

ARNOLD THE ENGINEER

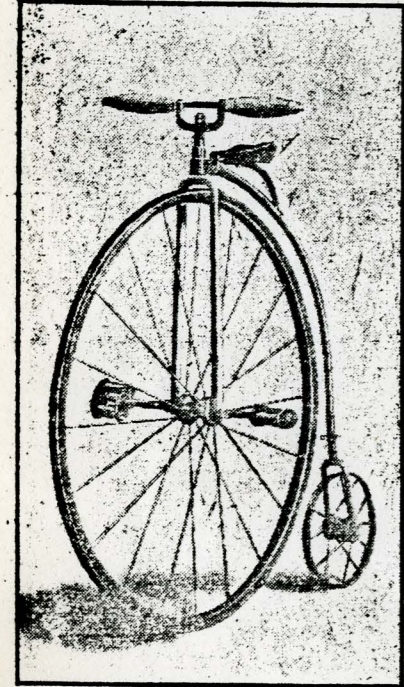
BY A. FREDERICK COLLINS.

A NEBRASKA BOY

WHO HAS WON WORLD WIDE FAME IN THE APPLICATION OF ELECTRIC POWER.

The man for the hour in Chicago is not a politician but an engineer. He is Bion J. Arnold, the man upon whom, by the votes of the citizens of Chicago, has recently been placed the great responsibility of putting into effect the traction ideas which he has for five years advocated as a solution for the problem of that city, and which not only involves the expenditure of over \$40,000,000 in the complete construction, under his direction of its transportation systems, but also the future of these properties which are valued at over \$100,000,000. It will be readily understood that this requires engineering and executive genius of the highest order.

The life of a genius is always interesting, doubly so if he is still living



FIRST BICYCLE EVER BUILT IN NEBRASKA.

This machine created a sensation around Lincoln nearly 30 years ago. Mr. Arnold occasionally rode it to his home in Ashland.

and trebly so if he is a young man. Bion Arnold conforms to the spirit of these requirements and thus stands today shoulder to shoulder with James Watt, George Stephenson, Robert Fulton and other energetic, persevering and skilful men who have formed the advance guard of the world's motive power and transportation facilities.

Now some men are born with exalted intellectual powers and others achieve these qualifications, but, unlike greatness, none can have the constructive faculties of invention, production and system thrust upon them, hence for our own good and the good we may do by assisting our sons and the sons of other men to win out, let us ascertain just how much of Arnold's success is due to heredity, to environment and to his own efforts.

The Arnold family was settled in the colony of Rhode Island before the beginning of the eighteenth century, where many of its members attained distinction. The earliest recorded ancestor of Bion Arnold was Jeremiah Arnold, who was born at Smithfield, R. I., in the year 1709, and from him the line of descent runs through Jeremiah Arnold, second, and his wife, Elizabeth Knight; his son Jeremiah Arnold, and his son Jeremiah, third, and his wife, Percy Rounds, were the parents of Joseph Arnold, the father of Bion Joseph, the subject of this sketch. The latter's paternal grandfather, Joseph Rounds, was a soldier in the revolution, while his maternal grandmother, Louisa Hale, was a mem-

ber of the hour in Chicago is not a politician but an engineer. He is Bion J. Arnold, the man upon whom, by the votes of the citizens of Chicago, has recently been placed the great responsibility of putting into effect the traction ideas which he has for five years advocated as a solution for the problem of that city, and which not only involves the expenditure of over \$40,000,000 in the complete construction, under his direction of its transportation systems, but also the future of these properties which are valued at over \$100,000,000. It will be readily understood that this requires engineering and executive genius of the highest order.

With the exception of about two years spent in Ashland, the succeeding years until the fall of 1872, the Arnolds spent upon their prairie farm and during this trying period all the trials and vicissitudes of the pioneer settler in a new and wild country were experienced by the entire family. The Indians far outnumbered the whites and, although considered friendly and actually proved so, in virtue of their intermittent warfare with the hostile Sioux to the northward, the settlers lived in a continual state of suspense in anticipation of possible attack, just as did the pilgrims who made history in the early colonial days.

In these strenuous times Mr. Arnold supplemented his meager income from the farm by teaching school, acting as a justice of the peace and serving as a member of the territorial legislature in which he sat as a member from the Ashland district in 1860 and 1866, while the mother, a former school teacher, added to her duties as the wife of a pioneer, by thoroughly instructing her children in not only the elements of education in which she was so well grounded, but in fortitude, self-reliance and those other cardinal principles which inspire ambition in the child and establish stability of character in the man.

It has been pointed out that however wonderful is the force of heredity, every child differs in some respect from its parents, but it does not require any special knowledge of these psychological laws to deduce the distinguishing characteristics and traits that were inherited by Bion as his birthright, yet he possessed a mental attribute that he may or may not have inherited from them, to-wit: an abnormal love for mechanism. It is true that his father as a pioneer made and repaired many of his farming implements and that his mother possessed a marvelously accurate eye for minute measurements, but while these accomplishments were undoubtedly factors in the boy's makeup, it is also well known that his father had a strong liking for jurisprudence, never having had a case reversed in a higher court, and intended his son to become a lawyer. So that, as we shall see, the wishes of the former were diametrically opposed to the desires of the latter.

Taste for Mechanics.

Again it seems hardly possible that environment could have exerted any favorable influence in developing his taste for mechanics, but environment, like heredity, is withal a complicated process, and who shall say that it was not without its effect? However that may be, the fact remains that his mechanical genius and the manual skill which he acquired under the greatest difficulties combined with it, thrived on the Nebraska prairie, even as does a cactus flourish on the Arizona desert.

As an illustration of his precociousness, his mother told the writer that he early developed a remarkable aptitude for mechanics, and during the period spent upon the farm, made many small sleds, miniature boats and trade models of farm implements, having during the winter of his sixth year built out of shingles something over 100 small sleds, which he hitched in tandem and proudly imitated the freighters' wagon trains he saw passing along the overland trail between Omaha and Denver before the days of railroads. "In fact," Mrs. Arnold says, "he was frequently in trouble due to his unconquerable desire to make things, and his too enthusiastic use of the visible supply of his father's nails, lumber, and other new materials, purchased at extortionate prices, but which were necessary for constructional purposes on the farm."

Fresh fuel was added to his burning love of mechanism when the Burling-

practice of law, and incidentally into other enterprises, that he might keep his large family of boys busily engaged, for he was firm in the belief that all boys should be taught to work, and kept as busy as bees, in and out of school.

This move gave Bion the chance he had dreamed about, for, while there were no manufacturing concerns in the new prairie town, yet there was a blacksmith and wagon shop, with its scanty, though to him wondrous, assortment of wood and metal working tools that delighted his eye, and made glad his heart. The dad's interest in these accessories, and his knowledge of the crafts, soon won over the owners of the shop, and they gave the youthful mechanic carte blanche to make whatever his fancy dictated, and every spare moment of the time he lived in Ashland found him there, making things.

Probably the most difficult problem his father ever had to solve was what to do with the boy, who, when put to work on Saturday mornings at the wood pile, charged with the responsibility of cutting enough wood to run the kitchen stove the following week,

dog, which he selected to utilize for driving the household churn, were among the numerous machines he produced in rapid succession during his twelfth and fourteenth years. His ambition to furnish the churn with dog power was crushed by his mother's refusal to allow the machine to be placed near the churn, for the grounds that the hair from the dog would get into the butter.

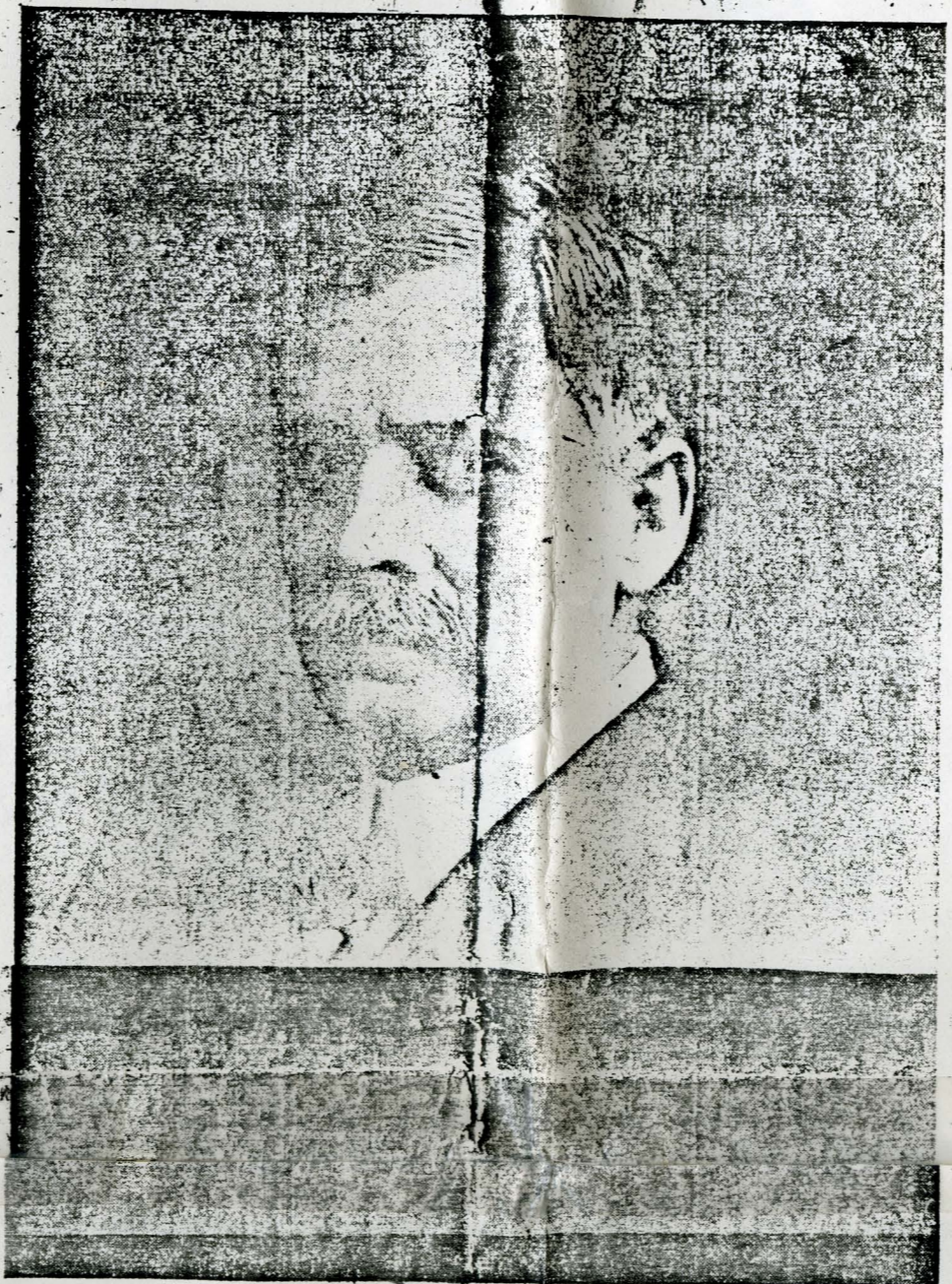
During these years and for some time later he had under construction a larger engine of about two horse power, by the use of which, when completed he hoped to drive the wood saw, his particular hobby, for supplying the weekly supply of wood, but with this ambition his father had no patience and the machine was never completed for the lack of funds. Relics of it, however, can still be found in Ashland.

At about this time his assiduous attention to his many mechanical devices so diverted his attention from his school work, at which his parents had thus far succeeded in holding him, that he became seriously entangled

late Sam D. Cox, then local editor of the Hesperian Student, the college paper, and later the editor of the Lincoln Evening Call, wrote of the machine, now partially preserved, as follows:

First Bicycle in Lincoln.

"The man with the bicycle is Bion J. Arnold of Ashland. The bicycle is entirely of his own construction, made from a shapeless mass of iron and a little wood for the front wheel. Mr. Arnold is a natural born machinist and can't help it any more than a boarding house can help making hash. The bicycle is an innocent looking creature as it leans quietly against the fence, and is very obedient when, under its owner, but when Ye Local, in response to an invitation from its accommodating owner, cautiously approached and endeavored to mount it, it showed signs of restlessness. However, by having Mr. Arnold hold it by the bits, we succeeded in mounting and he turned it loose. It didn't go more than ten feet when it took a notion to lie down; we expostulated, pulled it around to leeward and stuck



BION J. ARNOLD, THE ENGINEER

striction of the locomotive is worth doing at all it is worth doing well," and further "not to waste money, but not to slight the machine for lack of it." The result of the boy's labors, continuing over a period of many months, during which time in order to keep up his studies at school he worked from sixteen to eighteen hours per day, was a complete locomotive three feet long and this beautiful and brilliant testimonial of Bion Arnold's perseverance and skill now stands in a glass case in his offices in Chicago where its builder plans and executes gigantic traction schemes which net him over \$100,000 per annum, the city of Chicago alone paying him \$30,000 per year for a portion of his time.

The university of Nebraska, at the time he attended it, had no mechanical or electrical engineering department, and as young Arnold, who had by this time been thoroughly imbued with the idea of acquiring a complete education, had entered this school to prepare for Cornell, but while there learning to be a naval academy at Annapolis, it seemed possible to secure a commission with less expense than that at once set to work to obtain a commission for examination as a cadet at the United States naval academy. With this ambition neither of his parents concurred, but the father nevertheless assisted him, and on September 6, 1880, the boy left his western home full of that enthusiasm born of an intense desire to do things in his chosen field, but yet without a friend, relative, or even an acquaintance in that field, or in the country where he went. He was, however, thrilled at the thought of finally being amidst the great engineering work of the country and with the possibility of meeting the men who designed and built such things, thus making possible his realization of a hope which can only be appreciated by those who inspired or prompted by an extraordinary ambition have been raised far from the field of greatest interest to them, and who have experienced a similar transformation.

The boy's restlessness of disposition and bias toward his special field was so evident to the officers in the navy that they persuaded him he could, with the same amount of work, do better in less time outside of the navy than in it, and upon this advice, and the advice of other officers who had resigned from the service, he gave up his idea of serving Uncle Sam on the sea and set about procuring the rest of the education he needed without the assistance of the government.

Entered Hillsdale College.

In the fall of 1880 he entered Hillsdale college, an institution especially adapted to students of moderate means, where his parents were educated in their youth, and here he remained for four years, spending his summers traveling for manufacturing companies as an engine expert, in surveying work or in teaching school, and by means of which occupations he partially paid his way through college.

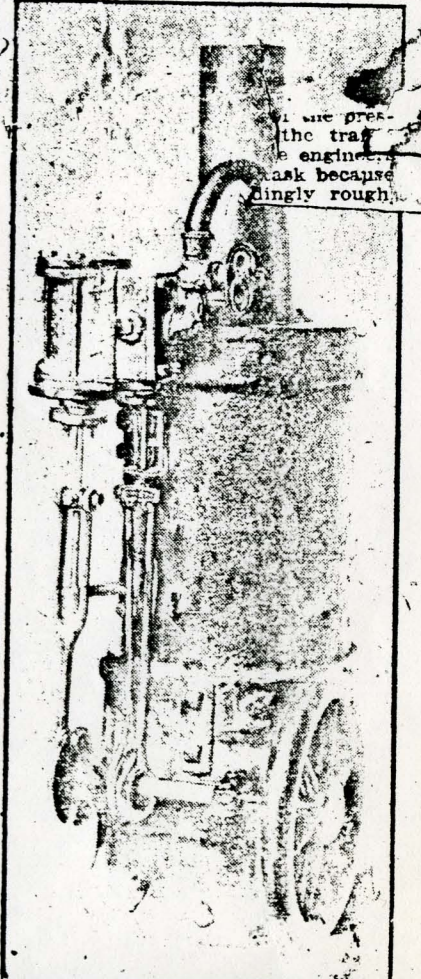
He graduated with the degree of B. S. in 1884 and the prize for having obtained the highest rank in mathematics of any member of his class during the entire four years; M. S. in 1887, and received, in 1889, from this institution, an honorary degree of Ph. D. for engineering work done subsequent to graduation.

On graduating from Hillsdale in 1884, being somewhat in debt and desiring to acquire a knowledge of business methods, he engaged with the Upton Manufacturing company of Port Huron, Michigan, builders of traction engines. In the capacity of general agent for this firm, he traveled throughout the United States, and in this school of experience he secured his first business training.

That he might get into a broader field of engineering work, he entered in 1886 the employ of the Edward P. Allis company of Milwaukee, Wisconsin, builders of Corliss engines, as

ject at Cornell, thus, after having graduated from a non-technical institution, and been in practice as an engineer for nearly five years, he realized his boyish ambition of attending Cornell, and received the only technical instruction he ever received except by self-application.

On leaving Cornell in the spring of 1889 he made application to several of the leading electrical manufacturing companies, but after investigation, he became convinced that the Thomson-Houston company was the one most likely to dominate the electrical railway field. Although offered better positions with two other companies he, in order to get connected with this company, accepted a semi-commercial position and was placed in charge of



UPRIGHT STEAM ENGINE BUILT BY ARNOLD WHEN 14 YEARS OF AGE.

its St. Louis office, and later, in 1890-'93, he acted as consulting engineer for this company after it had been consolidated with the Edison General company, now the greatest electrical manufacturing company in the world. While with this concern he also acted as consulting engineer for the Intramural Railway company, the builders of the elevated railroad at the Columbian exposition held in Chicago in 1893, this road being the forerunner of the present elevated electric roads.

Independent Consulting Engineer.

So conspicuously successful was this new third rail electric road that Mr. Arnold, following his pre-conceived ideas of eventually getting on an independent engineering basis, decided to open an office in Chicago, which he did in October, 1893. His marked ability as an electrical engineer combined with that extraordinary talent for mechanical construction which we have

Now some men are born with exalted intellectual powers and others achieve these qualifications, but, unlike greatness, none can have the constructive faculties of invention, production and system thrust upon them, hence for our own good and the good we may do by assisting our sons and the sons of other men to win out, let us ascertain just how much of Arnold's success is due to heredity, to environment and to his own efforts.

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Thus it will be seen that Bion came of those excellent families who made the strength of the early colonies and which have since become the bone and sinew of our country, and who have supplied the mentality necessary to have and to hold the United States in the front rank in the commercial and industrial world.

Emigrated to Nebraska.

So much for his ancestral inheritance and now something of his continuous or normal inheritance. His father, Joseph Arnold, following the spirit of the day, emigrated from Michigan to Nebraska in order to take advantage of the homestead laws and to secure a western ranch. Mrs. Arnold took Bion and his younger brother as far as Chicago by railroad and from this point the family journeyed to the far west, driving the entire distance in a large covered wagon familiarly known to the pioneers as a "prairie schooner."

This memorable trip consumed a part of the summer of 1864, and, after win-

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Fresh fuel was added to his burning love of mechanism when the Burlington railroad was built into Nebraska, and which entered the state at Plattsmouth in 1870, passed through Ashland and ended at Fort Kearney, 160 miles further west. Up to this time he had never seen a real locomotive, at least to remember it, but he had studied deeply the pictures of the wonderful iron horse in the family dictionary.

The construction of this road and the passing of its trains gave the youthful mechanic his first opportunity to actually see at close range a real locomotive. He was fired with enthusiasm at the glorious sight of a self-propelled steam engine traveling on wheels over the iron rails, and resolved then and there to build one, an ambition that obviously could not be realized at that particular time, but which, nevertheless, he actually consummated within the next few years, and which, further, was a vital element in determining his future career, as will be seen presently.

In the fall of 1872, after his father had proved up, and obtained title to the homestead, and achieved the maximum degree of success in the farm venture, the family moved to Ashland, where Mr. Arnold, sr., entered into the

would usually be found, after an hour or so, in this shop, busy with some lever, wheel or other "blamed thing of no earthly use to anybody," while his brother, Wayland, faithfully sawed the wood or did the chores allotted to Bion. Often, when the supply of wood was short, and the father's patience exhausted, he would come into the shop from his office, nearby, take the boy by the ear or arm, lead him to the door, and tell him to "mosey home and saw wood." His father's attitude, however, can be readily understood, when it is remembered that he was ambitious for his son to become a lawyer, and felt that the boy's "tinkerings not only interfered with his schooling, but would probably result in making a traveling tinker of him."

At thirteen years of age he had made a small horizontal stationary steam engine, about seven inches in length, casting its main parts out of lead and putting them together with such tools as the local gunshop afforded. Of this attempt a friend recently wrote him, after learning of his selection for the Chicago work, "I recall our early experience at trapping muskrats on Salt creek, and when you developed your mechanical ingenuity. I pumped the bellows on that hot afternoon in the old gun shop while you made the castings for your first attempt at a steam engine in miniature and how we were both nearly overcome with gas from the forge as we had closed up everything tight for fear someone would see us. All this, and many other things of our experience, comes back vividly to me."

His First Steam Engine.

At fourteen he constructed a vertical steam engine, about fifteen inches high, now in existence, using for a boiler an old piece of iron pipe which had been thrown away by the railroad company, an old lynch-pin wagon-hub band for a fire-box and an abandoned valve wheel for a fly wheel, while a gas cock, which he had picked up at Lincoln, served for a throttle valve.

At fifteen he had sent to a model maker's supply house in Boston, advertised in the Youth's Companion, for four iron rods, each one foot long and threaded their entire length. With these as uprights, and a supply of nuts threaded to fit and with castings he made out of Babbitt's metal, he constructed a vertical steam engine of about one-eight horse power and supplied it with steam from a crudely constructed sheet iron boiler with wooden heads. This boiler he supplied with water from an old kerosene barrel elevated a sufficient distance above the boiler to force the water into it when the steam pressure was low. In the construction of this engine he devised and used the piston valve now in common use on locomotives and other engines, believing himself to be its inventor, only to soon find, after a visit to the railway shops at Plattsmouth, that it had been invented long before he was born and was then in use on the steam engine driving the railroad shops.

Two foot-power scroll saws, by means of which all the walls of his home were filled with brackets, a crude turning lathe and a treadmill for his

with cube root, believing it to be a subject of no earthly value, and decided, thinking himself old enough to satisfy his ambition, to learn to run an engine, he ran away from home, found the only portable engine he knew of, and probably the only one in the state at that time. Having secured employment, he let his parents know where he was, and started in to learn the art of running an engine which was engaged, according to the season, in threshing in the country districts, or in driving a machine for shelling corn stored in cribs in the various towns along the railroad. His duties in this work, in addition to running the engine from sunrise to sunset, were to supply the engine with water, which necessitated his dipping up and pouring into a portable wagon tank over one hundred tobacco pail fulls of water twice a day, and hauling it by means of a yoke of oxen to the engine, his pay for his entire services being fifty cents per day and board. The father, thinking probably the work would not injure the boy and that it might be the means of teaching him the necessity of securing an education, did not interfere.

Comes to the University.

In this experience, as in many others before and since, he had to oppose the wishes of his family and act against their judgment and in accordance with his own. He having acquired during the two seasons he was absent, the skill he had sought in the handling of steam, and having met a boy who told him of a school called Cornell university, where they taught mechanical engineering, he resolved to get an education at Cornell if he could, and finally he returned to his father, who, upon being told by the boy that he desired to go to school exclaimed: "Well, my boy, I am glad you have come to your senses." Bion again entered the school he had left two years before, after more or less difficulty with his teacher on account of his lack of attention to his studies, and from that time on to graduation from college did industrious and eminently satisfactory work.

During these eventful school years at Ashland, in addition to acquiring experience in operating an engine, as just described, the boy turned out in rapid succession numerous boats, scroll saws, models of steam engines mentioned above, and, as a climax, built in his seventeenth year, without ever having seen one, the first bicycle made in the state, having as a guide nothing but an advertising cut about three-fourths of an inch high, which was being run by the Pope company in the Youth's Companion. He, however, originated, in so far as he was concerned, the suspension type of wheel now so common in bicycle construction, and in fact then used by manufacturers of bicycles, and built his wheels accordingly. Not only did he design and build the machine, but further, he accomplished what his father and friends thought impossible, namely: he learned to ride. This chef-d'oeuvre he took with him to the University of Nebraska at Lincoln, where he entered the civil engineering department in the fall of 1879. The

our feet through the wheel and braided them together, and punched the steering apparatus into our stomach. We had an idea that would hold her up; that's what we did it for, but it was no go, it would lie down, and did; we choose a soft spot where the dust was thick because we let it lie down, so we escaped without much injury. When it had gotten rested we took it up to the top of the hill and two men assisted us to get on. It didn't seem to want to lie down again—it was in a playful mood; and this time it ran down hill and over a basket of eggs with a small boy, then jumped the university fence and ran through the hedge; we expostulated again and stuck our feet through the front wheel, the front wheel stopped, but the rear one got its back up and tried to get upon the seat. The seat isn't very big so we got off and tried to smell some violets—some of those that that will get above the ground next spring—but that blamed thing kept following us up and stepping on us until we got to the fence and its owner came and drove it away. As we said before, its owner is an accommodating young man and would not hurt your feelings by refusing to let you ride it if you asked him."

Prior to leaving Ashland Bion had acted as messenger boy at the railroad station where he started to learn telegraphy, but the attraction of the locomotives was greater than that of the Morse alphabet, and in consequence he made the acquaintance of many of the trainmen running on the road. He had ridden repeatedly with the engineers while the firemen allowed him to fire and clean the engine and otherwise assist them until he was quite familiar with their construction and operation and he still cherished the desire to build one in order to demonstrate that he had sufficient knowledge to do so.

Made a Complete Locomotive.

Feeling that his father's consent could not be secured to so ambitious an undertaking, he remained silent about it while at home, but when well located at Lincoln he made frequent trips to the local round house to secure measurements of locomotives and set secretly at work afternoons making the boiler in the tinshop of a hardware store whose owner was kindly disposed toward him.

Bion, who was then just past seventeen years of age, soon produced a complete locomotive boiler one-sixteenth full size, and this attracted the attention of a Union Pacific locomotive engineer then running into Lincoln, who imparted information concerning it to the editor of the Lincoln Globe, and who in turn wrote a glowing account of the young student's ability. This article, and what had been said by some railroad men, entirely incidental a few days before, but nevertheless at the psychological moment, to his father when at Plattsmouth on legal business, entirely changed his attitude towards his son's endeavors, and from that time forward he did everything possible to assist him in his chosen field. The next mail brought a letter from the father enclosing a check with a request "not to neglect your studies," and a statement to the effect "that if the con-



BION J. ARNOLD, THE ENGINEER

facturing companies as an engine expert, in surveying work or in teaching school, and by means of which occupations he partially paid his way through college.

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That he might get into a broader field of engineering work, he entered in 1886 the employ of the Edward P. Allis company of Milwaukee, Wisconsin, builders of Corliss engines, as draftsman, and continued with them for some months, when he was offered, unsolicited and unexpectedly, a position as chief designing engineer of the Iowa Iron Works at Dubuque. At the latter place he remained a little over a year, and while there he designed and built numerous steam engines, not miniature models, but large, units, some developing as high as 1,500 horse power, and all of which are still in operation.

In order to get experience in a different line and furthermore to get into outside engineering work which, on account of his close confinement to office work while at Dubuque, he much needed, he resigned in the fall of 1887 and engaged with the Chicago & Great Western railway in the civil engineering department and afterwards when the road was turned over to the operating department, acted as its mechanical engineer, where he designed some of the company's locomotives and prepared the drawings for new equipments.

Adopted Electrical Engineering.

After graduation and prior to this time his policy had been to acquire as much experience in various branches of engineering work as possible before taking up a special line of work. Electric railroading was then in its extreme infancy, but having that keen foresight which has ever characterized his many epoch-making achievements he decided that it had a great future and he consequently took up electrical engineering as his particular profession. He might prepare himself for this work he resigned and spent the winter of 1888-89 as a post-graduate student in studying the sub-

BY ARNOLD WHEN 14 YEARS OF AGE.

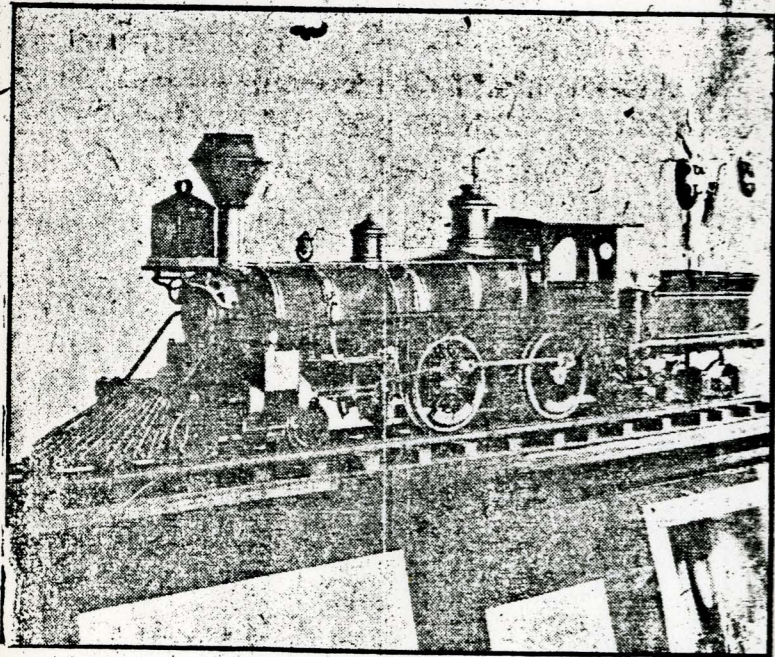
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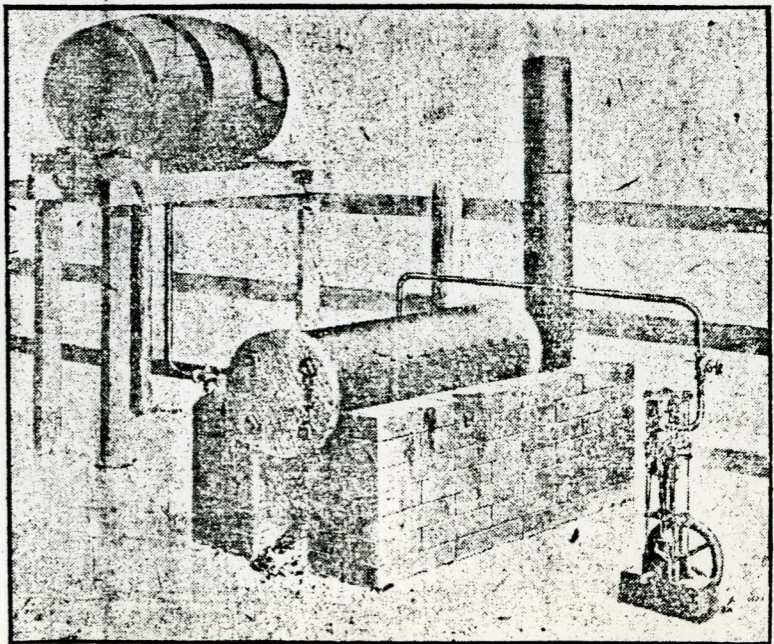
Mr. Arnold with his characteristic foresight was early impressed with the value of storage batteries in connection with electric plants, and with his usual dynamic energy set out perfecting plans for their use, and that he might better accomplish the results he deemed necessary to fulfill his standard of success he conducted many experiments in a laboratory which he fitted up in the basement of his home, and finally invested his entire means in their production, and even entered into the manufacture of batteries himself. This business, after a long and desperate struggle, so common to the storage business at that time, during which the company pulled through the panic of 1893, and afterwards lost its factory by fire, finally grew so rapidly and to such proportions that in about two and one-half years from the time it was founded by him it became sufficiently important to attract the attention of the so-called storage battery trust, and after weeks of negotiation, during which time he was pitted against skillful and experienced financiers, he sold the prop-

(Concluded on Ninth Page, Part Two.)



MODEL LOCOMOTIVE BUILT BY ARNOLD WHEN 18 YEARS OF AGE.

Described as follows in the Nebraska State Journal in August, 1880: "In the show window of Day's jewelry establishment may be seen a miniature locomotive, constructed by Master Bion J. Arnold, of Ashland, a university student, eighteen years of age, which is attracting general attention. The young man leaves for Annapolis, Md., where he will undergo an examination for cadet engineer in the U. S. navy, and he takes with him his little locomotive to show those in authority what he is capable of doing in mechanics. The locomotive is just thirty-six inches in length from the front of the pilot to the back end of the tank. It is built on a scale of three-fourths of an inch to the foot, after dimensions of locomotive No. 31, of the B. & M. Every part and parcel of the locomotive, from the cow-catcher to the tank bumper, is perfect, and not a screw, bolt, or any part of the engine but was made by the young man. Yesterday he got up a few pounds of steam and set his machine in motion, to the great amusement of a number of B. & M. and U. P. engineers, who pronounced it perfect in every respect. Mr. Arnold is possessed of remarkable genius, and it's a pity to spoil so fine a mechanic to make a sea-faring man."



COMPLETE STEAM PLANT BUILT BY ARNOLD WHEN 15 YEARS OF AGE.

