skill and the utmost care should be observed in dealing with them, lest in an attempt to remedy what may seem to be defective conditions, we might impair or perhaps forever destroy the fabric of our national greatness. They relate to matters of such magnitude that a single mind cannot comprehend them with all their numerous ramifications, but each problem must be resolved into its integral parts where the mind can grasp the various entities, and as such, deal with them according to fixed laws which have successfully withstood the disintegrating influences of time.

Such is the complex nature of the railroad situation today - the greatest economic problem that any nation has ever been called upon to consider - a problem yet unsolved, and it is of the utmost importance that the coming generation, who soon will be called upon to accept the responsibilities which will be theirs by inheritance, should be prepared to accept them and transmit them on to future

generations in a more acceptable form.

It is not at all improbable or unlikely that within the walls of these very buildings, a future genius now may be laying the foundation of elementary knowledge essential in the ultimate solution of this vitally important problem, and with this possibility uppermost in mind, and with the longing thought that I might lend him strength and courage, I feel the same keen thrill of pride and hope which the ancient father must have felt when he buckled his own armor around the body of his smiling confident son, entrusting to him the sword with which he himself had fought, and bade him godspeed on the field of battle.

Within the brief period of our national existence, wonderful progress has been made in almost every line of undertaking; but in no locality is progress so marvelously exemplified as it is in our own country where, within the span of a single human life, an almost unlimited acreage has yeilded to cultivation, beautiful cities by the hundreds have sprung into existence as if by magic, and an industrial development has taken place such as never before has been equalled in the history of the world.

Narrowing down our range of observation, we find that the greatest development is embraced within the period of twenty-four years from 1880 to 1904 (latest available data), during which period the wealth of the nation increased from forty-two billion to one hundred and

seven billion dollars, deposits in savings banks - most reliable barometer of national thrift - increased in a ratio twice as great, and public debt decreased from substantially two billion dollars to less than one billion dollars.

Now we are entirely too practical to harbor the thought that all this just naturally happened. We know, for instance, that no new sources of wealth have been created during this period, but simply that existing resources have been developed; and when we find that railroad mileage has increased in almost exact ratio with the increase in national wealth, we cannot escape the conviction that a very close relationship must exist between these two conditions.

In the retrospect, it seems impossible that these conditions should not be hightly satisfactory; and, in viewing the matter abstractly, one might wonder what the railroad problem really is -- why all this confusion, this threatened confiscation of property, the abuses, criticisms and restraints heaped upon and thrown about the railroads at an ultimate expense so great to the people. It is indeed very difficult to believe that the conditions under which these marvelous results have been produced could possibly be so radically wrong as we are led to believe.

Other nations, in adopting our representative form of government, believing that it contains the secret of national success, unconsciously and sometimes unwittingly

affirm the desirability of the results which we have materialized thereunder. In dealing with the Irish home-rule bill, the British Parliament, with profuse and critical reference to the American Constitution, voices its humble endorsement of the principles of our government. The overthrow of the ancient Chinese dynasty and the acceptance of the principles of American representative government, is a most gratifying acknowledgment of the superiority of our form of government.

The real crux of this whole proposition is the industrial, the commercial, and the financial prestige which it has been possible to develop under our form of government. Yet we ourselves profess to be greatly displeased - not only with the results accomplished, but also with the instrumentalities with which they were accomplished; and we have therefore undertaken to revolutionize our form of government in so far as it relates to these agencies of progress.

However, in enjoying the splendid results which actually have been materialized under the conditions which have prevailed, one can scarcely believe that there possibly could be anything so seriously wrong with the railroads themselves, nor with the primary conditions under which the railroads have been operated; not that governmental control is undesirable to the railroads, for in fact it is highly desirable when properly exercised, but this sixteen billion dollar institution of the railroads, erected almost entirely

by private subscription, is a national asset of far too great an economic value to be meddled with indiscriminately, or to be hampered by ill-advised legislation which caters to public prejudice and thrives upon public credulity and public passiveness. The truth of the matter is, the public has not yet been brought face to face with the really serious condition of affairs that actually exists, nor to a realization of the dominant fact that the public, regardless of the actual investment of not a single dollar in American railroad properties, collectively holds the controlling interest in these railroads and accordingly enjoys the greatest dividend returns.

Touching upon this phase of the situation, Professor Hadley of Yale recently made this statement; "I am afraid that neither the public nor the Government is awake to the real state of things. In our endeavors to control corporations, we too often try to lessen their efficiency - instead of increasing it. We are appalled by a railway accident, and we suggest that every engine should have two engineers instead of one. A fast train runs off the track, and a government officer suggests that the people ought not to want to travel so fast. If these views prevail, the day of America's greatness is done."

The railroads of America have been constructed almost exclusively by private capital. They are operated under charters binding them to the performance of certain public duties. Therefore the number of individuals involved

in the financial undertakings is considerably less than the number of individuals indirectly involved -- that is, either by employment or through public service rendered. Consequently, under the provisions of their charters, the owning interests constitute the minority in the regulation and control of the railroads by popular government.

Under these conditions, the opportunity for personal aggrandizement is oftentimes too alluring to be denied, and in the absence of a keen sense of realization of the responsibilities devolving upon the public, the absurdity prevails that the railroads are autocratic, and that they are sharing entirely too liberally in general prosperity.

The fact of the matter is that the railroads have long since realized an important truth which the general public has not yet learned; that is - that the interests of the railroads cannot be advanced without a healthy development of industrial and commercial possibilities; that these two factors constitute a two-horse team - when they pull together, public welfare is advanced, but when one of these factors is held in rigid restraint and the other eagerly urged forward, progress is simply impossible, if indeed this condition of affairs does not portend serious calamity.

Aside from this, aside from the relative strength in the matter of regulation and control, there is an equity in this case; and if, through any possible technicality of our constitutional law, this equity be denied, the day of America's greatness will indeed be done.

While enjoying the fruits of prosperity, the public - that is, those not directly interested in the finances of railroad properties - while depreciating the values and hampering the service of the railroads, seem to place a great abiding confidence in the stability of other values. As a matter of fact, the railroads being the chief instrumentality in creating such other values, still constitute the real value underlying such other values. If, for example, the railroads should be withdrawn, these artificial or contingent values would quickly collapse; and in the exact proportion that the railroads are withdrawn, through inefficient or inadequate service, such other values shall certainly depreciate.

There are amongst us people who entertain a consoling faith in the belief that the railroads will always be with us; and that about the worst that could possibly happen would be receiverships and reorganizations; and that receiverships and reorganizations are not altogether undesirable -- in fact, they might prove a very good solution for some of our alleged ailments; and that inherent values could not possibly suffer on that account. Reflection, however, suggests that they are reckoning without their host - confidence. Confidence is the greatest element of value that ever has or ever will be created. Destroy it, and all is lost.

When the original founders of American railroads - men of great wealth and men who understood the proper uses

of great wealth - undertook their chief constructive work, they placed absolute confidence in the honor of the American people, in the integrity of their government, and in the stability of their institutions -- whether these institutions be public, quasi-public or private, they did not stop to consider. They scarcely could have hoped for adequate financial returns within the narrowing scope of their declining years, but they were farseeing men. With the memories of bloody battle-fields still fresh in their minds - men fighting valiantly for the cause of their country - they saw their duty and neither luxuriant ease nor the threatening dangers of their large undertakings could swerve them from it.

Have we in so short a space of time forgotten our legacy and all that it represents! Have we forgotten that we ourselves have certain imperative duties to perform in preserving the honor of our country which our forefathers defended with their lives! Have our splendid public schools, our colleges and our universities, already defeated the very ends for which they were created!

When we stop to consider the precarious situation of the railroads - the very values which underlie our government bonds themselves, the endowment values upon which have been constructed public institutions without number, the foundation and the buttress of our national strength and our national greatness, serious doubt arises.

In our own Declaration of Independence, you will doubtless recall this section:

"Prudence, indeed, will dictate that governments long established should not be changed for light and transient causes; and accordingly all experience hath shown that mankind are more disposed to suffer, while evils are sufferable, than to right themselves by abolishing the forms to which they are accustomed."

Prudence, indeed, should dictate that governments and forms of governments, long established should not be changed for light and transient causes. The terms "light and transient" are relative terms, necessarily; and when we consider the marvelous wealth which has been developed and accumulated in this country within the past thirty years, and our enviable position among the nations of the world today, one wonders how he should classify the causes which have brought down upon the railroads the awful avalanche of restrictive legislation.

"Experience hath shown that mankind are more disposed to suffer, while evils are sufferable, than to right themselves by abolishing the forms to which they are accustomed".

But the question is, how much more radical legislation will be required to convince the people that the situation is fast becoming insufferable? In plain words, how much longer are the people going to stand for this revolutionary state of affairs? Are they so blinded by

prejudice that they cannot, or rather will not see the error of their way until it will be too late? Passing years will prove convincingly whether "Prudence" indeed has been consulted in our present legislative functions. Already indications are becoming apparent to the trained eye that something is wrong. Railroad securities, our letters of credit abroad and incidentally the strongest national defense that any nation ever erected, are being returned to us under protest and subject to severe discounts which we ourselves are imposing. Again I ask the question, has Prudence been consulted and is Confidence protected as you want it protected?

Are we not even now changing a form of government long enough established to produce a wealth of ONE HUNDRED BILLION DOLLARS in substantially forty years and place us in the foremost ranks of all the nations of the world? And are not these changes due to "light and transient causes" in the intended and accepted sense of the expression? In plain words, are we not "killing the goose that laid the golden egg"?

That there were certain abuses of privilege in the early days of pioneering, is not denied; nor should this be the cause of undue wonderment as they were relatively very insignificant indeed compared with the marvelous prosperity which actually has been realized. These abuses are now far beyond recall, and the possibility of their recurrence is entirely removed.

The duties of the railroads to the public have not been shirked. Our rates for service are lower - much lower than any other country in the world, and we pay higher salaries and wages than any other country in the world. In the matter of passenger rates and facilities for travel, the railroads themselves are anxious that they shall be as low and adequate as possible consistent with proper business methods; they are factors which stimulate travel, and travel is a wonderful educator. The more intelligent a community becomes through travel and kindred influences, the quicker it will perceive and avail itself of opportunities for betterment and development, thus automatically creating the industrial, commercial and financial ganglions - those little centers which we see on the railroad map from which the sensitive nerves of the nation radiate.

Reasonably low freight rates, also are desirable to the railroads, because they are are conducive of larger development and greater expansion. Naturally freight rates must be sufficiently low to protect the industries located along a railroad; sufficiently low not to invite too much competition-- an economic condition that answers its own question automatically. Just as naturally, freight rates must be high enough to protect the railroad, but this side of the question appears to require legislative action for some reason or other, although it must be apparent to all that very desirable results have accrued under the conditions where freight and passenger rates were automatically

adjusted by conditions of railroad operation, sensed and heeded by the railroads themselves. These results would seem to indicate that the less tampering with these finely poised economic conditions through arbitrary legislative enactment, the better for the public good.

A railroad plant is not totally unlike any other kind of a plant. It is an organic structure which is supposed to grow, and it thrives best under cultivation. But who would think, for instance, that he could raise more wheat to the acre by heaping upon productive fields, all sorts of rubbish that prejudice could conceive, and in addition thereto, passing the laws that the kernels shall be larger and the stalks shorter! This seems very much like an absurdity, but I ask you in all sincereity, is it not a pertinent analogy?

Shorn of its many bewildering absurdities, this is the real railroad problem of today, a condition which actually exists. It is illegitimate of birth, destructive in its tendencies, and is wholly unworthy of the support of the public. It is a dire danger stalking amongst us in the purloined cloak of public approval, alongside which the yellow peril, leering over our western border like a threatening jack-in-the-box, presents an amusing diversion, critical though the situation may be.

To those of us who have enjoyed the splendid beneficence of Providence to partake of the choicest fruits of prosperity as expressed in such excellent institutions as

this University of Illinois, an imperative duty is manifest. For patriotic reasons, if not for reasons of protecting personal property rights and property values, it is the duty of the coming generation to accept the responsibilities which soon shall be theirs by inheritance, and transmit them on to posterity in a more acceptable form. And in offering you the armor of fact and the sword of truth, I feel a thrill of hope and a sense of pride in bidding you godspeed on the field of battle, for the conflict is none the less real, the cause none the less just, and the victory none the less glorious because it is intellectual.

THE CHAIRMAN: The next speaker, who will talk to us on Modern Problems of the Electric Railway, needs no introduction to any one in this audience, I am sure. I have great pleasure in introducing, however, Mr. William B. McKinley, President of the Illinois Traction System.

MR. McKINLEY: Mr. Chairman, Ladies and Gentlemen,- As a citizen of Champaign, where I have lived practically all my life, it is a pleasure to me today to see the men distinguished in other lines here, taking an interest in the dedication of these new buildings and taking an interest in the University. I attended school here in the early days of the University, but as I come over here from time to time, from month to month, every time I come I am impressed with the growth and development of this University.

I was very glad indeed to hear the few words that Mr. Worthington spoke in appreciation of Dean Goss. We know it is all true. I have at different times heard railroad men speak of him and say of him that there was a professor -- you know we practical people call you all professors -- there was a professor that had good common sense and that they could all get along with. (Laughter and applause.) As a resident here and man that knows these men, I want to say of President James and Dean Goss -- we are now just talking of the engineering side -- I have found both those men not only having plenty of intellect and Dean Goss having plenty of ability, but they also have good common sense and know how to get along with us fellows that have not the intellect. (Laughter).

I have been in the electrical business for very nearly twenty-five years; I got into it because I liked to see the wheels go round. I have worked along with it, and, as you all know, both electric railways, and particularly interurban railroads, have simply just "growed" like Topsy. It never occurred to me that a paper was due from them, and I will assure you that this paper that I will read today is quite inoffensive, and it is Dean Goss' fault and not mine.

(See next page for address)

MODERN PROBLEMS OF ELECTRIC RAILWAYS.

By Mr. W. B. McKinley, President,
Illinois Traction System, Champaign, Illinois.

I am asked this morning to take up ten minutes in speaking of the "Modern Problems of Electric Railways". Every day brings problems, each more modern than the one preceding, and as one of my friends suggests, "If it isn't one thing, it's two".

The electric railway is a modern institution. Its development has been within the last decade, and practically all of its problems are modern ones. The trail had to be blazed and the experiences and troubles of our big brothers, the steam roads, offered little in the way of guidance. My experience in the electric railway world has been literally from the ground up, and in the early days many an unsolved problem accompanied me to bed.

The problems of one road are often those of another. To speak of a concrete example, let us consider the Illinois Traction System, of which I have the honor to be President, and which I have had the pleasure of financing, constructing, operating, and also of watching its successful development. This System now comprises over five hundred miles which have been unfolded from the construction of six miles from Danville to Westville in 1901. In the financing, building and placing of the lines upon an operating basis, many problems

have arisen, but the most important seem to fall into five groups.

Some fourteen or fifteen years ago I saw the possibilities of electric railroads, and my attention was directed to them from the operation of city lines. This brought up the first and very highly important question of financing. It was necessary to convince capital that the new and practically untried form of investment would be profitable. Before even the preliminary survey is undertaken provision must have been made for ample capital to carry on the work. The readiness with which money lends itself to any new project depends upon the prospects represented to investors for a reasonable return upon their investment, and the future stability of the enterprise.

Capital having been interested, the next important step is to secure legislation to enable the roads to be built and operated; and also to prevent unfair legislation when the road is in actual operation.

By "unfair" I mean legislation brought about by "destructive criticism". Burdensome restrictions may be imposed, under which electric railways are unable to maintain the proper relations between earnings and expenses, resulting in loss to investors, and, as a consequence, inferior service. "Constructive" criticism is a help to any company. In order to accomplish its duty of furnishing the public with the service for which it was constructed it became necessary

to ask for favorable laws, both from the state and the cities and towns through which it passed. This brings up the question of franchises, which is a vital problem to all electric lines. In order to properly serve the cities along its lines it is necessary that the cars of the company pass through or enter the business districts. Permission must be requested and franchises secured that will be fair to the public and to the investors. It is a mutual service, and where this feeling of mutual benefit exists, franchises are granted that properly safeguard the rights of the people, and at the same time, do not hamper the development of an electric railway service that often brings prosperity to the city which it enters.

The third big problem is the securing of proper operating executives. There are probably fifteen million boys in the United States at the present time busily engaged in becoming "Ty"Cobbs, "Christy" Mathewsons, or "Jake" Stahls, and of this number probably a dozen will succeed in their ambitions. Managers of large enterprises have discovered that the perfect executive is a very scarce article. It is the continual struggle of any one building up a large organization to secure men who have the executive ability to "Hit the ball" in their respective positions, as well as the willingness to make good.

The success or failure of any enterprise in great measure depends upon the men upon whose shoulders fall the burdens of operation. It has been said that every institu-

tion is but the shadow of some man, and this is true in all departments of business as well as in all the various divisions of electric railroad work. Trained men must be found; men not only with training but with the ability to think, to plan, and with the executive ability to carry out their own plans and those of their superiors. The investors in the securities of any electric railway can well rest easy when they know that the affairs of their property, in all its branches, are in capable, competent hands.

The fourth problem, as important as the securing of executive ability, is that of labor. Work must be done and men must do it. And on the feeling of mutual benefit and personal interest much depends. There is a great distinction between a "co-worker" instead of an employee. And in order to make men consider themselves as co-workers they must be so treated. It is a big problem to secure good men, keep them satisfied, arouse in them a personal interest in their work, and to inspire them with the feeling that by doing their best for the organization they are also subserving their own interests.

To bring about these conditions requires consideration, tact and good judgment on the part of the superintendent in charge. To my mind this problem is worked out most successfully by consideration for the individual man and his welfare.

We have been able to maintain the best of feeling among our 3500 employees by keeping in close touch with

them. The courteous manners, splendid appearance, loyalty and interest of the men on the Illinois Traction is one of the most noticeable features of the System, and the one first commented upon by all visitors.

We unite with our men and assist them in their clubs, mutual aid societies, our Hospital Association and Death Benefit Association. The affairs of these organizations are conducted by trustees elected by the men and they have proved successful in every way.

And last, but most important, is the problem of operating the property in a manner that will return a reasonable profit to the Company, and give the maximum convenience and service to the public. My experience leads me to feel that the strong efforts of every man connected with the operation of electric railways should be to convince the public of the mutual interests of the people and the Company. In this lies success to one and service to the other. The relations existing between an electric railway and the communities which it serves are very closely united, and on these relations depends in great measure the success of the undertaking. The frequency of the service, the convenience to the farmer in having the cars stop at his highway crossings, the familiarity which the patrons have with the organization, caused by daily use - all these things go to make the electric line a home institution. The modern electric railway is one of the most progressive agencies in any

community. All it asks is fair play, honest criticism, and the opportunity to assure its splendid service by making a reasonable profit.

These are the big problems. There are thousands of others that must be met to insure success. Each succeeding day brings more and more. But as time goes on, the constant overcoming of difficulties makes for progress. Electric railways have been proved a success, but who can say what the future holds. Given time to improve, to master the problems of every day operation, they bid fair to become a more and more important factor in the world's transportation. And prosperity and progress follow the arteries of transportation. As electric railways grow and as the map becomes more and more criss-crossed by the red lines showing their growth, these easy and practical means of communication will effect a great social and economic change in bringing about a closer relationship between city and country, and will bind closer with steel rails the friendships and business relations of state-wide communities.

THE CHAIRMAN: We were to have heard on the third topic from Mr. Charles B. Moore, Vice-President, Jacobs-Schupert United States Firebox Company. I am sorry to say Mr. Moore has been unable to be present.

The next speaker who will speak to us on the same subject, "Modern Problems of the Manufacturer," is a man who used to belong to Illinois, used to be with the Chicago and Northwestern Railroad, who is known to most of the students as the author of the text-book on "Locomotive Operation," who is now consulting engineer of the Baldwin Locomotive Works, Mr. George R. Henderson.

Mr. President, Ladies and Gentlemen: It is a great pleasure for me to be here today before this assembly, and especially to see right in front of me one of my old friends, Mr. Quayle, with the emphasis not on the "old." Mr. Quayle was the one who first induced me to come to Illinois, and if it had not been for him I probably would not have been here today. Professor Goss is another one of my friends in the same category, with whom I worked many years ago at Purdue University on the testing plant, and it is a great pleasure to see him here today also. There have also been several others that I have met for the first time today, as Mr. Worthington has said, with whom, although not knowing them, I have yet been in communication for years, so it is doubly a pleasure, and triply a pleasure, to be here today.

Before I start with the small amount of infliction which I intend to impose upon you, I merely want to refer to a point that Mr. Worthington mentioned in his paper, and that was about the question of charges of American railroads as compared with foreign ones, and I thought it might possibly be of interest to you to have one or two exact examples. Several years ago I was in Europe and I had occasion to go from London to Paris, and found that the lowest rate at which I could get a first class ticket was 50 shillings, $12.50, the distance being about 250 miles. If you should travel on almost any railroad of any size in this country and get the best Pullman accommodations, the cost would be just about one half, it probably would be $5 for the railroad ticket and $1.25 for the Pullman. That is just one half of what they pay in Europe.

Take another train, the Sud Express between Paris and Madrid; The distance is almost identical with that between New York and Chicago, I believe one is 908 miles and the other 907. By the special schedule that was in force some time ago the time between New York and Chicago was eighteen hours, and the cost, if you would consider your sleeping car accommodations and meals, about $32 for the trip. The time of the Sud Express, Madrid to Paris, is 25 1/2 hours, and the cost on the same basis would be about $68. So we have two pretty good examples of the high cost of railroading in this country.

Mr. Chairman, when this subject was given me of the problems of the manufacturer, it seemed to me that we might take a few moments to consider one of the problems, and that is, the power.

Those of you who heard Mr. Insull last night were no doubt convinced that the only thing to do is to buy power. I had a talk of that kind with him about a month ago, and I do not think he has changed his opinion since then.

I should like to emphasize the fact for the benefit of students, that in any case of this kind, of course this is true in all mechanical problems, but particularly in the application of power of the various kinds, whether to be produced or manufactured, or what kind of power we are to use, every individual case must be studied on its own basis and in its own environment. We cannot say because a certain kind of power is good in one establishment that it is necessarily good or best in another. As an illustration, I remember a few years ago when some of the electrical experts were quite enthusiastic over the subject of electrifying steam lines, and some of them started out to base their figures on the cost of operation of the elevated railways in New York, and on the basis of those figures attempted to show a possible enormous saving in operation of lines out here in the western part of the country, hauling stock through the agricultural districts, and they were working upon figures obtained on the New York elevated. Of

course, that was absolutely preposterous, but it merely serves to show that every case must be studied by itself, and I do not think we can take any one case and say because such and such operation was perfectly satisfactory, from an economical standpoint, it will be so in every other case. Mechanically that is probably true, but when we come to the financial point, and that is a point that must be considered in all its bearings, because we cannot afford to put up a mechanical contrivance that is not an economical proposition, it is absolutely necessary that a proposition of this kind must be studied in its entirety and in its own environment.

MODERN PROBLEMS OF THE MANUFACTURER, POWER

By Mr. George R. Henderson, Consulting Engineer,
Baldwin Locomotive Works, Philadelphia, Pennsylvania.

It has been said that "Knowledge is Power", but both Knowledge and Power are required to operate to advantage a modern manufacturing plant, and one is verily as important as the other.

Few such plants can be located so near to natural sources of power that a careful consideration of this question may be eliminated. The burning question is often whether to buy power or produce it, or if the former be impracticable, how shall the power be produced and transmitted. The same question often arises with plants already in operation and where electric power has later been produced and distributed in the neighborhood of such plant, and it is frequently more difficult to form a correct decision in the latter case than in the former; but on the other hand when the plant is already existent we have definite knowledge of the consumption of power, light, heat and other necessaries which, with a new plant must be eliminated.

When a new factory is to be built all the different kinds of power, heating, light, compressed air, water pressure etc., must be carefully computed and studied in order to determine what can be purchased with advantage and what

must be supplied by the manufacturer. If heat be a necessary part of the process of manufacture and low pressure steam will answer the purpose, and moreover, if the quantity of heat and power are in the proper proportion the one to the other, the power can be obtained at small cost by reducing the steam from the boilers to the operating pressure by means of a non-condensing engine. In this case only interest, depreciation and repairs need be charged against the power (with some supervision), as it takes practically no more fuel to generate the steam, first passing through the engine, than it would if it is only required to do the heating.

In other cases steam must be used at high pressures, as in steam hammers, and here the exhaust steam can be passed through low pressure turbines after being used in the hammers and a large quantity of power extracted from this waste product, the amount of course, depending upon the number, size and use of the hammers. In this case the cost of such power will be only the charges above enumerated, as there will be no additional fuel needed, provided that there is sufficient exhaust steam to furnish the necessary power. Under such circumstances as these it is impossible for a public service corporation to supply power at an attractive figure.

There are, however, many factories where these conditions do not apply and where the owner would be glad to save the capital investment and charges of an expensive power plant, and the smaller the installation the more

attractive will be the proposition to purchase power, especially if the requirements be such that they can be made to fill the "valleys" of the station load diagram, and so obtain a correspondingly lower charge per kilowatt-hour.

In existing plants where the original charges must still be carried, it will be more difficult to demonstrate a saving, but often the engine attendance, handling of coal and ashes, and the operation of boilers will constitute a cost great enough to make the purchase of power attractive, although each case must be considered on its own merits and the enthusiasm of electrical engineers must not be allowed to get the better of good judgment, which, if it did, would almost invariably result in economic failure. In these cases, Knowledge is more than Power.

Then we sometimes have a condition where waste gases can be utilized, as from coke ovens and blast furnaces, in which case we must decide between gas engines and gas fired boilers, or possibly coal fired boilers. The high fixed charges attendant upon an installation of gas engines sometimes throw the economic balance in favor of the steam boiler and engine, but here also each case must be considered on its individual merits and surroundings.

The rapidly advancing price of oil deprives that material of its rights to recognition as a power producing fuel, except in certain localities, although for some metallurgical operations it is invaluable. The fluctuation in price is as great a detriment to its use as a fuel as the

high figure to which it has recently attained.

Sometimes the proximity of dwellings makes considerations other than economy of prime importance. This has been given great prominence lately in the desire of certain large cities to eliminate smoke. If the desire to "clean up" a city really exists, why attack the railroads which, at the worst, do not ordinarily make over 25% of the smoke, and leave the small offenders free, such as the heating furnaces in houses which, though small individually, are great collectively, and moreover, commit their smoke offences in the heart of the residence district. Why should not the whole question be studied systematically and thoroughly and plans prepared which would prohibit any coal being burned in the city, except under municipal control in approved smokeless furnaces? Heat could be distributed from central stations operated by the municipality; gas could be used for cooking and electricity for light and power, even if it were brought from power plants located near the mines where refuse coal could be obtained at low cost. This would make a city really smokeless and the burden would come upon all the citizens and not upon a few selected industries alone. It might require fifty or even one hundred years to accomplish this transformation to "Spotless Town" in the case of a large city; but it is the only way in which the real abolition of smoke can be accomplished, and it certainly seems worthy of careful consideration by municipal authorities.

THE TECHNICAL SOCIETY AS AN INFLUENCE IN EDUCATION.

By Mr. Albert Reichmann, President,
Western Society of Engineers, Chicago, Illinois.

Your Dean in Engineering has conferred upon the speaker the honor of asking him to address you, and has suggested that he choose for his subject, "The Technical Society as an Influence in Education".

Applying myself at once to the subject may I remind you that the development of any single industry invariably results in the development of other industries which spring therefrom until the ramifications are so extensive as to be almost inconceivable. For example: the advent of the steam locomotive immediately quickened development in the manufacture of iron and steel far beyond the conception of even the most optimistic. This was followed immediately by great activity in the development of the sciences of telegraphing, signalling, and interlocking. It also made possible, and indeed created the conditions which were responsible for the development of modern bridges, grain elevators and other storage plants.

These in turn necessitated the development of industrial and commercial centers to a degree before unknown in history, and following or accompanying this development of the industrial centers came the study and development of such enterprises as municipal water supply,

lighting, and urban and interurban transportation.

It must further be evident that the development of these various lines of industry and commerce called for the employment of men of constructive genius. Now the ordinary artisan with his necessarily limited education was not capable of performing the required tasks, and it became apparent that to successfully cope with all the various problems entailed it was necessary that men should be especially trained, and it was this, undoubtedly, which led to the development of the technical schools; schools which should furnish the means whereby the embryo engineer might form the foundation upon which to build his future success.

Engineering, however, is not an exact science. Therefore, to be proficient an engineer must have in addition to his theoretical training the requisite amount of practice and experience. The training that an engineer receives at a University is so broad that to a limited degree it enables him to commence the practice of almost any branch of his profession. But so very broad is the field of Engineering and so keen the competition in every line that in order to excel, an engineer must choose a comparatively narrow field of activity. The progress of the world is so rapid, the field of human achievement so complicated that a man must be unusually able in order to anywhere near keep step with the onward march of events.

An engineer, therefore, must specialize along certain specific lines if he hopes to attain success; he must not only give the best that is in him to his immediate calling, but he must also study and observe the relation of his work to that of the other lines which have a bearing thereon. For instance: the expert in the construction and maintenance of railroad track should not only master the subject of track construction, but he must also watch the developments that are taking place in the motors and the rolling stock which pass over the road. The man who designs an engine must know absolutely the uses to which that engine is to be put. We have a notable example of this in connection with the development of the steam engine. After it was generally believed that this machine had attained its maximum efficiency it was found that it was not suitable for generating electricity, and as a result the steam turbine was evolved.

It is very evident, therefore, that an engineer in order to be successful cannot be a recluse. He must associate with his fellow engineers. Now he can best secure such association through the technical societies. The meeting of engineers under conditions where all are on a common footing fosters a spirit of kindly co-operation and helpfulness which binds them together and makes each of greater usefulness to the other. It is only by wide co-operation that the best advancement can be made in engineering science and achievement.

As in the legal profession the decisions of the judges are entered and published, thus forming a basis of precedent for future use, so also it is desirable that records of important engineering work should be published in order that we may benefit by the experience of others. Many of the larger engineering undertakings are the result of the co-operation of several engineers who are proficient in their respective fields. It is, of course, customary to have a chief engineer at the head of any important enterprise, nevertheless, the work which he supervises is usually the product not of himself alone but of those also who are associated with him. If frequently happens that on large undertakings experts in various lines of the work are employed and the duty of the chief then consists in determining the general scope of the work, - the special features being developed by these experts in their respective lines. For example: the building of a large steel plant requires expert metallurgical engineers, electrical engineers, mechanical engineers and structural engineers. It is manifest then that as the work becomes of great magnitude it is most important that accurate records of the same should be made available. Those records can best be promulgated through the proceedings of Technical Societies.

Such published proceedings find their way around the world and furnish material to the Universities whereby recruits may be trained to successfully solve the problems of the day.

The literature published by the Technical Societies keeps the student abreast of the times; familiarizing him with the large problems with which engineers have to cope; and putting him in touch with the opinions and investigations of professional engineers who have devoted their lives to the development and progress in some special branch of engineering. The articles carefully read will be of great value to the student in solving his own problems in after life.

Technical Societies also afford the younger engineers the opportunity of securing the experience of older engineers, resulting from the fact that they are permitted to participate on an even footing in the discussion of the papers presented.

The older engineers should and generally do take great interest in the work of the student engineers, and the latter may greatly profit thereby.

The influence of the Technical Society and its value to the professional engineer is probably even greater than to the student. The practicing engineer is no longer under the guidance of professors and instructors and his opinions and development of ideas must be largely molded by those with whom he associates.

To be well educated involves not merely the mastery of knowledge, statistics and current events, but must also embody the broadmindedness which can see the justice and good sense of the other fellow's opinions and beliefs.

A comprehensive judgment of various views and solutions is only possible through the assimilation of ideas and associations such as an engineering society offers.

In the Technical Societies the various steps of mechanical development are depicted both from the practical and theoretical standpoint. They afford the engineer an opportunity to supplement his own knowledge by the experience of his fellow engineers. They afford him the opportunity to present to the world what he himself has accomplished and to receive criticisms and suggestions from his fellow men. Growing out of the discussion of the various subjects which are presented the engineer learns to appreciate the benefits of co-operation, which often means a benefit to all concerned.

THE CHAIRMAN: Mr. Crawford, who was to speak to us on the next topic, "The Changing Character of the Problems of the Railroad," is unable to be with us. I should like to read a letter which has been received from him:

PENNSYLVANIA LINES
West of Pittsburgh
General Office, Pennsylvania Station

Pittsburgh, Pa.
May 5, 1913

Dear Professor Goss:-

I now find it will be impossible for me to join you in the dedication of your Transportation Buildings at Urbana on the ninth. I regret this very much indeed as it would give me great pleasure to accept your courteous invitation. I wish to extend to the University, to you and your assistants, my hearty congratulations upon the completion of this very important part of your equipment, as I am sure it will permit of the accomplishment of much work which will be useful to all of the people.

Yours very truly,

(signed) D. F. Crawford

Professor W.F.M.Goss
University of Illinois
Urbana, Illinois

THE CHAIRMAN: The next speaker on this topic is the Superintendent of the Car Department of the Chicago-Northwestern Road and President of the Western Railway Club, Mr. T. H. Goodnow.

MR. GOODNOW: Mr. President and Students of the University, and Visitors, - Having been assigned the subject that is on the program, I am considerably handicapped on account of two other speakers being assigned to the same subject, and not knowing what they were going to say, did not know how to shape my own in. I feel that this meeting has lost a very capable speaker in not having Mr. Crawford with you, and I feel that he would be able to handle the subject very much better than I will be able to.

(For address see next page)

THE CHANGING CHARACTER OF THE PROBLEMS OF THE RAILROAD.

By Mr. T. H. Goodnow, President,
Western Railway Club, Chicago, Illinois.

I esteem it an honor, and I assure you it is a pleasure and a privilege to be with you on this occasion, and it would afford me a very great deal of pleasure to be able to address you in such a manner as to be entertaining, as well as instructive, but I am afraid that I may fall far short in my efforts and anxiety to do so. In the limited time alloted to me to address you, I will endeavor to give you briefly my experiences in the Mechanical Department of the Railroad, and to express my gratification at meeting with so large a number of young men, whose faces bear the unmistakable mark of American Citizenship.

It is you and your boys who must be the future industrial makers and builders of the railroads and commercial interests of the country through the mechanical pursuits and industries along the lines you may follow.

It is especially gratifying to me to know that there is so large a number of American boys who realize the necessity of a technical education, a privilege denied to many of the men who are today the leaders in the important mechanical pursuits of this country, and who have mechanical instincts bred within them. You, who are of a

mechanical turn of mind, which combined with the education which you are here acquiring, should make giant builders of the industrial pursuits of this country, which has been blest so abundantly in being provided with raw materials of all kinds to produce the manufactured articles necessary to the welfare and happiness of us as a people.

Your Dean and Director, Dr. Goss, has assigned to me the subject of "The Changing Character of the Problems of the Railroad", but for what reason I do not know, as I have never been called upon before to deliver an address when the subject which has been assigned, and it is considerable of a task for a man not accustomed to such occasions to concentrate his thought along such lines as will be interesting and instructive, so that I can only speak to you of the progress that has been made in the science of railroads, especially along the car lines in which I have been specially employed for the past quarter of a century.

A quarter of a century ago, the freight equipment cars of the country were constructed small in size, light in weight, carrying from 28,000 to 40,000 pounds each. Few, if any safety appliances were provided for the protection of those handling cars in the yard and train service. Hand brakes were the only means of controlling cars in motion. Trucks were of light construction, having axles with 3-1/2" x 6" journals, and the wheels were small in diameter and light in weight. At that period, cars were made up in trains whose tonnage was from 400 to 600 tons, and speed was

correspondingly slow as compared with present day requirements.

Today, the cars have been enlarged, lengthened and strengthened; their carrying capacity has been increased to 80, 90, and 100,000 pounds each, and we are now building cars to carry as much as 150,000 pounds of special commodities. Specialties of every description are provided for the improvement of the car, both from a loading and service standpoint. They are being fully equipped according to the Federal Laws with Safety Appliances for the protection of trainmen and yardmen.

The draft gear arrangement has been developed so as to absorb the heavy blows that the equipment is compelled to stand in ordinary handling in switching trains under modern railroad methods. Trucks have been increased correspondingly, having axles with journals up to 5 1/2" x 10" and 6" x 11", and, under the increased size and weight of car and trucks, has followed changes with the cast iron wheel, increasing its weight and contour of tread and flange to the limits of track conditions, which the cast iron wheel makers have been fully awake to the importance of producing. We have also witnessed the introduction of the all steel wheel of several different types, and the combination steel-tired wheel, with iron or steel center, which is being used with a greater or less degree of success. Practically all cars are now equipped with air brakes, which has made possible the running of freight trains at speeds that were not attempted

with passenger trains a few years back, and, at the same time, these trains represent a gross tonnage of from 2000 to 4000 tons or more per train.

Likewise, the same change has been brought about with the passenger equipment. Only a few years back this class of equipment was built entirely of wood, light of weight, and stove-heated. Oil lamps were used for lighting. Today these cars, which were marvels a few years ago, are not considered satisfactory for even branch service in the back-woods. In their place, we have the solid vestibuled, all steel passenger equipment, steam heated, electric lighted, dining car service, barber shops and bath room, and, in fact, all of the conveniences of modern times. These cars, in trains of 10 to 12 or more, rush across the country at speeds of a mile a minute or better, under the control of the engineer through modern air brake apparatus, making it possible for him to completely control the momentum of his train and stop at will.

The past decade also has been one of changing conditions as regards the employment of labor by the railroads. The various organizations have had their influence, and have had to be met and dealt with by the heads of mechanical departments. Today there is a lack of the right sort of young men entering the shops of the railroad, and more and more is it becoming necessary to depend upon the foreign immigrant to fill the need for employes of all crafts.

The educating and handling of the employes, has become a great problem, and promises to become even more important in the near future. The increased carrying capacity and speeds demanded, will require entirely new methods and designs to be employed by the railroads. I hope many of you young men will find your way into the service, and it will be you, young men, who will have to insugurate these new systems, establish the new organizations, design the new cars, and meet the new problems which are to be solved. All of these changes must be worked out along the lines of a reduction in the freight rate, thereby increasing the market value to the man who produces the freight, cheapening the cost to the man who consumes it, which will add the greatest degree of success in the development of this land of ours, where have been brought together the nations, the creeds and colors of all the world. Among the generations to come will be found the American boy who will be able to solve the secrets of the elements and utilize them for the success and prosperity of this nation.

THE CHAIRMAN: The next topic is, "Proper Aims in Training for Railway Service." It is especially fitting that we could have with us the speaker who is to address us on this subject; for he is one of the men who was here at the conference two years ago when we began the process, the culmination of which we are celebrating today, Mr. H. G. Hetzler, President of the Chicago and Western Indiana Railway Company.

MR. HETZLER: Mr. Chairman, Students of the University of Illinois and Guests, - It was my pleasure to be present at the meeting our chairman spoke of, and I assure you that it is a very great pleasure for me to be here today to take this small part in the dedication of the Transportation Building, but before I do that I just want to add my testimony to President Worthington's and President McKinley's in regard to our good friend, Dean Goss. I have had the pleasure of working with him in the city, and I know him to be just the sort of fellow that he has been described here to you.

(For address see next page)

PROPER AIMS IN TRAINING FOR RAILWAY SERVICE.

By Mr. H. G. Hetzler, President,
Chicago & Western Indiana Railway Company, Chicago,
Illinois.

When Dean Goss asked me to present "The Proper Aims in Training for Railway Service", the thought occurred to me that it would be comparatively easy to point out a few particular aims that a young man should have in entering this service. But after considering the subject, and I have been in railway service a number of years, the particular aims above others that one should have are not easily discerned. To be successful in any line of work requiring a technical education demands the same sort of diligent work, and the application of sound business principles. Therefore, I think it would be well to define in a general way, what goes to make up railway service.

Owing to the territory covered, the volume and variety of business handled, and the various conditions met with in building and operating a railroad, it is necessary to divide the service into a number of departments, such as Operating, Engineering, Accounting, etc., which are in turn divided into sub-departments. From this, it will be seen that in entering the service of a railroad, one must of necessity, become thoroughly acquainted with some one of these departments in order to be prepared to go forward satisfactorily with the work.

In deciding upon the kind of service that one will devote attention to, the aim should be, if possible, to select that which will be congenial, and for which the individual is seemingly best qualified, as it would be a mistake to choose for life's business a work that is distasteful, and into which it would be hard to throw one's best thought and energy. There is really no easy road to what is termed "Success". Advancing in railroad service is no exception to this rule. The work is exacting and sometimes discouraging; but I want to assure you that the field is a splendid one.

During the past few years the civil engineers have been busy studying methods and schemes to increase the effeciency of the railroads and at the same time reduce the cost of operation. Improvement has been made in many cases where lines have been relocated so as to reduce the grades and improve the alignment; terminals have been changed and enlarged so as to facilitate the movement of traffic through them. The mechanical engineer has been just as active, and splendid development has been wrought in motive power and car equipment.

The electrical and signal engineers, by their endeavors, have not only aided in efficiency, but have also to a marked degree increased the safety of operation. Nevertheless, the opportunities for the future engineer in the service are unbounded.

The development of our country will demand, in order to meet its requirements, the addition of thousands of miles of track, together with the equipment and facilities necessary to operate them. Laws and regulations have been and constantly are being imposed by state and nation upon railroads, which give rise to many new conditions.

The increase in population, with the consequent increase in the value of property, as in our growing cities, add their share to the difficulties encountered. These and many other conditions indicate that the engineer of the future should aim not only to be familiar with strictly engineering problems, but also to keep in touch with the desires of the public and endeavor to comply with them, and at the same time obtain the best results from a railroad standpoint.

Special attention should be paid to the less important duties that one would naturally be called upon to perform when entering the service. For example, if entering the maintenance of way department, special attention should be given to rail, switches, track layouts, maintenance and alignment of track, and to all the various details that go to make up the maintenance of way department of a railroad. In other words, one should be prepared to do the work that would naturally come to him, in such a way as to warrant the continuous assignment of more important duties.

From this it might be thought that the aim should be merely to do the small things well and not aspire to the

mastering of the more important problems. This is not true, but I simply want to carry home the fact that by successfully performing each duty as assigned, one will master the details of the department and become familiar with every phase of the work, and be in a position to become a leader in his chosen branch of the service.

As I have stated, the railroad service is made up of various departments, each differing from the other in its requirements. They are, however, so thoroughly dependent, one upon another, that if for any reason one department does not come up to the required standard the entire service is affected more or less by this weakness. Therefore, one should, in addition to being familiar with his own department, understand in a general way the requirements of the other departments, in order to thoroughly cooperate with and bring about the best results, not only for the railroad but for one's self. I can best illustrate this by a personal experience.

Some years ago I was employed in the maintenance of way department of a railroad when a vacancy occurred in another branch of the service which would have been a promotion for me if I had obtained the appointment. The superintendent, thinking that I might feel disappointed on account of not receiving the promotion, called me to his office and said he would have liked very much to give me the position; but, because I apparently had not been thinking of any department buy my own, he did not believe I

should be transferred to the other department. This certainly was a new viewpoint for me, and I immediately commenced to study not only my own work, but at the same time to become familiar with the work of the other departments, and I assure you that although I was disappointed at the time, the disappointment proved to be a benefit.

On entering the service of a railroad, one becomes a part of a large force of employes working in various occupations. It should be the aim to keep in such a frame of mind and thought as to enable one to work hand in hand with brother employes for the improvement of the service. One cannot advance materially in the service without becoming a leader of men, and to become a leader, one must not fail to co-operate with and hold the esteem of one's fellow workers.

A railroad being a public service institution, its prosperity (the same as an individual or business concern), depends to a large extent upon its standing in the community served. Therefore, the aim should be to serve the public in such a manner, if possible, as to warrant its approval.

As I have stated, it is difficult to point out the particular aims that apply more especially to railroad service than to other work, but I will feel that I have partially succeeded if you carry in mind those I have mentioned, which can be summarized as follows;

First. Endeavor to enter the service by choosing

the department that will be congenial and for which you feel best qualified.

Second. Keep in touch with the demands of the Public.

Third. Master the details of your chosen department and become familiar with the requirements of other departments.

Fourth. Co-operate with your fellow workmen and the public.

THE CHAIRMAN: Mr. W. L. Park, who was to speak to us on "Vocational Education in Connection with Railroad Work", cannot be with us, but has sent his address, which I will read.

(For address see next page)

VOCATIONAL EDUCATION IN CONNECTION WITH RAILROAD WORK.

By Mr. W. L. Park, Vice-President,
Illinois Central Railroad Company, Chicago, Illinois.

The dedication of a great temple to learning is no uncommon event, yet no human mind can fathom its possibilities, or the effect upon millions yet to be. To railroad men, as well as others, the contemplation of this magnificent edifice can only open to their minds a vague conception of the influence to be thrown out from here. The results to be achieved by those who will pass through the portals of this modern Transportation Building, equipped with that special knowledge which whets the appetite for the accomplishment of new things yet to be created, cannot be estimated. New methods that will herein be created will bestow upon mankind blessings that ever continue to burst from the fruits of progressive civilization.

The practice of a decade ago which confused our minds with its ingenuity, sinks today without comment into the common-place or is rejected as primitive. We have come to expect great things as a matter of course, and perhaps we have a right to do so, when we make the path of knowledge so attractive by our great institutions of investigation, research and accomplishment.

We, as railroad men can, without any great prophetic vision, discern something of that which will be the

fruit of this modern railroad school. Our experiences of the past teach us that there are yet many short cuts, not to perfection, perhaps, but to more economic methods of both supervision and practice, and that these improvements are essential to our progress and the prosperity of the nation, through the efficient and economical operation of our great railroads.

We fully realize that in many particulars the operation of our railroads is far short of that to be desired. As we grope into the mysteries of unworked problems, we learn of our deficiencies and are appalled at our shortcomings. - We have gone so fast in the formative periods of construction that we have lost sight of the refinements of the service.

The magnitude and ingenuity of the great progressive achievement of our railroads has been so wonderful, and the results so beneficial and far reaching, that we have, to a great extent, lost sight of the necessity of economizing; we must now take cognizance of the terrific waste and crude methods, and begin to apply scientific methods.

We must bring about a better system of activities before we have wasted our birthright of natural resources. This power of efficiency must come out of institutions of this character - with their equipment for experimentation and ability to explore the world for knowledge and to make it available to the student.

I would not deprecate in any way all that is intended by these great schools of special training. There are too few of them and those that do exist are frequently restricted in their accomplishment by lack of funds to do all that the faculty have in mind.

I would, however, impress upon those who are responsible for the future prosperity of our railroads, the importance of maintaining a proper balance in the human equation. We must not forget the thousands in the ranks who are deprived of the very rudiments of learning, upon whom we must yet continue to place great responsibilities. The knowledge, concentrated in our educational institutions, should be made available in some degree at least to those deprived of these advantages, until there comes a time of more equal opportunities, when some system of education yet, to be evolved, will give to those seeking knowledge of a vocation, an opportunity while employed in it to acquire such knowledge.

It may yet be possible for some, who have no means, to work their way through our colleges and technical schools. If others are not dependent upon them for the daily bread and butter, this is perhaps possible. There are now, and always will be, however, those who through circumstances entirely beyond their control, are deprived of such opportunities. They must not be overlooked. It is essential that the intelligence of the rank and file of our railroads shall rise with the intelligence of the

supervision, if we are to obtain the full benefit of such great institutions as we have dedicated here today.

There must be vocational education of those who are to continue at the throttle; who decide in a flash questions of safety; those who carry the great responsibilities of the conductor, brakeman or switchman, must be given opportunities to advance in mentality as such responsibilities grow. The agents and operators must not be confined to the dull routine of their duties. They have time to acquire knowledge, and they have capacity for increased responsibilities; they are hungry for information.

The men in the shops and on the track carrying heavy responsibilities of safety and economy desire to learn and advance, and should be assisted and encouraged.

When we recall how difficult it is at times to obtain certain information with all the advantages of a great city or college, we should have some conception, vague though it may be, of the conditions surrounding an operator, towerman or section-foreman isolated almost as if on a lonely island, by the environments of his occupation.

We have, on the Illinois Central, taken cognizance of these conditions. That there is much eager demand for greater knowledge of their chosen professions through such avenues, is evidenced by the thousands who are availing themselves of the opportunities presented by the Educational Bureau. That it raises the plane of

intelligence there can be no doubt - that it enables some who have the requisite talent and genius, to advance, is evidenced by the recorded results. Employes who have ambition are using the Educational Bureau as a stepping stone to more advanced positions.

The apprentice in the shop, if his circumstances will permit, can attend the high school and learn his trade at the same time, or he can devote his entire time to his employment, and receive special instruction not only in the trade but in general knowledge.

There is no branch of the service it does not reach - no employe it cannot help. The work, like any genuine uplift, is not manifest as some might unreasonably expect in spontaneous loyalty and changed adverse sentiments. There is a leavening, however, of the personnel which must produce results - an irresistible tendency to grow in mentality in spite of one's surroundings and obstacles, that no influence, disloyalty, shiftlessness or idle frivolity can control. Were it otherwise, railroad men have indeed sunken to a pitiful condition.

The time will never come to me when I shall willingly withhold the helping hand to those who through heart-breaking restrictions, are deprived of the opportunities vouchsafed to their more fortunate fellow beings, to acqure the knowledge that will make their life work more easy and their advancement possible.

It is not the history of great achievements that it is absolutely essential that the foundation of knowledge must be laid within palatial walls of learning. Railroad managers and educators must be broad enough to grasp the situation as it is. They must not depreciate learning acquired in other than conventional ways; they must assimilate the theoretical and technical with the practical and the superficial.

All the technical knowledge of the world cannot grasp a critical situation to prevent an impending railroad accident. The most learned professors cannot navigate a ship across the seas. The unlearned wireless operator becomes the most important human being among scholars, scientists, statesmen and business experts, in an emergency at sea.

In conclusion, in fear of being misunderstood as depreciating the value of special and technical knowledge, I desire to reiterate the sentiment that I have previously expressed. To those who devote themselves to the work of imparting such knowledge, we as railroad men, owe a deep sense of gratitude. The specialist in railroad work is doubly welcome as the field is broad and practically unfurrowed. We must depend upon the technical graduate for the substantial and permanent betterment of our transportation facilities.

As citizens of this State, we must take a great

pride in our new school -- we expect it to take a place of great prominence in the industrial as well as the educational world. Under the leadership of its Dean, assisted by the able corps of assistants, its reputation must come to be international. We pledge it our hearty support and co-operation.

THE CHAIRMAN: The speaker on the next topic, "How Can the Technical School Help in the Solution of Railway Problems," is Mr. Robert Quayle, General Superintendent of Motive Power of the Chicago and Northwestern Railroad, Past President of the Master Mechanics' Association, and, I am sure Mr. Qualye will permit me to add another title which will interest the student body, Father of "Bob" Quayle.

(For address see next page)

HOW CAN THE TECHNICAL SCHOOL HELP IN THE SOLUTION OF RAILWAY PROBLEMS.

By Mr. Robert Quayle, General Superintendent Motive Power, Chicago & Northwestern Railroad Co., Chicago, Ill.

Mr. Henderson referred to the old man, or his old friend. Now, if he were to stand up here before you and you should judge by the hair on the top of the head, I think you would think he was the older man.

"How can the Technical School Help in the Solution of Railway Problems?" The Problems of the railways are numerous, and I think that legislation is one of the worst problems we have to contend with today. I think that all railroad men understand that, and also that the employes are back of that very legislation.

The railroad companies have just two things to sell, freight and passenger transportation, and the rates of both passenger and freight are fixed by people outside of the railway. If I were to build a house for you, young man, or any one of you young men today, if I were the contractor, and the house was to cost $4,000, or rather, if I built one for you last year, and another young man would come to me now and say, "Mr. Quayle, I want you to build a house like Charley So-and-So had last year; I am going to be married, I have got to have a home to put my bride in, and I want a house just like his". "All right, all right,

but it will cost you $5,000". "Five thousand dollars, why, you built Charley's house for $4,000." "Yes, but labor has gone up, material has gone up, every man expects a little more profit this year than last year, therefore I have got to add 25 per cent to it." That is all right. He can take care of his work, and he comes out all right in the end. But the poor railroad fellow, he cannot do that. Rates are getting less rather than more, so you see we have got to do something to cut down the operating expenses to make a better showing, to keep the higher officers, board of directors, and everybody else satisfied.

How can we help? Coal is a large factor in expenses with the railroads of the country. On the railroad with which I am connected it amounts to something over eight million dollars a year. Eight million dollars of coal seems a great deal, and yet if we can save 10 per cent of that, we will save $800,000, and it is possible, absolutely possible, if every man were simply to say, "I can do my duty, I can do my part, and I will do my part". Then the result is already attained. The snow flake comes floating down, and we look at him and say, "What do you amount to?" But he keeps constantly falling and falling, until these great giant locomotives are stopped, the trains are stopped. So if every individual of the 40,000 men on the railroad with which I am connected will do his part, do it well, do as Lord Nelson said: "England this day

expects every man to do his duty," something will be doing, young men, and the result will be that that coal bill will be cut down. How are you going to do it?

You are going to go into fuel engineering and you are going to be connected with a railroad company. First, you must have a love for your job. As said by Mr. Hetzler, you must love your job, and if you do not love your job, then get out and be superintendent of motive power, where you can look wise and don't have to do much. (Laughter). But if you are interested and in love with your job, you will learn just how to go at it and you can work it so cleverly that you will not get tired, and you can go to bed at night and sleep and you can eat a good breakfast in the morning and so be ready for a good start each day.

Now then, you can make a very fine analysis of the coal, and having made that, you must have the condition in the fire box just right. The grate is a very important thing, the opening in the grate, the amount of air that you let in there, is a very important thing. If you let in too much air you will probably cool down the temperature of the fire box so that the carbon will not burn, and if you have too little air you will not have sufficient oxygen for proper combustion. It generally requires the oxygen of 300 cubic feet of air to burn one pound of coal, if the coal is properly broken up, and I think we are making a mistake in putting too large lumps of coal on our tenders. I wish Dean Goss would have these experiments

made, and determine what size of coal, air space, etc..., will give the best results in the fire box.

The front end of the locomotive has been gone into very thoroughly; every relation of the tip in the exhaust pipe to the stack. I worked on that some years. I was chairman of that committee, and I don't know that it meant very much after I got through. If it did not, it was the fault of the fellow who was on the job. Now, what we want to do is to get the best general conditions for obtaining the most out of one ton of coal. It is up to you young men to do that. I think that with this testing plant we ought to get these results. Now, that calls to mind just one thing, that you have got a splendid equipment here, and you young men, the railroads all through this state, this country, and the people of this commonwealth, are to be congratulated that you have such a splendid outfit, and such a splendid equipment, and such splendid men at the head of it, who will give you such instruction that if you stay by it and earnestly study and practice it, that you will be men worth while. The methods of firing, you can practice on the locomotive that you have on your testing plant, for the method of firing is a very important thing. Some men will take a number of scoops of coal, say ten at a time, and throw it in, and the scoops will average anywhere from 14 to 20 pounds of coal, according to the size of the scoops, and if you throw in 20 pounds

each time, you will have 200 pounds. By this method you will reduce the temperature of the fire-box equal to the absorbing quality of the coal, in fact, you will reduce the temperature so much, that the carbon will pass off unconsumed in the form of smoke, and we need to look out for that, so that communities will not get after us and tell us that we are ruining the health of men and destroying tapestries, lace goods and that sort of thing so much that they are going to put us out of business.

The amount of coal placed in, and the frequency with which it is put in, has much to do with economy. Some men will put in 15 to 20 scoops of coal at a time, and then sit up on the back seat and say, "That is fine, see the black smoke rolling out of the stack". Whereas, if we got him down on the deck and insisted on his putting it in at proper intervals of time, and looking for the thin places and placing the coal where it is needed most, it would be easier work for him, Intelligence is what moves the man, you all know that, because that is what you are developing here, intelligence.

I might tell you also about the depth of the coal, upon the grates, how deep it should be; but that must be learned by experience. The ratio of grate area to heating surface is also a very important thing, as well as the ratio of firebox area to tube heating surface. Perhaps you can develop something along that line. I know Dr. Goss will develop something along that line if he can, and I know if

he will that he can, so that is settled.

We must have larger power, because rates are going down, there is only one thing left to us, that is to have large units of power to pull the tonnage over our railways. That means something. We will have to have heavier rails, heavier bridges and longer sidetracks, and also new coaling facilities, higher coaling stations and higher water tanks, and then when we come to ask for all these things, the president of the railway who has all the things before him that the different departments have asked for, will say, "I have got so much money to give out, and they have already asked for twice as much as I have", and so he will have to cut everybody's request down. Everybody does not know what the president has to deal with, they think he has got the money down in his trousers pockets, and all he has to do is to dig down and get it, but he has not. He has got to do the best he can. And the head of each department, in railroad parlance, "feels sore", because he does not get what he wants.

In order to get the maximum result from the big locomotive it is up to the young men of today who belong to the student body to see what kind of material can be used by certain alloys, to see what can be done to increase the strength and reduce the weight of materials used in frames and machineries, and to put the weight saved into the boiler, which is the foundation of the whole machine, the thing that generates the power, and if you can generate

the steam for twelve to fifteen pounds of coal per horse power hour, then you will do more than can be expected of you for the next ten years. But keep at it, it is everlastingly keeping at it that wins out, you know.

Superheaters. We are doing quite a good deal with superheaters these days, are not we, Mr. Basford?

MR. BASFORD: Yes.

MR. QUAYLE: All right. It is a wonderful thing. When we first began to use superheaters, we had a great deal of trouble because of the excess of heat, I mean the heat in excess of the temperature of saturated steam at whatever pressure used, but we are coming to think that instead of getting along with a steam of 600 degrees temperature, we will go a thousand some day, and then, when we come to that, look out for the electrical fellows. They will come and ask us, "How are you able to furnish so much power for so little money?" We do not want to put them out of business, we want to keep them going. They have a good start, but we will keep them in a stern chase all the time.

You will have a splendid opportunity to look after the internal friction on the locomotives on your testing plant. There is more there than you have an idea of. These increasing diameters of journals make for a good deal, because they are getting more nearly down to where the crank pin is, and when you come to figure that, you will find out that you will have a great task. It may be ball bearings, I don't know, but you have got to do something

to overcome the tremendous friction that we have in the ever increasing size of locomotives.

Lubrication of the superheater engine is quite an important factor now. We used to have pumps, you know, and we pumped oil in. We have now done away with the five-feed lubricators, and have introduced the three-feed lubricators, and inject the oil right into the valve chamber, and of course the steam carries it down into the cylinder. Any schoolboy ought to know that, but we did not. We know it now.

I have not seen your testing plant. I know something about it, I have read about it and I have seen cuts of it. But, young men, the testing plant may be all right. It means that it will spell efficiency in capital letters, but what of the man that is going to operate this testing plant, what of the boy that will have to do the work there? Are you studious? Are you taking it all in, are you making notes, are you questioning, just like the little boy does on the cars? He goes through the country saying, "Papa, what is this? How do trees grow?" All that kind of questioning. That is all right, always ask questions, but be sure that you get the answer, be sure that you hold the answer, be sure that you use the answer. There are so many of us in life, young men, that know so much and do so little. What is the sense of my having something up here in this cranium of mine, sir, when it is not of any value

so far as its use is concerned. Do you know, it would not be of any concern to the railway that I serve, to ask me how much I know. They ask, "What does he do? What is the cost of operation? How much does it cost to keep a locomotive in repair per thousand ton miles, or per engine mile". Then they make comparison with other roads, and if the comparison does not show up well, they say, "Well, I guess Quayle is getting old, I guess we will have to put him over." Then I go down the toboggan, you know, quite easily done. I want to tell you that old men can be young, and young men can be old in their thought and old in their action, and I appeal to you, young men, students of this university, that when you go out from this school, not only that you will have a pride that you graduated from this university, but thatyou will make everybody proud that you have graduated from this university by what you are doing every day.

I have a splendid high regard for Dr. Goss. When I used to know him many years ago, he was just "Professor" Goss, now he is "Dr". Goss, and he has well earned the title. He is a man whom we can trust, and, young men, think of that, can we trust you? How about it? Character is everything. Let that be the first fundamental, and build up on it grandly.Then when you go out from this place everybody will say, "Well, he has been under proper instruction, and he has character and he has education, he has all the facilities necessary to make a splendid man in his line,

watch him grow." And they will trust you. As somebody said in one of the other papers, confidence is one of the best assets, one of the greatest assets any man can have. Then they will have confidence in you, and then you should measure up to the confidence, measure up to the trust imposed in you. You cannot do it by lethargy, you cannot do it by license, you have got to do it simply by burning the midnight oil, you have got to do it by getting up, being in your place of business when the other fellow starts, and see what he is doing, and then the other fellow will say, "Young man, you have done well, come up higher." And in this way you will go up.

THE CHAIRMAN: Mr. Chubbuck, who was to speak to us on the last topic on the program, is unable to be present.

I am sure that we are all sorry that Mr. Chubbuck has been prevented from being with us. Our exercises will be concluded by an address on "Research as a Factor in Railway Administration, by Mr. Samuel O. Dunn, Editor, Railway Age Gazette.

MR. DUNN: Mr. President, Ladies and Gentlemen: - It is a gratification and an honor to be here on this occasion. I had the pleasure of being with the delegation of railway men who came down here a few years ago when Mr. Park's resolution pledging the support of railway men to this enterprise was adopted.

Mr. Quayle's concluding remarks about the importance of development of character suggested to me a point in which you may be interested. I came down here some three years ago to get a man, - we needed a man in one of the departments of our paper, and on Dr. Goss' recommendation employed a young man who had just then graduated from the engineering department of this school. If all the young men that this school turns out are like the one that I got, it certainly deserves all the support that this state can give it. I have known a good many young men in my time, but I have never known one who in intelligence, in industry and in character is a finer type of American young manhood than the graduate of this school whom, I am very glad to say, we have on our editorial staff.

RESEARCH AS A FACTOR IN RAILWAY ADMINISTRATION.

By Mr. Samuel O. Dunn, Editor,
Railway Age Gazette, Chicago, Ill.

Railway transportation is one of the largest industries. And it is also the newest of the large industries. The first train propelled by steam was run in England in 1825. The first rail of the oldest railroad in America, the Baltimore & Ohio, was laid by Charles Carroll on July 4, 1828. Any new industry is sure to have many unsolved problems. A new industry which in less than a century has expanded to the enormous magnitude that railroad transportation has, is sure to present many unsolved problems of the first importance. The importance of the unsolved problems presented by railroad transportation in the United States is in proportion to the extent of the development of the industry here. And the mileage in this country exceeds the total state-owned mileage of the world, equals that of the continents of Europe, Africa and Australasia together, and is, indeed, about 40 per cent of the total mileage of the earth.

The most important of our railway problems, are perhaps first, that of securing the greatest practicable economy of operation; second, that of increasing the safety of operation; and, third, that of putting the relations between the railways and the public on an equitable, wholesome and stable basis.

It is needless to emphasize the desirability of the greatest economy in operation consistent with reasonable compensation and working conditions for employes, and good service. Economy is most effectively promoted by handling traffic in the largest units. For years the ingenuity and energy of railway engineering, mechanical and operating officers have been directed chiefly toward increasing the sizes of transportation units. The capacity of cars and power of engines have been augmented, grades have been reduced and curvature eliminated, almost entirely for this purpose. Supplemented by ever more thorough supervision of car loading and train loading, these things have made the railways of the United States the leaders of the world in economy ofoperation, in spite of the fact that the wages of labor here are higher than in any other country, and over twice as high as in Europe.

There must, however, be some limit to the extent to which we can practically and economically increase the capacity of cars, the size and power of engines, and the length of trains. Probably the day is near when the old, strenuous and largely "rule of thumb" methods by which the big economies have been made must be supplemented, or even largely supplanted, by methods of greater refinement, which will secure more numerous, but individually smaller, economies. It seems clear that there is going to be need for more thorough, searching and scientific investigation to ascertain all of the means by which the most efficient use

of money, men and materials may be secured. Take, for example, the problem of economical grade reduction. We know that numerous railways have made large savings by reducing their grades, and that others could do so if they had the ready money to pay for the work. But while every reduction of grades reduces operating expenses, every one also increases fixed charges. Profits are increased only if the resulting reduction in operating expenses is greater than the increase in fixed charges. Where, then is the limit to economical grade reduction? Again, experience demonstrates that by piece-work and bonus schemes of wages, the amount of work done by individual employees in shops can be increased. But experience also shows that more supervision is required under the bonus or premium system than under the day wage system. Just where is the gain secured by the increase in individual effort turned into a loss by the increase in the cost of supervision?

There are innumerable problems connected with the larger problem of economical operation for whose solution prolonged and thorough research work is essential. These problems may be roughly divided into two classes, those common to many or all railways and those largely growing out of the local conditions of the individual railway. Each railway must solve its own local problems; and there is an increasing tendency to establish testing and investigating bureaus of various kinds, which are really research bureaus.

The problems common to many or all railways may be, and are studied by their great technical organizations, and also by the technical departments of the large universities. It would seem that increasing use in research work might advantageously be made of the professors and laboratories of the universities. In the first place, the professors are apt to have both more time and more fitness for investigating purely scientific questions than railway officers, the ablest of whom are rapidly promoted to the higher offices where they must deal with the pressing practical problems arising daily rather than with the purely scientific ones. In the second place, when the facilities of a university for scientific researth are utilized by a considerable number of railways the university can afford to provide a better plant for the dual purpose of investigation and instruction than an individual railway would be disposed to provide for only the former purpose; and then, students are benefited who will subsequently make use -- many of them in railway service -- of the knowledge they acquire in the course of the investigations.

The most difficult, and in many ways, the most important problem of railway administration in this country, is how to increase safety. In point of economy of operation our railways lead the world. In point of safety they rank low. Their accident record is much misunderstood and much misinterpreted. Some people try to make it appear much better, and other much worse than it is. We will make more

progress toward improving it by studying its causes and remedies than by either defending or denouncing it. The cause of a majority of fatalities is universal trespassing on railway property; and everybody must know by this time that the only way to remove their cause is by the passage and enforcement of proper laws. As to the rest of the accidents, they are due to plant failures, man failures and combinations of these. The class of plant failures that recently has been increasing most, and that demands the most study, is derailments. A large majority of derailments is due to a faulty relationship of one kind or another between track and equipment. In numerous cases this faulty relationship grows out of the fact that the weight of equipment and speed of trains have increased faster in proportion than the strength of track; and on many roads one remedy is to construct and maintain the track to the best modern standards. But a considerable number of the derailments occur on roads having both as good equipment and as good track as money can provide. There is need of profound and thorough research to find out just what are the proper and safe relations between wheel loads, train speeds and track. The derailment problem is but one of several affecting safety whose solution demands combined laboratory and service research. For example, there is the big question of automatic train control. Can any mechanical means be devised which under the varied and hard conditions of trunk line railroad operation can be implicitly relied on always

to bring trains to a stop in the presence of imminent danger of accident? And, if so, is the use of such a device desirable? The man who advocates the indiscriminate use of automatic train control in the present state of the art knows little about the complexities of the subject. But surely no one can be criticised for urging careful study of the matter.

However, the big problem in regard to safety is how to get employes selected and disciplined so that they will so conduct themselves as to protect themselves and other persons. Most of our railway casualties, even aside from those to trespassers, are due to the national vice of carelessness and recklessness. The statistics on the subject indicate that if all the railways of the United States were made as physically perfect as engineering skill and money could now make them, and no improvement were made in the human element, at least 75 per cent of all the people killed in railway accidents annually would be killed anyway. It is a remarkable fact that if there had not been a single accident to a train in the United States in the year ended June 30, 1912, ninety-two percent of all the people who were killed on our steam railways would have been killed anyway. That means that for every person killed in a train accident there are over 12 killed in other ways, as by getting struck by moving cars and engines; falling from trains; being struck at highway grade crossings, etc. It is an actual fact that the number of railway employes killed while not on duty in this country about equals the total number of

passengers killed in all ways, the number of passengers killed in 1912 being 318 and the number of employes killed while not on duty 315. There is grave reason to fear that there never will be any substantial reduction in our railway accidents until this terrible national vice of carelessness and recklessness has been remedied. The field afforded by that vice and its results for investigation and action in the interest of humanity is one of the widest and most potentially fruitful in this country.

The third great problem of railway administration I have mentioned is presented by the relations between the railways and the public. The problem of establishing fair, satisfactory and stable relations is very far from solved. There has been plenty of discussion of rates, and service, and government control in recent years, but much of it having started with baseless assumptions, has naturally landed in equally baseless conclusions. There is no absolute standard of the reasonableness of railway rates of service. There is no absolute standard for fixing the proper relation between the government and the railways. These things all depend on the conditions; and there is room and need in this country for an enormous amount of research and hard thinking regarding them. Since it is the duty of the railways to serve the public equitably and well, it is the duty of their managers, as part of the regular administration of the properties, to take the initiative in research to determine just what the relations of the railways to the public

are, what they ought to be, and how they can be made what they ought to be. About three years ago the roads established a sort of economic research department at Washington under the name of the Bureau of Railway Economics, the investigations of which have been admirable for their thoroughness, accuracy and tone. Some of the best contributions to the investigation and discussion of railway economic problems have been made by our university professors, with Dr. A.T. Hadley at their head; and it might be added that some of the misleading and partisan literature on the subject also has come from university professors. The professor of economics usually has less opportunity to intimately familiarize himself with the workings of railways and other business concerns than those who are more closely identified with them. But his training, his calling and the atmosphere in which he lives usually tend to give him a minimum of bias and to fit him pre-eminently for investigation and sound thinking unless he sets out to be primarily a social reformer and only secondarily an economist, as many of our economists do nowadays. The railways themselves might well provide able and conscientious economists with means for research regarding railway economic problems. There is just as much reason for this as for giving professors of civil or mechanical engineering means and opportunity for research along their special lines; it has been done to some extent; and it might be done more, to the advantage of our educational institutions, the railways and the public. One of the very interesting and

important things that might profitably be made the subject of thorough research is the cost of rendering the various kinds of railway service.

It is a pity that the learning and intellect in our universities, and especially our state universities, are not used more by the public in the work of railway regulation also. The state of Wisconsin has set a good example in that respect. It made one of the professors of economics in its university a member, and later chairman, of the state railroad commission; and he is now a member -- and one of the ablest, fairest and best-equipped members -- of the Interstate Commerce Commission. Wisconsin has also used the engineering department of its state university in the extensive valuations of public utilities made under the supervision of its railroad commission. There is no question that to the way in which it has availed itself of the brains and facilities of its state university is largely due the success Wisconsin has had in the regulation of public utilities. If there were more men having scientific training, and animated by the scientific spirit that disposes men to get at the facts and act accordingly, connected with our regulating commissions in this country, and fewer of political training and animated only by a political spirit, public regulation would be much more expert, much fairer, and much more beneficial to the public. There is an opinion abroad that the main need in our public affairs is more "direct government". I venture to

hold the opinion that the main need is more intelligence, expertness and fairness both in legislation and administration. When we get more statesmanship into the management of our business concerns, and more business into the management of our governments, public regulation will be more of a success and we shall all be better off. In this college-bred country of ours the universities should be able to exert a great influence for getting more statesmanship into business and more business into statesmanship.

CONVOCATION IN AUDITORIUM, MAY 9.

ABSTRACT OF ADDRESS BY

Dr. Edmund J. James,
President of the University of Illinois.

Guests and members of the University:

We are gathered here today to mark the setting of another milestone in the progress of the University of Illinois. This progress has been almost unbroken from the very foundation of the University forty-five years ago until the present time. Nobody could have foreseen, when this seed was planted more than a generation ago, what a great tree it was destined to become. Or rather, when some men did foresee it, though as it were with the vision of a prophet and a seer, other men jeered at the large ideas based upon small evidence of accomplishment which had been the outcome of an agitation of fifty years in the state of Illinois for the foundation of a state university. Dr. John M. Gregory of blessed memory, the first president of this university, not only dreamed of the future greatness of the institution; but he saw as clearly as anyone can see into the future, that however discouraging the circumstances of this early foundation; however difficult and numerous and perplexing the problems which were facing it for solution; however annoying and troublesome and dangerous the opposition forces

were; yet, in spite of it all, this institution would grow up in the long run to be enrolled among the great academic centers of the world.

We are privileged to reap where he sowed. We are privileged to see with our own physical eyes the realization of the vision which was plain only to his inner and spiritual eye. Surely our lines have fallen in pleasant places, as we see, decade after decade, and year after year, nay, almost month after month and even day after day, some new evidence of the increasing usefulness of this institution.

The great German author Lessing declared that that which we do not see growing we find after a time grown. But we are privileged both to see the institution growing and to see it grown. To one occupying the position which I hold, a part of whose function it is to keep track of the activity of every individual department and subdepartment of the University, it is plain that every day in the year some stake is driven farther afield to take possession of new territory, or the plow driven in more deeply to cultivate more thoroughly the territory already in possession.

The University of Illinois is with every passing hour measuring itself up more fully to its responsibilities as an institution which in its comprehensive scope and

organization, in the high character of its scientific and instructional activity, shall answer the needs of a great commonwealth like Illinois.

We are greatly rejoiced today for the people of this commonwealth that they have advanced to a time when they recognize the fundamental necessity of all these different elements, and have come to see that agriculture and engineering and architecture and chemistry are no more necessary to the development and preservation of a civilization than are ethics, and literature, and art and the drama.

It is because of this fact and because of a growing recognition on the part of everybody in the community, of the essential solidarity of all learning and the essential necessity of developing every possible side of human intellect and human aspiration, that we all come together today on this common ground and rejoice with those who do rejoice on this especial occasion for the particular advantages which this new addition to our facilities implies. I am sure I speak, therefore, for every department in this University when I say that we rejoice in this new evidence that our engineering college and our engineering experiment station are getting ready to perform a larger service for this institution, for this community, for this commonwealth, for this nation, nay for the world.

In the brief remarks that I shall make today, I should like to raise two questions for the consideration of our friends the professors in this department of engineering, and for our friends the practical men engaged in the great work of industrial development who are interested in the development of the engineering school primarily because of the service which it may render to these industries.

Nothing has been more striking in the development of American education, and indeed one may say education in general in western Europe, than the growth of the professional school. Derided, hooted at, ridiculed, misunderstood, misinterpreted, ignored by the practical men and by the profession, and one may say further, by other educationalists, i.e., men engaged in other departments of education, the engineering school has gone steadily forward in its development in all countries until it represents today an absolutely essential element in the system of higher education in every modern country. It hasn't been so very long, even in as enlightened a country as this, since doctors were in the habit of getting their training, not in medical schools with great laboratories and adequate equipment, but in the private office, bottle-washing for some medical practitioner. It has not been so very long since the averagd lawyer found his training as copy clerk in the office of a practicing lawyer. Nor very long since

the engineer and the architect got what training he received at all in a practical way by contact with practical men, doing things as well as he could, learning as well as he could, all that he knew about his profession in the actual practice of an office or a shop. There are still men who believe that these great engineering schools represent a gigantic attempt to hoodwink the public; that they really have nothing to offer of value to young men who wish to pursue their courses. If so, it certainly is a striking commentary upon the intelligence of modern nations, for the young people are crowding into these schools in all countries in ever larger numbers. They evidently <u>think</u> they are getting something. We are succeeding in hoodwinking them to a remarkable degree, if, as a matter of fact, they get nothing.

Now all this has come about at the same time that there is scarcely a single fundamental question concerning the proper course for an engineer to pursue, concerning the proper method of study, concerning the proper organization and integration of the various elements of the curriculum which can be said to be solved. If you ask one engineering professor to sketch out for you the ideal engineering course, he will, if he has ever thought on the matter at all, proceed to give you one suggestion. If you ask another engineering professor, he will give you another suggestion, and sometimes these two suggestions are so different from

each other that you wonder whether these men are talking about the same thing or not. That is to say in this field of engineering pedagogics, so to speak, there is the widest variation and difference of opinion, first, as to what elements ought to enter into an engineering course, second, what emphasis ought to be laid upon the respective elements that go into it. And third, what method ought to be adopted to train the students in utilizing this curriculum.

But in spite of this uncertainty of professional opinion as to what is desirable, and in spite of the criticism made upon our curricula and our methods of handling them, the young men are still crowding into these schools in such numbers as to keep them always on the strain to provide even meager opportunities for their full development.

How greatly this stream would be increased if we could find out really what is the desirable thing, what is the best thing to do, and were then equipped with money and with men so that we could properly do the thing which we should ascertain to be the best!

Now I am of course a non-expert in this field of engineering education. I suppose if there is any one thing I know less about than another, it is subjects which fall within this general field. Indeed I have in my own case a striking illustration of how possible it is for a man to have his hands and head and heart full of work and find,

generally speaking, if not a satisfactory, at any rate a bearable condition of life along with bottomless ignorance concerning such questions as electricity, - not even understanding the most common terms implied in this field of investigation. And so it is from the view-point of an absolutely objective observer and from the standpoint of one who does not know the details and who cannot therefore have his attention swallowed up by the trees to such an extent that he cannot see the forest, that I venture to make a few suggestions as to the direction in which an engineering school ought to be developed to do the largest service for our day and generation.

First of all I should like to call attention to two or three very striking facts.

It was a common notion when law schools were first established, that they ought to be located in the very heart of some great city where they could get hold of practicing lawyers, and judges on the bench, to do the teaching, and where the students could in their leisure time attend the meeting of courts, listen to the argument of counsel, ponder upon the able points dealt by the judges, etc. etc.

As long as that condition prevailed, the law school was a poor spindling thing as a professional school. It offered comparatively little improvement over the old method of learning law, which consisted chiefly of sweeping

out the lawyer's office and copying legal documents. But when Harvard College, a generation ago, adopted an entirely new plan which involved giving the student all the work he could possibly do while in actual attendance at his law school, so that, even if he had a hundred courts, he couldn't attend them and at the same time do his college work; and when it demanded of the faculty that they should be law school teachers, first of all, and not law practitioners, and then gave these men so much to do in the work of teaching that they had no time for practice - - I say when these things were done (although at that time the law professor prophecied a complete failure and a fiasco) the real beginning of professional education in the field of law had been made. The Harvard College law school is located in Cambridge. That is a large city, it is true, but I will venture to say that neither Harvard College professors nor Harvard College students are to be found in any considerable numbers attending any court in the city of Boston. Why? Because they can use their time for the purpose of getting the advantages of a professional education to a far better purpose during the years which they give to law school study.

So complete and overwhelming was the victory of the Harvard system that we find now all over the country law schools in connection with the great universities in which the principle of the Harvard school has been adopted,

and in proportion as it has been adopted have these schools grown and flourished and struck their roots deep into productive soil. So overwhelming was this victory of the Harvard College law school that other schools have imitated even the very weaknesses and peculiarities of the Harvard system of instruction. Indeed I was told of a case in which the professor in a certain law school quite distant from Harvard had even imitated the very tones and inflections of the Harvard law school professors because they thought that was a part of the course.

Today a first-class law school can be built up entirely away from the great centers of population - entirely away from centers of courts and legal business. You only need men for the faculty, and the library for the students, in order to develop a law school of the very finest quality, even in the remote district of Podunk.

Something of the same thing has happened in the medical schools. It was supposed at one time that the best way to study medicine was to get the practical work in a doctor's office and then go up to the city and attend the clinics and see the physicians at their work. The argument was that the only place to get this medical work was in a great center of population; and of course there is much justification in that argument, owing to the fact that the material for laboratory work is more abundant in the city than in the country.

But here again we see the same development. Just in proportion as the systematic, regular work offered in the medical school is given by men who are giving their whole time and attention to teaching these subjects has been increased and modified to such an extent that the medical student must now in the best schools spend all his time on the work outlined by the medical school, has professional education in the field of medicine been developed and perfected.

The same thing is true in the great field of engineering education. The idea makes a very strong and subtle appeal to the imagination, that if you can get great engineers who are doing things, digging great canals, building great bridges, erecting great structures, to become professors in engineering schools, and then let the students spend as much of their time in manual work as possible and get out and visit shops and all that sort of thing, you will develop a great engineering school, and that was the idea, of course, in the beginning days. Just in proportion as engineering colleges have come to accept the new standards, the new ideals, the new notions of engineering education, viz. that the professor should be a professional teacher and the student give all of his time to the work, have they become an effective, permanent and ever more important element in our scheme of engineering training.

In other words there is a certain period in a boy's life, if he has had an adequate preliminary training, when he can learn more and lay better foundations by giving all his time to the mastery of a certain kind of school curriculum, than he can learn in any other way. In brief, if a man is going to spend ten years in his engineering training, say from twenty to thirty, before he may be considered a competent engineer, it is a better thing for him to spend four or five years of that time in pursuing the systematic work of a thoroughly well organized school curriculum, under the direction of competent teachers, and then to spend five years in the practice, applying, supplementing, increasing his knowledge, than if he had spent the whole ten years in practical work. And this is the justification of the engineering school. If this is not true, then the boys are wasting their time in our engineering colleges, and the state is wasting its money in supporting and developing them.

That this is true is rather evident from several interesting things in the history of engineering schools. I don't know that any better illustration can be found than in the development of our own engineering college, right here on this campus. Who would have thought twenty-five years ago that one of the great engineering schools in the world, which this has already become, could be developed here upon the banks of the Boneyard stream, more than a hundred miles from any great machines, from any

great buildings, from any great industries of any sort, that here where the student would have no chance to see the things which are done in the great shops, no chance of visible contact with the organization of great industries; that here we should found and develop a center to which the students are resorting in ever larger numbers. Why the idea seemed to be absurd! How has it come to be realized? In the first place by the recognition of that fundamental fact that there are certain things which a boy may learn in a school more rapidly and more efficiently and more thoroughly than he can learn in the same time in practice. Again that he can learn this by giving his whole time and attention to these particular intellectual occupations which the mastery of the curriculum compels. In other words, a recognition of the fact that we can block out a curriculum which will take all the student's time to such an extent that he has no opportunity to visit great machine shops or great industrial enterprises, I mean visit them regularly every day, but which requires him to spend his entire time, and all his energies and all his thought upon the things which the school can give to him. The second element in this success has been the important fact that we have had men here in this work, elaborating and teaching it, who have been on the job every hour in the day, and you may say for every day in the year. In other words we have not attempted to build

up a great engineering outfit here and a great engineering school upon the basis of a distinguished man at the head of a department, who himself is not interested in teaching and never appears upon the ground.

We are delighted to have the service of great engineers. We are pressing them to come here all the time, and to bring the message which their most recent contact with experience has enabled them to formulate. To bring the inspiration which only the vision of men who have done things can bring to young people such as are studying here in this college, and who can give out of the rich storehouse of their experience, advice which will prove a stimulus and a guide to faculty and students alike. But after all, that work is supplementary, and it has little or no value if we, the teachers, are not ourselves here, hour after hour, day after day, month after month, year after year, doing the work which we can do because of our training and because of our experience and because of our interest in educating these young men and making them ready to profit by the opportunity of contact with these great engineers.

Now our men have had to sacrifice many things because of their devotion to this teaching side of the work. If they lived in a large city they would be called upon by companies of all kinds for their services, and would be paid for it handsomely. If the policy of the University were to encourage that sort of thing, our

professors could be all the time employed as experts in giving advice to public and private corporations. Every one of them would have five times as much practice as he could manage. But such a thing would destroy the very essence of our purpose.

The administration of a great university like this is always between the dangers of Scylla and Charbydis. The steady tension of the pull and push of the outside world to absorb the time and energy and thought of our professors makes a constant danger that they will be drawn away to too great an extent to make their work here effective; and, on the other side, there is a real danger that men who do not keep in touch with practice, may become too theoretical, too dogmatic, or too dried up to be effective leaders of the young in this great work of acquiring an engineering education.

These two fundamental things, then, gentlemen, a curriculum which absorbs the time of the student so that he can do nothing else; secondly, a staff of teaching professors who give their time to this particular work, are fundamental conditions, to my mind, of a thoroughly efficient professional school, and we are building up these elements here in the University of Illinois. And because we have been doing that with such a measure of success do you see this magnificent result which we have before us in this body of young men who come up here and

spend time and energy and money for the sake of the benefit which they may acquire in this great plant which the people of this commonwealth have given to us in trust to use for the benefit of these young men and their successors into all succeeding generations.

And now, friends, I just want to say one or two other things. Inside the curriculum itself there is continued struggle between the predominance of practice and theory. We were proud to have the first shops in connection with any engineering school in the United States. There was a tendency for a time to multiply and increase this shop element. The tendency is now in the opposite direction. Which is the wiser? Now it seems to me the principle is plain, though the application is difficult and must be referred to the men who actually conduct the curriculum itself. No student should be doing that work in the school which he can do better somewhere else or can do just as well somewhere else. Now beyond a certain modicum of shop work, I believe that the so-called practical experience can be acquired in the great shops and in the great industries far better than they can be acquired in our laboratories, our lecture rooms and our drawing rooms. We have to have enough of this particular work to enable the student to get a real understanding of the theory.

But practical experience, the kind of experience that makes a college graduate immediately worth something

to his employers, is the kind of thing that he can safely let go for the acquisition of other better and more useful things. And this leads me to the second principle, namely; that he ought to be getting those things in school, in the curriculum, in the university, which he can acquire best or only in that place. Now what are these things? Why, they are first the intellectual development that leads him to master a problem. Then it is the acquisition of certain mental tools, such as mathematics in some departments, that will give him the facility for grappling with the largest and highest and most difficult theoretical questions that come into the whole problem of practical or theoretical engineering. The school ought to occupy all his time for four years, or five years possibly. It ought to occupy his time about those things which are valuable and those things which can be better acquired within this period of five years than at any other period of his life. I think it is safe to say that the man who does not acquire a mastery of mathematics, for example, for purposes of investigation in his particular department while he is in the college and university, will, with very rare exceptions, never acquire this facility and power, but will turn his mind and attention in other directions in which this particular facility and particular power are not needed.

I have said that the student's entire time ought to be occupied. I do not mean by that that he ought to

be kept all day at drawing or mathematics, or thermo-dynamics, or physics, or electricity, or what not, but that his time should be devoted to the mastery of the combinations of things which enter into the curriculum. Furthermore, a boy who knows how to react to his environment has acquired an experience in his four years of college life which will be of immense advantage to him in meeting and handling and dealing with the men with whom he may come in contact in subsequent years.

So much for the general underlying principles of the curriculum. Now a word for the professor himself.

I believe myself that no man ought to be in a university faculty, that no man ought to be a professor in a department representing an important subject of instruction, who isn't himself doing something in a positive way for the advancement of the theoretical side of his subject. In other words, who isn't adding to our scientific knowledge, and who isn't adding to the valuable literature of his profession. The university professor should be writing the practical handbooks; should be making theoretical contributions to the science of engineering, using that term in the largest sense; and no man ought to be on a university staff who isn't doing that kind of thing.

If any particular department, like civil engineering for example, has all its scientific problems solved, then it ought by all means to be taken out of the university

and put into an ordinary coach school in which students are taught what we know, that being all that ever is to be known. If there are unsolved scientific problems, then the professors in the university should be the men who are concerned about them.

I believe that every professor in an engineering school should have that amount of contact with life which will enable him to understand the practical bearing of every subject he is teaching, and to keep himself up in the practical applications of the same, but anything beyond that, any devotion of his time or energy to routine work outside of that is an absolute deduction from his usefulness as a member of the university staff. And this commonwealth would find it greatly to its advantage to pay salaries to men engaged in the work of teaching in this line that would justify them in giving their entire time, and energies, to original investigation and to effective teaching, rather than compelling us to pursue the policy which we are now compelled to pursue so largely, of relying upon a man's getting additional service somewhere else, for which he will receive money necessary to enable him to lead the ordinary, worthy human existence and take care of and raise a family.

The problem then for a great commonwealth like this is to pay a living salary to men engaged in this business of teaching and investigation, and then insist that

they give their entire time, thought, and energy, to effective teaching in the school itself and the development of the subject. They will thus be able to render the largest public service to the people of the commonwealth.

Friends, if we could organize an engineering faculty on that basis, we should have something so supremely excellent as compared to anything achieved up to the present, at work in the field of engineering education, that the whole commonwealth, when it came to realize the fact, would rise up and call us blessed, instead, as many of them do, of rising up and cursing us for the supposed extravagant expenditures connected with this great enterprise.

Let us dwell on this for a moment. It is seldom I get an opportunity to talk to a committee like this. Seldom I get a chance to talk to practical men on engineering education. They won't listen to us. But I am going to use this opportunity to say two or three things to them which I should be glad if they would carry forth to their friends. The development of a great engineering school and of a great university like this is of course largely a question of ideal, and idea, and conception in the public mind as to what a university should be. Now if we are going to secure for a university career in the next generation the ability which we ought to have, such ability as we have represented here on this platform in the practical work, we must offer larger salaries. If we are going to

have men of first class ability devote their time and energy to this work of teaching and advancing the interests of engineering schools, we must either raise salaries or we must expect to have our men spend a large part of their time in mere money-making outside; or we must be content to take a low class of instructors, such as can be obtained by low salaries. Now friends if you can help educate this commonwealth toward a higher view, you will do a great service to the state and the nation. If for instance this Western Society of Engineers would say to the trustees of the University of Illinois, representing the people of the state, "We will endow a chair of electrical engineering, to the extent of five thousand dollars per annum, on condition that the state will add five thousand dollars more, so that the trustees can pay a salary of ten thousand dollars for this particular chair, and they shall get the best man they can find for ten thousand dollars. And the minute they can't find a man worth ten thousand dollars, then kindly return us our money. If you can only find a man worth five thousand dollars, then let the state pay him. But we are willing to contribute to get a man of different type, or, what amounts to the same thing, to enable a man of the type you have to give all his time and energy to the one thing which you have in mind, namely, developing the department of electrical engineering." If in the same way, public spirited citizens who are wondering how they can move up the level

of education in general, would say; well I am going to give the University of Illinois a hundred and fifty thousand dollars to endow a chair in, say English literature, on condition that the University will add five thousand dollars or six thousand dollars per annum. And the University shall go out and get the best man it can find in the world for ten or twelve thousand dollars, and as soon as it does that, we will pay half the salary. Friends, I believe if public spirited citizens of this commonwealth, or wealth men who want to see things move along, would say to their fellow citizens, we are willing to make this contribution for the purpose of accomplishing this end, I believe in a generation you would have made an enormous contribution to the uplift of our society.

It would be a great mistake for the University of Illinois not to utilize these adequate facilities in the department of engineering to develop the graduate work in this field. The tern graduate work is used in American colleges and Universities in two entirely different senses. Harvard University, followed by some other institutions, by adopting the practice of calling those schools graduate schools, entrance to which is conditioned upon holding a college diploma, has demoralized, and in my opinion degraded the use of that term. Graduate work in any particular field ought not to mean work carried on by graduates in some other department, but work carried on by baccalaureate graduates in that particular field. A graduate student

in engineering should be, not a bachelor of arts who is studying elementary engineering, but a student who holds a baccalaureate degree in engineering and who is going on to develop and expand and enlarge his engineering knowledge upon the basis of the work completed in the undergraduate course. This is the sense in which we use the term graduate work at the University of Illinois. It means advanced work, at any rate in regard to all those subjects which are ordinarly taught extensively in undergraduate courses. Now in the field of engineering we are just beginning to recognize the fact that the boy who has completed his ordinary undergraduate engineering course is only just ready to begin the serious study of important branches of scientific engineering, and the University of Illinois in its graduate school is trying to develop courses which it will be worth the while of young men of more than ordinary ability who have completed the undergraduate course in engineering, to take up and pursue for one or two or three years in addition.

This is an entirely new idea in engineering work, and not more than half a dozen institutions in the country have done anything worth while in this direction.

We shall have an unusual opportunity, owing to these enlarging facilities here at the University of Illinois, to advance this side of our work, so that we can turn out a number of men, even though it be very small each year, who will be destined to make their mark in the theoretical side of engineering.

We have reached a point already in which we do not consider that a man should be appointed instructor in chemistry for example, who has not had at least equivalent advanced work corresponding to the requirements for a doctor's degree in chemistry. That means three years hard study in chemistry as a specialty, in addition to the ordinary work of an undergraduate course. We shall have made a great advance in the effectiveness of teaching and the effectiveness of research and the effectiveness of higher work in engineering when we are in a position to say we will not appoint a man as instructor in the College of Engineering who has not, in addition to having completed the undergraduate course in engineering, also pursued for a period of from two to three years, advanced studies in some theoretical work in some one of the numerous branches of engineering.

When we can do this we shall have solved very largely the question of securing an adequate supply of properly trained men for engineering professorships, and it is difficult to say how we can accomplish this end unless we can do some such thing as I have outlined.

To the young men who are in this engineering course who are looking forward to work in the engineering field, I wish to urge upon your attention the fact that in the great field of teaching engineering or investigation in the field of engineering, there is an opportunity for

the exercise of the very highest talent in a way to be of supreme value to your day and generation. I only hope that as the people of this commonwealth increase our facilities and opportunities we may be able to build up here in these subjects a center to which the best young men from all parts of the country will naturally resort because here will be the best work of that kind to be found.

We are dedicating this building, then, first of all to the service of the commonwealth in the largest and widest sense. And this service involves first, a service to the students, the most effective possible teaching which we can render; the most effective possible training which we can develop for the benefit of the young men, - and young women too, if they want it, - who choose to take up this line of work; feeling that if we did nothing else but send out into the bosom of the commonwealth, men of ability and training and inspiration, the institution will have done a valuable service and rendered a full return for all the sacrifice which the commonwealth has made. But after we have done that, noblesse oblige. We should never be satisfied with one service or any particular number of services until we have done all the service that we can render. The next service, besides effective teaching, would be continual additions to the sum total of human knowledge, in the shape of effective, valuable literature of the profession so that this would be one of the great centers

of scientific investigation in the field of engineering.

And finally, as complete a service to the state as can possibly be rendered, in the form of what has come to be known as extension work, the largest possible return to our cities and towns and villages and townships and counties, the largest possible return in the way of assistance and advice to our industries -- all this combined, administered by every indivudual professor and instructor who may work in these buildings under a sense of high responsibility to the people of the commonwealth and the nation.

ADDRESS BY HON. W. L. ABBOTT

President of the Board of Trustees
of the University of Illinois.

The dedication of the Transportation and Mining Buildings marks a tardy recognition by the State of the importance of investigation and study of these two great industries. Involving as they do an investment of upwards of seven billions of dollars, and doing a business of nearly one million dollars a day, they aggregate an industry of greater financial importance than the combined agricultural interests of this great farming state.

The hundreds of thousands of transportation employees, with other hundreds of thousands depending upon them for support, who absorb in wages three-quarters of the gross receipts of the business, form no inconsiderable element of the brain and sinew of our population. When we consider our twenty-five thousand miles of railroad tracks, the hundreds of millions of passengers and the hundreds of millions of tons of freight carried annually, it is apparent that transportation in this state is the corner-stone of our commercial system; and when we consider also our vast coal deposits underlying whole counties and amounting to tens of billions of tons of easily accessible coal of fair quality, we realize that in this buried treasure lies

an assurance of the continued prosperity and the future manufacturing supremacy of our great commonwealth.

But great as are the material benefits flowing from these activities, they are not the greatest. Dwellers in communities having little intercourse with those outside usually consider and often call the luckless stranger within their gates a "foreigner" and sometimes resent the intrusion by heaving a stone at him. Someone has said in substance, "Mountains interposed make enemies of peoples that had else been friends". Granting the truth of this proposition, its corollary would be, "Railways connecting make neighbors and friends of isolated communities that had else been mutually indifferent or actually hostile". The possession of an abundance of cheap fuel is an assurance that the community will supply itself with an abundance of cheap power, and such a supply of power distributed over the length and breadth of the state will induce a development of our social system whose possibilities can only be realized by comparing the condition of those countries which consume great quantities of power with the condition of those countries which use power but sparingly.

Much has been said, - some of it wisely and some of it foolishly, about the great and unnecessary wastes and inefficiencies in the conduct of our large commercial affairs. It is undoubtedly true that preventable wastes do exist in these as in all other rapidly developing human

affairs and constitute a direct tax upon the community, falling alike upon the producer and upon the consumer; upon capital and upon labor. What if a tenth of the costs of conducting these great enterprises were found to be preventable wastes (and they doubtless are), and what if through the investigations and teaching of this College of Engineering a tenth of such preventable wastes would be saved (and such an assumption is not unreasonable), that alone would effect an annual saving to the state greater than the largest appropriation the state has ever made for the support and development of the entire University for any year.

To the state, whose continued liberality has made possible the great and permanent growth of its various departments, the University renews its assurance of loyalty and ambition to serve; and its Board of Trustees prays that no indiscreet nor ill-timed course on its part may forfeit the confidence which the state has so many times and so strongly expressed in the conduct of the University.

To the Dean of the Engineering Department I tender my heartiest congratulations for the high standard to which the work of his department has been brought and for the confidence which the transportation and mining interests manifest in his undertakings. The University gladly acknowledges its debt to its great Engineering Dean and hopes that that indebtedness may be yet many fold increased.

To the President of the University, a non-technical man at the head of a technical institution, and yet intensely practical and in a sense a great engineer, I need not remind you that while the State encourages and demands the development of those departments which stand for the professions, the humanities and the finer arts, it is primarily for the study of those practical problems relating to its intense industrial life that the University has been founded and developed. A university is an aggregation of schools and colleges, representing a diversity of lines of intellectual endeavor, each of which contributes in its own peculiar way to the life and to the living of the people, and harmoniously combine as one great uplifting force. It has been the pleasure of the Board during the past few months to place under your charge, in addition to those older departments and buildings, Lincoln Hall, the College of Medicine, the Commerce Building, and now this engineering group. It is your duty, and happily your ability, to weave all of these functions into one grand symposium of which the departments which we honor this day shall be a strong fundamental tone.

ADDRESS

by

Mr. Willard A. Smith, President
Railway and Engineering Review, Chicago, Ill.

There are no longer cloistered halls of learning. As the church has turned in the extreme later days from monastic cells, from storied windows, rich trappings and dim religious light, from the burning of martyrs and from theological disputations to social service, so the institutions of learning at last are turning to the assistance in the development of the great material world progress, as well as the intellectual. The world is turning backward to the primal words of creation, "Let there be light".

Today our medical schools are sending their rays of light through the entire human system. Our schools of engineering, of technology, and the sciences, are sending the X-rays through the material problems which the world is crowding faster and faster, year by year, within our view.

The business of railroading is an emergency business. This is illustrated very clearly today in the absence of several of your promised speakers. The men engaged, therefore, in railway management and operation, have neither the time nor the opportunity to carry on that systematic work of research and investigation which is fraught with such tremendous possibilities. The railroad

manager's mind is diverted instantly, to the instant need of things. The work of study and investigation must be laid aside, for this emergency or for that particular engagement, and it cannot be prosecuted by them as it can be done only in institutions devoted to research, investigation and instruction.

Born in the State of Wisconsin, nurtured in the State of Illinois, where I spent most of the years of my life, I feel great pride today in recognizing the advanced work of the state universities of the sister states of the west.

Transportation is of just as much importance to civilization from every possible standpoint, not merely from that of material advancement, the accumulation of wealth, but from that of the advancement of religion and morals, and all those finer things, as agriculture. It comes just as near the home, the heart and the thought of every American citizen as does agriculture. What an important step, therefore, has been taken by these universities, and especially by the University of Illinois, by the State of Illinois, in recognizing this fact and in establishing, I will not say for the first time, but almost the first time, a school of transportation in which the study of economics is closely correlated with that of engineering

The State of Illinois has started out to perform its duty towards transportation. The advancement of transportation depends upon three things, every feature of which

is of the utmost importance to every citizen. They are efficiency, safety, and economy. You will note that I place safety second. "Safety first," is all right as a propaganda, it is a magnificent movement, but first of all we must have transportation. Railroads must be operated; the advancement of all the interests of the country depend first of all upon the efficiency of its transportation means. Secondly comes the subject of safety, from many points of view equally important, but still second, because we must have transportation. Last of all comes the subject of economy. These subjects are closely correlated. They interlace with each other, they cannot be separated, but the careful study of the entire subject can only be pursued in such schools as that which has here been established in the University of Illinois.

It is for old men to dream dreams, it is for young men to see visions. I have walked today as in a dream, the realization of the vision of years, not only for myself but to many others here. How grateful it has been to us many of you can feel.

To the younger men I, who am of those who are wearing the white roses in place of the red, will have just one word to say in closing, - Morituri Salutamus - we who are about to die, salute you. I want to say that if your visions command your future life, if in the great testing laboratory of life into which you are entering after you have finished your studies here, you do as creditable work

as has been done by more than a score of those who are present here today, the world will commend you, and you will have great reason for self-congratulation. Yours is the opportunity, yours is the future, the foundations have been laid for you, the opportunity is open to you. You are to be judged in your life and all your future work by the measure in which you rise to those opportunities. You have facilities unknown to those who have gone before you, the question for you to decide is whether or not you will make proper use of them.

I want to say just another word in closing. I notice that President Markham was to speak a word of congratulation. I do congratulate the faculty of this great institution, its chairman of the Board of Trustees, the State of Illinois, I congratulate all of you and all of us together on this great achievement. I heartily sympathize with all the kindly words of appreciation which were expressed this morning for Dean Goss, his character and his work, I should like to add a word for the breadth of view and the commanding character and the power of the President of the University, and a further word of appreciation for Professor Schmidt, the head of the Department of Railway Engineering, and all those associated in the work. They heartily deserve recognition; it is a wonderful achievement and we feel that the institution so happily established, with so great possibilities for the future, is in good hands. I know that you will all heartily agree with that expression. I congratulate you.

LIST OF OUT-OF-TOWN PEOPLE IN ATTENDANCE AT
DEDICATORY EXERCISES OF TRANSPORTATION
BUILDING AND LOCOMOTIVE LABORATORY
Urbana, Ill., May 8 and 9, 1913

Name	Address
Abbott, W. L.	Chicago, Ill.
Affleck, B. F.	Chicago, Ill.
Alexander, Walter	Milwaukee, Wis.
Allard, A. F.	Danville, Ill.
Ames, Joseph H.	Chicago, Ill.
Anderson, A. R.	Columbus, Ohio
Armstrong, T. W.	Chicago, Ill.
Armstrong, W. C.	Chicago, Ill.
Arnold, Bion J.	Chicago, Ill.
Back, Thomas P.	Springfield, Ill.
Balzer, F.	Chicago, Ill.
Barron, A. E.	Chicago, Ill.
Basford, G. W.	New York City
Baumgardner, F. M.	Clinton, Ill.
Baumgardner, Mrs. F. M.	Clinton, Ill.
Baxter, W. M.	Chicago, Ill.
Beagle, N. R.	Peoria, Ill.
Bean, T. H.	Decatur, Ill.
Bell, J. M.	Elkhart, Ind.
Benjamin, C. H.	Lafayette, Ind.
Bennett, Chas.	LaSalle, Ill.
Bennett, Geo. M.	Urbana, Ill.
Bent, E. T.	Chicago, Ill.
Bird, Paul P.	Chicago, Ill.
Bolt, Martin	Springfield, Ill.
Brandon, G. R.	Flossmoor, Ill.
Brandon, Mrs. G. R.	Flossmoor, Ill.
Brinley, W.	Westvell, Ill.
Brooke, W. E.	Minneapolis, Minn.
Brooks, G. S.	St. Louis, Mo.
Bryant, J. M.	Urbana, Ill.
Buchanan, G.	Chicago, Ill.
Buelher, H. A.	Rolla, Mo.
Burlingame, Chas.	St. Louis, Mo.
Burris, W. S.	Danville, Ill.
Busey, Mrs. Mary E.	Urbana, Ill.
Butler, Nathaniel	Chicago, Ill.
Canby, J. L.	Chicago, Ill.
Carley, R. F.	Peoria, Ill.
Carter, Henry W.	Chicago, Ill.
Carter, Mrs. Henry W.	Chicago, Ill.
Carter, Macauley	Chicago, Ill.
Carter, Warren Gillette	Chicago, Ill.

Name	Address
Cartlidge, Oscar	Springfield, Ill.
Catney, J. A.	West Burlington, Ia.
Clair, John C.	Chicago, Ill.
Clifford, H. E.	Harvard University
Cokeley, Thos.	Danville, Ills.
Coleman, M. S.	Canton, Ill.
Collett, Robt.	Springfield, Mo.
Cooper, G. W.	Danville, Ill.
Crandall, C. L.	Ithaca, N.Y.
Crawford, John G.	Chicago, Ill.
Criswell, Jas. F.	Chicago, Ill.
Crowder, Harry J.	Westville, Ill.
Cushing, Geo. H.	Chicago, Ill.
Dahlin, J. E. B.	Chicago, Ill.
Detry, Victor	Tower-Hill, Ill.
Dickerson, Chas. T.	Clinton, Ill.
Dickerson, Mrs. C. T.	Clinton, Ill.
Douglas, H. T. Jr.	Chicago, Ill.
Dubois, James	Westville, Ill.
Dunlap, John	Peoria, Ill.
Dunn, Samuel O.	Chicago, Ill.
Durr, H. A.	Chicago, Ill.
Eich, H. C.	Burnside, Ill.
English, Thomas	Springfield, Ill.
Evans, Walter H.	Chicago, Ill.
Fairbairn, J. W.	Marion, Ill.
Fairchild, Richard	Chicago, Ill.
Fern, Frank D.	Chicago, Ill.
Ferriday, Robert	Indianapolis, Ind.
Fischer, F. W.	Chicago, Ill.
Fischer, Mrs. F. W.	Chicago, Ill.
Fischer, Walter	Chicago, Ill.
Fisher, Frank R.	Springfield, Ill.
Fogg, J. W.	Chicago, Ill.
Foord, James L.	Chicago, Ill.
Forester, James	Du Qouin, Ill.
Fowler, E. J.	Chicago, Ill.
Forester, Robt. J.	Du Qouin, Ill.

Name	Address
Frauenthal, Barney W.	St. Louis, Mo.
Friday, C. B.	Chicago, Ill.
Fursmon, M. J.	Clinton, Ind.
Garcia, John A.	Chicago, Ill.
Gennet, C. W. Jr.	Chicago, Ill.
Gibbs, J. R.	Hainsburg, Pa.
Glover, J. A.	Champaign, Ill.
Goodnow, T. H.	Chicago, Ill.
Goodwin, Geo, S.	Silvis, Ill.
Graves, Wallace H.	Chicago, Ill.
Gray, E.	Chicago, Ill.
Grebelhausen, Jacob	East Peoria, Ill.
Hall, Robt. F.	Chicago, Ill.
Hall, W. B.	Chicago, Ill.
Hall. W. F.	Elkhart, Ind.
Hartman, J. J.	Tipton, Ind.
Haskins, Geo. H.	Grape Creek, Ill.
Hays, C. J.	Urbana, Ill.
Hellenthal, K.	Chicago, Ill.
Hellenthal, Mrs. K.	Chicago, Ill.
Henderson, G. R.	Philadelphia, Pa.
Henery, Wm.	Danville, Ill.
Henrotin, Mrs. Ellen B.	Chicago, Ill.
Hetxler, H. G.	Chicago, Ill.
Hight, E. S.	Peoria, Ill.
Hildreth, F. F.	Terre Haute, Ind.
Hill, W. C.	Chicago, Ill.
Hinton, T. A.	Georgetown, Ill.
Hoit, O. W.	Geneseo, Ill.
Hooper, B. C.	Chicago, Ill.
Horswell, L. A.	Chicago, Ill.
Hounold, F. C.	Chicago, Ill.
Houser, A. M.	Chicago, Ill.
Howard, C. P.	Chicagom Ill.
Hudson, Thos.	Galva, Ill.
Hume, W. H.	St. Louis, Mo.
Hunt, Robert W.	Chicago, Ill.
Insull, Samuel	Chicago, Ill.
Jacobs, P. C.	Chicago, Ill.
Jacobson, Chas P.	Brereton, Ill.
Jenkins, S. T.	St. Louis, Mo.
Jenkinson, Chas.	Mobile, Ala.
Johnson, Frank E.	Chicago, Ill.
Johnson, F. L.	Chicago, Ill.
Jones, John Edw.	Danville, Ill.
Junkersfeld, P.	Chicago, Ill.

Name	Address
Knight, T. K.	St. Louis, Mo.
Knott, R. F.	Marseilles, Ill.
Koepke, Frank	Chicago, Ill.
LaRue, Henry	Chicago, Ill.
Langsdorf, A. S.	St. Louis, Mo.
Laughlin, Geo, F.	Chicago, Ill.
Lawrence, Grace	Peoria, Ill.
Lewin, F, A. W.	Zeigler, Ill.
Lucas, James	Grape Creek, Ill.
McAllister, H.	Streator, Ill.
McCabe, L. E.	Mattoon, Ill.
McCracken, R. A.	Paxton, Ill.
McCruder, David	La Salle, Ill.
McDonald, A.	Westville, Ill.
McDonnell, F. V.	Logansport, Ind.
McFadden, Jas.	Danville, Ill.
McKinley, W. B.	Champaign, Ill.
McLaren, A. B.	Marion, Ill.
McNeil, B. F.	Irwin, Pa.
Maltby, A. T.	Chicago, Ill.
Manchester, A. E.	Milwaukee, Wis.
Mauck, L. T.	Danville, Ill.
Mauck, Wm.	Danville, Ill.
Maujer, A. R.	Chicago, Ill.
May, M. J.	Spencer, Ind.
Midgley, S. W.	Chicago, Ill.
Moderwell, C. M.	Chicago, Ill.
Montgomery, H. M.	Chicago, Ill.
Moody, W. O.	Chicago, Ill.
Moorshead, A.	St. Louis, Mo.
Morava, W. M.	Chicago, Ill.
Morgan, Harry	Springfield, Ill.
Morgan, H. H.	Chicago, Ill.
Morgan, W. L.	E. St. Louis, Mo.
Moses, Thos.	Westville, Ill.
Motherwell, J. W.	Chicago, Ill.
Naylor, C. W.	Chicago, Ill.
Neal, W.	Danville, Ill.
Needham, Jas.	Ottawa, Ill.
Nelson, Ben	Chicago, Ill.
Neuffer, J. G.	Oelwein, Ia.
Newsom, R.	Peoria, Ill.
Nichols, S. T.	Chicago, Ill.
Nichols, Mrs. S. T.	Chicago, Ill.
Nolte, C. B.	Chicago, Ill.
Norwood, C. H.	Chicago, Ill.
Ostberg, A. H.	Aurora, Ill.

Name	Address
Ostermann, R. M.	Chicago, Ill.
Pangborn, J. G.	Baltimore, Md.
Parkey, E. W.	Washington, D. C.
Parsons, Floyd W.	New York City
Patton, Geo. A.	Sandoval, Ill.
Peabody, Francis S.	Chicago, Ill.
Perry, Allen Mason	Chicago, Ill.
Peters, J. D.	Herrin, Ill.
Pettigrew, Robert	Danville, Ill.
Pope, Joseph	Springfield, Ill.
Pownall, W. A.	Decatur, Ill.
Pratt, E. W.	Chicago, Ill.
Preston, Geo.	Urbana, Ill.
Quayle, Robert	Chicago, Ill.
Rees, Leonard	Logansport, Ind.
Reese, Dan	S. Danville, Ill.
Reese, John P.	Gillespie, Ill.
Reeves, W. F.	Chicago, Ill.
Reichmann, Albert	Chicago, Ill.
Ripley, C. T.	Chicago, Ill.
Roberts, S. S.	Chicago, Ill.
Robinson, C. W.	Kankakee, Ill.
Robinson, E. M.	Chicago, Ill.
Robinson, Mrs. E. M.	Chicago, Ill.
Rock, David	Westville, Ill.
Ropiquet, R. W.	Belleville, Ill.
Ropiquet, Mrs. R. W.	Belleville, Ill.
Rosenbach, R. G.	Chicago, Ill.
Rosenbach, Miss	Chicago, Ill.
Rossbach, E. J.	St. Louis, Mo.
Russell, J. R.	Danville, Ill.
Ryan, Thos.	Collinsville, Ill.
Schmick, W. L.	St. Louis, Mo.
Scholz, Carl	Chicago, Ill.
Schuchardt, R. J.	Westville, Ill.
Schultz, F. C.	Chicago, Ill.
Schwyer, C. A.	Oak Park, Ill.
Seley, C. A.	Pittsburgh, Pa.
Shanahan, J. C.	Gillespie, Ill.
Shaw, Jas. W.	Chicago, Ill.
Smull, H. H.	Chicago, Ill.
Smith, Willard	Chicago, Ill.
Snell, H. W.	Chicago, Ill.
Stewart, M. B.	Pekin, Ill.
Stevens, P. E.	Chicago, Ill.
Stewart, R. J.	Chicago, Ill.

Name	Address
Strehlow, O. E.	Chicago, Ill.
Stubb, F. W.	Oelwein, Iowa
Stub, W. P.	New York City
Strith, Arthur J.	Chicago, Ill.
Taylor, James	Peoria, Ill.
Thomson, G. R.	Chicago, Illinois
Thrush, D. E.	Farmington, Ill.
Tinlin, Charles	Springfield, Ill.
Towal, James	LaSalle, Ill.
Town, S. B.	Greencastle, Ind.
Tratman, E. E. R.	Chicago, Ill.
Tratman, Mrs. E.E.R.	Chicago, Ill.
Tucker, J. H.	Danville, Ill.
Turlay, A. G.	Clinton, Ill.
Turlay, Mrs. A. S.	Clinton, Ill.
Wagner, L. C.	Chicago, Ill.
Warder, J. H.	Chicago, Ill.
Watson, Jay R.	Chicago, Ill.
Watts, Alex.	Christopher, Ill.
Webb, E. W.	Chicago, Ill.
Weissenbow, F. E.	Staunton, Ill.
Whitaker, A.	Urbana, Ill.
Whitaker, W. B.	Urbana, Ill.
White, J. L.	St. Louis, Mo.
William, W. W.	Litchfield, Ill.
Williams, R.	Harrisburg, Ill.
Willis, Lansing	Chicago, Ill.
Wilson, E. B.	Scranton, Pa.
Worthington, B.A.	Chicago, Ill.
Worthington, Mrs. B. A.	Chicago, Ill.
Worthington, May	Chicago, Ill.
Wolschlag, Stephen	Peoria, Ill.
Yeager, F. E.	La Fayette, Ind.
Zeleny, Frank	Aurora, Ill.
Zimmerman, J. M.	Springfield, Ill.

Total - 255.