# THE BEGINNING OF BUSINESS

On May 31, 1921, the Ford Motor Company turned out Car No. 5,000,000. It is out in my museum along with the gasoline buggy that I began work on thirty years before and which first ran satisfactorily along in the spring of 1893. I was running it when the bobolinks came to Dearborn and they always come on April 2nd. There is all the difference in the world in the appearance of the two vehicles and almost as much difference in construction and materials, but in fundamentals the two are curiously alike - except that the old buggy has on it a few wrinkles that we have not yet quite adopted in our modern car. For that first car or buggy, even though it had but two cylinders, would make twenty miles an hour and run sixty miles on the three gallons of gas the little tank held and is as good to-day as the day it was built. The development in methods of manufacture and in materials has been greater than the development in basic design. The whole design has been refined; the present Ford car, which is the "Model T," has four cylinders and a self starter - it is in every way a more convenient and an easier riding car. It is simpler than the first car. But almost every point in it may be found also in the first car. The changes have been brought about through experience in the making and not through any change in the basic principle which I take to be an important fact demonstrating that, given a good idea to start with, it is better to concentrate on perfecting it than to hunt around for a new idea. One idea at a time is about as much as any one can handle.

It was life on the farm that drove me into devising ways and means to better transportation. I was born on July 30, 1863, on a farm at Dearborn, Michigan, and my earliest recollection is that, considering the results, there was too much work on the place. That is the way I still feel about farming. There is a legend that my parents were very poor and that the early days were hard ones. Certainly they were not rich, but neither were they poor. As Michigan farmers went, we were prosperous. The house in which I was born is still standing, and it and the farm are part of my present holding.

There was too much hard hand labour on our own and all other farms of the time. Even when very young I suspected that much might somehow be done in a better way. That is what took me into mechanics - although my mother always said that I was born a mechanic. I had a kind of workshop with odds and ends of metal for tools before I had anything else. In those days we did not have the toys of to-day; what we had were home made. My toys were all tools - they still are! And every fragment of machinery was a treasure. The biggest event of those early years was meeting with a road engine about eight miles out of Detroit one day when we were driving to town. I was then twelve years old. The second biggest event was getting a watch - which happened in the same year. I remember that engine as though I had seen it only yesterday, for it was the first vehicle other than horse-drawn that I had ever seen. It was intended primarily for driving threshing machines and sawmills and was simply a portable engine and boiler mounted on wheels with a water tank and coal cart trailing behind. I had seen plenty of these engines hauled around by horses, but this one had a chain that made a connection between the engine and the rear wheels of the wagon-like frame on which the boiler was mounted. The engine was placed over the boiler and one man standing on the platform behind the boiler shoveled coal, managed the throttle, and did the steering. It had been made by Nichols, Shepard & Company of Battle Creek. I found that out at once. The engine had stopped to let us pass with our horses and I was off the wagon and talking to the engineer before my father, who was driving, knew what I was up to. The engineer was very glad to explain the whole affair. He was proud of it. He showed me how the chain was disconnected from the propelling wheel and a belt put on to drive other machinery. He told me that the engine made two hundred revolutions a minute and that the chain pinion could be shifted to let the wagon stop while the engine was still running. This last is a feature which, although in different

fashion, is incorporated into modern automobiles. It was not important with steam engines, which are easily stopped and started, but it became very important with the gasoline engine. It was that engine which took me into automotive transportation. I tried to make models of it, and some years later I did make one that ran very well, but from the time I saw that road engine as a boy of twelve right forward to to-day, my great interest has been in making a machine that would travel the roads. Driving to town I always had a pocket full of trinkets - nuts, washers, and odds and ends of machinery. Often I took a broken watch and tried to put it together. When I was thirteen I managed for the first time to put a watch together so that it would keep time. By the time I was fifteen I could do almost anything in watch repairing - although my tools were of the crudest. There is an immense amount to be learned simply by tinkering with things. It is not possible to learn from books how everything is made - and a real mechanic ought to know how nearly everything is made. Machines are to a mechanic what books are to a writer. He gets ideas from them, and if he has any brains he will apply those ideas.

From the beginning I never could work up much interest in the labour of farming. I wanted to have something to do with machinery. My father was not entirely in sympathy with my bent toward mechanics. He thought that I ought to be a farmer. When I left school at seventeen and became an apprentice in the machine shop of the Drydock Engine Works I was all but given up for lost. I passed my apprenticeship without trouble - that is, I was qualified to be a machinist long before my three-year term had expired - and having a liking for fine work and a leaning toward watches I worked nights at repairing in a jewelry shop. At one period of those early days I think that I must have had fully three hundred watches. I thought that I could build a serviceable watch for around thirty cents and nearly started in the business. But I did not because I figured out that watches were not universal necessities, and therefore people generally would not buy them. Just how I reached that surprising conclusion I am unable to state. I did not like the ordinary jewelry and watch making work excepting where the job was hard to do. Even then I wanted to make something in quantity. It was just about the time when the standard railroad time was being arranged. We had formerly been on sun time and for quite a while, just as in our present daylight-saving days, the railroad time differed from the local time. That bothered me a good deal and so I succeeded in making a watch that kept both times. It had two dials and it was quite a curiosity in the neighbourhood.

In 1879 - that is, about four years after I first saw that Nichols-Shepard machine - I managed to get a chance to run one and when my apprenticeship was over I worked with a local representative of the Westinghouse Company of Schenectady as an expert in the setting up and repair of their road engines. The engine they put out was much the same as the Nichols-Shepard engine excepting that the engine was up in front, the boiler in the rear, and the power was applied to the back wheels by a belt. They could make twelve miles an hour on the road even though the self-propelling feature was only an incident of the construction. They were sometimes used as tractors to pull heavy loads and, if the owner also happened to be in the threshing- machine business, he hitched his threshing machine and other paraphernalia to the engine in moving from farm to farm. What bothered me was the weight and the cost. They weighed a couple of tons and were far too expensive to be owned by other than a farmer with a great deal of land. They were mostly employed by people who went into threshing as a business or who had sawmills or some other line that required portable power.

Even before that time I had the idea of making some kind of a light steam car that would take the place of horses more especially, however, as a tractor to attend to the excessively hard labour of ploughing. It occurred to me, as I remember somewhat vaguely, that precisely the same idea might be applied to a carriage or a wagon on the road. A horseless carriage was a common idea. People had been talking about carriages without horses for many years back - in

fact, ever since the steam engine was invented - but the idea of the carriage at first did not seem so practical to me as the idea of an engine to do the harder farm work, and of all the work on the farm ploughing was the hardest. Our roads were poor and we had not the habit of getting around. One of the most remarkable features of the automobile on the farm is the way that it has broadened the farmer's life. We simply took for granted that unless the errand were urgent we would not go to town, and I think we rarely made more than a trip a week. In bad weather we did not go even that often.

Being a full-fledged machinist and with a very fair workshop on the farm it was not difficult for me to build a steam wagon or tractor. In the building of it came the idea that perhaps it might be made for road use. I felt perfectly certain that horses, considering all the bother of attending them and the expense of feeding, did not earn their keep. The obvious thing to do was to design and build a steam engine that would be light enough to run an ordinary wagon or to pull a plough. I thought it more important first to develop the tractor. To lift farm drudgery off flesh and blood and lay it on steel and motors has been my most constant ambition. It was circumstances that took me first into the actual manufacture of road cars. I found eventually that people were more interested in something that would travel on the road than in something that would do the work on the farms. In fact, I doubt that the light farm tractor could have been introduced on the farm had not the farmer had his eyes opened slowly but surely by the automobile. But that is getting ahead of the story. I thought the farmer would be more interested in the tractor.

I built a steam car that ran. It had a kerosene-heated boiler and it developed plenty of power and a neat control which is so easy with a steam throttle. But the boiler was dangerous. To get the requisite power without too big and heavy a power plant required that the engine work under high pressure; sitting on a high-pressure steam boiler is not altogether pleasant. To make it even reasonably safe required an excess of weight that nullified the economy of the high pressure. For two years I kept experimenting with various sorts of boilers the engine and control problems were simple enough - and then I definitely abandoned the whole idea of running a road vehicle by steam. I knew that in England they had what amounted to locomotives running on the roads hauling lines of trailers and also there was no difficulty in designing a big steam tractor for use on a large farm. But ours were not then English roads; they would have stalled or racked to pieces the strongest and heaviest road tractor. And anyway the manufacturing of a big tractor which only a few wealthy farmers could buy did not seem to me worth while.

But I did not give up the idea of a horseless carriage. The work with the Westinghouse representative only served to confirm the opinion I had formed that steam was not suitable for light vehicles. That is why I stayed only a year with that company. There was nothing more that the big steam tractors and engines could teach me and I did not want to waste time on something that would lead nowhere. A few years before it was while I was an apprentice problems were simple enough - and then I definitely abandoned the whole idea of running a road vehicle by steam. I knew that in England they had what amounted to locomotives running on the roads hauling lines of trailers and also there was no difficulty in designing a big steam tractor for use on a large farm. But ours were not then English roads; they would have stalled or racked to pieces the strongest and heaviest road tractor. And anyway the manufacturing of a big tractor which only a few wealthy farmers could buy did not seem to me worth while.

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that the big steam tractors and engines could teach me and I did not want to waste time on something that would lead nowhere. A few years before - it was while I was an apprentice - I read in the World of Science, an English publication, of the "silent gas engine" which was then coming out in England. I think it was the Otto engine. It ran with illuminating gas, had a single large cylinder, and the power impulses being thus intermittent required an extremely heavy fly-wheel. As far as weight was concerned it gave nothing like the power per pound of metal that a steam engine gave, and the use of illuminating gas seemed to dismiss it as even a possibility for road use. It was interesting to me only as all machinery was interesting. I followed in the English and American magazines which we got in the shop the development of the engine and most particularly the hints of the possible replacement of the illuminating gas fuel by a gas formed by the vaporization of gasoline. The idea of gas engines was by no means new, but this was the first time that a really serious effort had been made to put them on the market. They were received with interest rather than enthusiasm and I do not recall any one who thought that the internal combustion engine could ever have more than a limited use. All the wise people demonstrated conclusively that the engine could not compete with steam. They never thought that it might carve out a career for itself. That is the way with wise people - they are so wise and practical that they always know to a dot just why something cannot be done; they always know the limitations. That is why I never employ an expert in full bloom. If ever I wanted to kill opposition by unfair means I would endow the opposition with experts. They would have so much good advice that I could be sure they would do little work.

The gas engine interested me and I followed its progress, but only from curiosity, until about 1885 or 1886 when, the steam engine being discarded as the motive power for the carriage that I intended some day to build, I had to look around for another sort of motive power. In 1885 I repaired an Otto engine at the Eagle Iron Works in Detroit. No one in town knew anything about them. There was a rumour that I did and, although I had never before been in contact with one, I undertook and carried through the job. That gave me a chance to study the new engine at first hand and in 1887 I built one on the Otto four-cycle model just to see if I understood the principles. "Four cycle" means that the piston traverses the cylinder four times to get one power impulse. The first stroke draws in the gas, the second compresses it, the third is the explosion or power stroke, while the fourth stroke exhausts the waste gas. The little model worked well enough; it had a one-inch bore and a three-inch stroke, operated with gasoline, and while it did not develop much power, it was slightly lighter in proportion than the engines being offered commercially. I gave it away later to a young man who wanted it for something or other and whose name I have forgotten; it was eventually destroyed. That was the beginning of the work with the internal combustion engine. I was then on the farm to which I had

It was in 1890 that I began on a double-cylinder engine. It was quite impractical to consider the single cylinder for transportation purposes - the fly-wheel had to be entirely too heavy. Between making the first four- cycle engine of the Otto type and the start on a double cylinder I had made a great many experimental engines out of tubing. I fairly knew my way about. The double cylinder I thought could be applied to a road vehicle and my original idea was to put it on a bicycle with a direct connection to the crankshaft and allowing for the rear wheel of the bicycle to act as the balance wheel. The speed was going to be varied only by the throttle. I never carried out this plan because it soon became apparent that the engine, gasoline tank, and the various necessary controls would be entirely too heavy for a bicycle. The plan of the two opposed cylinders was that, while one would be delivering power the other would be exhausting. This naturally would not require so heavy a fly-wheel to even the application of returned, more because I wanted to experiment than because I wanted to farm, and, now being an all-around machinist, I had a first-class workshop to replace the toy shop of earlier days. My

father offered me forty acres of timber land, provided I gave up being a machinist. I agreed in a provisional way, for cutting the timber gave me a chance to get married. I fitted out a sawmill and a portable engine and started to cut out and saw up the timber on the tract. Some of the first of that lumber went into a cottage on my new farm and in it we began our married life. It was not a big house-thirty-one feet square and only a story and a half high - but it was a comfortable place. I added to it my workshop, and when I was not cutting timber I was working on the gas engines - learning what they were and how they acted. I read everything I could find, but the greatest knowledge came from the work. A gas engine is a mysterious sort of thing - it will not always go the way it should. You can imagine how those first engines acted! power. The work started in my shop on the farm. Then I was offered a job with the Detroit Electric Company as an engineer and machinist at forty-five dollars a month. I took it because that was more money than the farm was bringing me and I had decided to get away from farm life anyway. The timber had all been cut. We rented a house on Bagley Avenue, Detroit. The workshop came along and I set it up in a brick shed at the back of the house. During the first several months I was in the night shift at the electric-light plant - which gave me very little time for experimenting - but after that I was in the day shift and every night and all of every Saturday night I worked on the new motor. I cannot say that it was hard work. No work with interest is ever hard. I always am certain of results. They always come if you work hard enough. But it was a very great thing to have my wife even more confident than I was. She has always been that way.

I had to work from the ground up - that is, although I knew that a number of people were working on horseless carriages, I could not know what they were doing. The hardest problems to overcome were in the making and breaking of the spark and in the avoidance of excess weight. For the transmission, the steering gear, and the general construction, I could draw on my experience with the steam tractors. In 1892 I completed my first motor car, but it was not until the spring of the following year that it ran to my satisfaction. This first car had something of the appearance of a buggy. There were two cylinders with a two-and-a-half-inch bore and a six-inch stroke set side by side and over the rear axle. I made them out of the exhaust pipe of a steam engine that I had bought. They developed about four horsepower. The power was transmitted from the motor to the countershaft by a belt and from the countershaft to the rear wheel by a chain. The car would hold two people, the seat being suspended on posts and the body on elliptical springs. There were two speeds one of ten and the people were working on horseless carriages, I could not know what they were doing. The hardest problems to overcome were in the making and breaking of the spark and in the avoidance of excess weight. For the transmission, the steering gear, and the general construction, I could draw on my experience with the steam tractors. In 1892 I completed my first motor car, but it was not until the spring of the following year that it ran to my satisfaction. This first car had something of the appearance of a buggy. There were two cylinders with a two-and-a-half-inch bore and a six-inch stroke set side by side and over the rear axle. I made them out of the exhaust pipe of a steam engine that I had bought. They developed about four horsepower. The power was transmitted from the motor to the countershaft by a belt and from the countershaft to the rear wheel by a chain. The car would hold two people, the seat being suspended on posts and the body on elliptical springs. There were two speeds one of ten and the other of twenty miles per hour obtained by shifting the belt, which was done by a clutch lever in front of the driving seat. Thrown forward, the lever put in the high speed; thrown back, the low speed; with the lever upright the engine could run free. To start the car it was necessary to turn the motor over by hand with the clutch free. To stop the car one simply released the clutch and applied the foot brake. There was no reverse, and speeds other than those of the belt were obtained by the throttle. I bought the iron work for the frame of the carriage and also the seat and the springs.

The wheels were twenty-eight- inch wire bicycle wheels with rubber tires. The balance wheel I had cast from a pattern that I made and all of the more delicate mechanism I made myself. One of the features that I discovered necessary was a compensating gear that permitted the same power to be applied to each of the rear wheels when turning corners. The machine altogether weighed about five hundred pounds. A tank under the seat held three gallons of gasoline which was fed to the motor through a small pipe and a mixing valve. The ignition was by electric spark. The original machine was air-cooled - or to be more accurate, the motor simply was not cooled at all. I found that on a run of an hour or more the motor heated up, and so I very shortly put a water jacket around the cylinders and piped it to a tank in the rear of the car over the cylinders. Nearly all of these various features had been planned in advance. That is the way I have always worked. I draw a plan and work out every detail on the plan before starting to build. For otherwise one will waste a great deal of time in makeshifts as the work goes on and the finished article will not have coherence. It will not be rightly proportioned. Many inventors fail because they do not distinguish between planning and experimenting. The largest building difficulties that I had were in obtaining the proper materials. The next were with tools. There had to be some adjustments and changes in details of the design, but what held me up most

## WHAT I LEARNED ABOUT BUSINESS

My "gasoline buggy" was the first and for a long time the only automobile in Detroit. It was considered to be something of a nuisance, for it made a racket and it scared horses. Also it blocked traffic. For if I stopped my machine anywhere in town a crowd was around it before I could start up again. If I left it alone even for a minute some inquisitive person always tried to run it. Finally, I had to carry a chain and chain it to a lamp post whenever I left it anywhere. And then there was trouble with the police. I do not know quite why, for my impression is that there were no speed-limit laws in those days. Anyway, I had to get a special permit from the mayor and thus for a time enjoyed the distinction of being the only licensed chauffeur in America. I ran that machine about one thousand miles through 1895 and 1896 and then sold it to Charles Ainsley of Detroit for two hundred dollars. That was my first sale. I had built the car not to sell but only to experiment with. I wanted to start another car. Ainsley wanted to buy. I could use the money and we had no trouble in agreeing upon a price.

It was not at all my idea to make cars in any such petty fashion. I was looking ahead to production, but before that could come I had to have something to produce. It does not pay to hurry. I started a second car in 1896; it was much like the first but a little lighter. It also had the belt drive which I did not give up until some time later; the belts were all right excepting in hot weather. That is why I later adopted gears. I learned a great deal from that car. Others in this country and abroad were building cars by that time, and in 1895 I heard that a Benz car from Germany was on exhibition in Macy's store in New York. I traveled down to look at it but it had no features that seemed worth while. It also had the belt drive, but it was much heavier than my car. I was working for lightness; the foreign makers have never seemed to appreciate what light weight means. I built three cars in all in my home shop and all of them ran for years in Detroit. I still have the first car; I bought it back a few years later from a man to whom Mr. Ainsley had sold it. I paid one hundred dollars for it.

During all this time I kept my position with the electric company and gradually advanced to chief engineer at a salary of one hundred and twenty-five dollars a month. But my gas-engine experiments were no more popular with the president of the company than my first mechanical leanings were with my father. It was not that my employer objected to experiments - only to experiments with a gas engine. I can still hear him say: "Electricity, yes, that's the coming thing. But gas - no."

He had ample grounds for his skepticism to use the mildest terms. Practically no one had the remotest notion of the future of the internal combustion engine, while we were just on the edge of the great electrical development. As with every comparatively new idea, electricity was expected to do much more than we even now have any indication that it can do. I did not see the use of experimenting with electricity for my purposes. A road car could not run on a trolley even if trolley wires had been less expensive; no storage battery was in sight of a weight that was practical. An electrical car had of necessity to be limited in radius and to contain a large amount of motive machinery in proportion to the power exerted. That is not to say that I held or now hold electricity cheaply; we have not yet begun to use electricity. But it has its place, and the internal combustion engine has its place. Neither can substitute for the other which is exceedingly fortunate.

I have the dynamo that I first had charge of at the Detroit Edison Company. When I started our Canadian plant I bought it from an office building to which it had been sold by the electric company, had it revamped a little, and for several years it gave excellent service in the Canadian plant. When we had to build a new power plant, owing to the increase in business, I had the old motor taken out to my museum - a room out at Dearborn that holds a great number of my mechanical treasures.

The Edison Company offered me the general superintendency of the company but only on condition that I would give up my gas engine and devote myself to something really useful. I had to choose between my job and my automobile. I chose the automobile, or rather I gave up the job there was really nothing in the way of a choice. For already I knew that the car was bound to be a success. I quit my job on August 15, 1899, and went into the automobile business.

It might be thought something of a step, for I had no personal funds. What money was left over from living was all used in experimenting. But my wife agreed that the automobile could not be given up that we had to make or break. There was no "demand" for automobiles - there never is for a new article. They were accepted in much the fashion as was more recently the airplane. At first the "horseless carriage" was considered merely a freak notion and many wise people explained with particularity why it could never be more than a toy. No man of money even thought of it as a commercial possibility. I cannot imagine why each new means of transportation meets with such opposition. There are even those to-day who shake their heads and talk about the luxury of the automobile and only grudgingly admit that perhaps the motor truck is of some use. But in the beginning there was hardly any one who sensed that the automobile could be a large factor in industry. The most optimistic hoped only for a development akin to that of the bicycle. When it was found that an automobile really could go and several makers started to put out cars, the immediate query was as to which would go fastest. It was a curious but natural development - that racing idea. I never thought anything of racing, but the public refused to consider the automobile in any light other than as a fast toy. Therefore later we had to race. The industry was held back by this initial racing slant, for the attention of the makers was diverted to making fast rather than good cars. It was a business for speculators.

A group of men of speculative turn of mind organized, as soon as I left the electric company, the Detroit Automobile Company to exploit my car. I was the chief engineer and held a small amount of the stock. For three years we continued making cars more or less on the model of my first car. We sold very few of them; I could get no support at all toward making better cars to be sold to the public at large. The whole thought was to make to order and to get the largest price possible for each car. The main idea seemed to be to get the money. And being without authority other than my engineering position gave me, I found that the new company was not a vehicle for realizing my ideas but