out in the last game of the last set may serve; and the same privilege is given to their opponents in the second game of the new set.

34. The players shall take the service alternately throughout the game; a player cannot receive a service delivered to his partner; and the order of service and striking out once established shall not be altered nor shall the striker-out change courts to receive the service, till the end of the set.

35. It is a fault if the ball served do not drop between the service line, half-court line, and service side line of the court, diagonally opposite to that from which it was served.

36. It is a fault if the ball served do not drop as provided in law 35, or if it touch the server's partner or anything he wears or carries.

MOTORING: THE EVOLUTION OF THE AUTOMOBILE.

BY

CHARLES WELSH.

You can make all the motors run some of the time, and some of the motors all of the time; but you can't make all the motors run all of the time.

WHEN that famous old fraud, Mother Shipton, prophesied in the time of Henry VIII. that "Carriages without horses shall go," she was only prophesying after the event, for sails, windmills, and springs had been employed as means of power locomotion on common roads early in the sixteenth century. These early inventions, it is true, were rude, clumsy, and imperfect. Johann Hausted, of Nuremberg, for example, made a chariot about this time which was propelled by springs. It was capable of a speed of one and a quarter miles an hour! A veritable Nuremberg toy alongside of our modern machines with a record of seventy-five miles an hour.

But far-sighted men had believed in the possibility of automobility for hundreds of years. The automobile was foreshadowed by Roger Bacon in the thirteenth century, for he wrote, "We will be able to propel carriages with incredible speed without the assistance of any animal."

If we take a hasty glance along the stream of Time, noting by the way what the last four hundred years have brought forth in the shape of self-propelled carriages, we shall remark that the great Newton suggested propulsion by the reaction of a steam jet in 1680, and that Father Verbiest, a Jesuit missionary in China, actually constructed a machine so propelled in 1665. The celebrated engineer, Pupin, built a model for a road carriage to be propelled by an engine with a cylinder and piston, and as soon as steam began to come into practical use the idea of self-propelled vehicles became very general, and many busy brains set to work on the problem.

The great Frenchman, Cugnot, who constructed the earliest practical power locomotives for road use during the years 1763-1771, may almost be called the father of automobilism. His first carriage was

designed to transport cannon. His second steam carriage, built in 1770, is still preserved in Paris at the Conservatoire des Arts et des Métiers. "The ideas of Cugnot," says the Marquis de Chasseloup-Loubat, "were an entire century in advance of the mechanical means by which they could be realized."

The atttempt led to no satisfactory results. Everything was defective—motive power, steering, control. Nevertheless the carriage ran, and ran so well that it broke down the enclosure of the ground on which it was tried. It is an incontestable fact that Cugnot is the inventor of automobile locomotion, and that the honor of first having imagined and realized a new method of transport, estimated to play an important part in the welfare of many lands, belongs to him.

F. Moore in London, 1769, and Livingston, in 1784, were well-known makers of steam carriages of a kind, as were also Oliver Evans and Nathan Read in this country, who made some serviceable machines.

It was the idea of the automobile that led to the invention of the steamboat. Late in the eighteenth century John Fitch, of Hartford, Conn., conceived the idea of a steam carriage. It occurred to him to construct it so that it could cross a river, and this led him to build the first steamboat, which he ran on the Connecticut River. The first horseless steam fire-engine was devised by Frank Curtis, of Newburyport, Mass., shortly after 1860, and it ran successfully under its own steam. In 1867 Mr. Curtis built a steam carriage with a speed of twenty-five miles an hour, and it ran for eleven years.

But to return to our chronological order, there is one machine made by Wm. Murdock, in England, about 1784, which is still in good working order, and the celebrated Cornish engineer, Trevithick, began to build road engines in 1803. The first compressed-air auto-car was made about 1810. "It was in England toward the third decade of the nineteenth century," says the authority before quoted, "that we saw the idea of Cugnot reappear. The same impulse which moved English engineers to build railroads in order to free the great industrial centres from the economic tyranny of those who constructed canals urged them to study methods of automobile locomotion on highways. That is to say, in its inception automobile locomotion was considered as an auxiliary to the railroad, which it really is."

Unfortunately the promoters of the railway lines did not at all understand the respective spheres of action of the machine on the rail and the machine on the road. They took umbrage at automobile locomotion, and since they had much capital and influence at their disposal, they secured a law from the English Parliament which effectually killed automobile evolution. It ordained among other things that a man carrying a red flag by day, or a red lantern by night, must be kept a hundred yards in advance of every automobile vehicle.

Until about 1840 steam was a common motive power for road vehicles. The road engine then, as the bicycle and automobile to-day, led to great improvements in road building in England and on the

Continent of Europe. The famous MacAdam, Telford, and Neill, men whose names are indissolubly connected with the best modern road-making, flourished at about this time. But British ingenuity never succeeded in making the light and easy-running machines which the Frenchmen and the Americans achieved in these later years.

With the coming of the railroad, the road-engine was practically doomed for the time, although in reality the former was the outcome of the craze for the latter.

The vested interests in the railroad, as we have seen, soon became so enormous that legislation was directed to the restriction of the road-engines, and they were employed under all sorts of crippling rules and regulations besides these referred to, until they practically disappeared, and their more powerful and swifter rival held the field alone for steam transportation for men and merchandise until the modern revival, which may be said to have had its origin in about 1878, when Leon Bollee, a French engineer, established his auto-car, which weighed three and a half tons. Compare this with the modern Daimler petroleum motor, which weighs but one ton and will do twice as much work. In 1886 Count Albert de Dion in his steam automobile showed what was the first practical horseless carriage of the modern type. Another Frenchman, Serpollet, was among the beginners of the modern perfect steam auto-car, and from Germany comes the first oil motor—the Bentz.

A great step in the popularization of the auto-car was made in the early nineties, when the owners of *Le Petit Journal* of Paris organized a race between the various makers which attracted world-wide attention, and in 1898, when the Exhibition was held in Paris under the auspices of the Automobile Club of France, at which 1100 vehicles were shown and thirty thousand spectators were present.

A great impulse to the development and use of the automobile in England was given by the withdrawal in 1897 of many of the laws which had hitherto hampered and restricted them. Meanwhile our own inventors and manufacturers were not idle, and they soon set about working out the possibilities of the machine and developing it, until to-day the American automobile, if it does not lead the world, is at least abreast of those of the pioneer countries of Europe. In June, 1896, an automobile contest organized by the proprietor of the *Cosmopolitan Magazine,* was made in New York from the City Hall to Tarrytown on the Hudson and return. And this seems to have given a remarkable and powerful impulse to automobile industry in this country. It attracted attention all over the country. The winner was the Duryea gasoline motor-wagon.

It was these and other contests which brought about the formation of the American Automobile Club, with headquarters in New York —which has now a large and increasing membership roll. It has already coöperated with the League of American Wheelmen in their

good work on behalf of good roads. It is said that in the summer of 1898 there were not thirty automobiles in the United States, but by August, 1899, at least eighty companies had been organized, with an aggregate capital of nearly $400,000,000. Two years later over three hundred firms were making automobiles, while to-day these figures may fairly be doubled, although there are no reliable statistics available.

The patent office records furnish a sure indication of the directions in which the minds of our vast army of inventors are running, and of the interest taken in any given industry. No less than 275 patents dealing with automobiles in some shape or another were recorded during the last ten years of the nineteenth century, and the annual average since then has been considerably larger.

This enormous industry has naturally led to the establishment of important periodicals devoted to its interests all over the country,—east and west, north and south. About twenty such periodicals are extant to-day, and the magnitude of the industry is reflected in the most striking manner by the immense advertising patronage which they enjoy. Automobile literature in Europe is as extensive. The number of books devoted to the subject, the attention it receives in the magazines, and the number of new automobile journals which spring up every week is too great even to be chronicled here. But it is not necessary to go to the trade journals to see this. It is scarcely possible to take up a magazine or a newspaper to-day without being reminded of the presence of this new industry, and the streets of every great city, and every highway in the United States, give evidence that this great adjunct to, and developer of, commerce has come to stay.

We have referred to the effect of the automobile and the cycle on the development of good roads, and have given some idea of the enormous industries to which it has given rise, furnishing employment to hundreds of thousands throughout the country. But this new means of locomotion is doing more than this.

As men "run to and fro, knowledge is increased," new tracts of country are opened up not only for the traveller for pleasure, but for profitable purposes as well. The chief interest in the automobile has hitherto been in its usefulness for the transportation of man. It is now receiving considerable attention as affording increased facilities for the transportation of merchandise, and it may be the means for sending a great proportion of the dwellers in crowded cities back to the land. With increased facilities of cross-country transportation there comes the possibility of that *petite culture,* in which "every rood of land maintains its man," such as is found *par excellence* among the prosperous and contented peasantry of Belgium. Of course we must have our agriculture on the grand scale in the West, but around and about our Eastern cities there are countless acres of land which might be turned to profitable use, if only there were cheap and easy methods

of bringing their produce to market, and the automobile may be the means of accomplishing this.

Indeed, it has already done so in England and in Europe. The use of motors for farm and market work is capable of enormous development. But there is no limit to their employment. The War Department, the post-office, the doctor, the commercial traveller—all must use the automobile in the time to come, and as has been well said, "the revolution worked by railways is a small thing compared with the revolution now being produced by the motor-car."

We have seen that there are three great periods in the evolution of the automobile—first, the long period of its inception before the invention of railroads, and its partial development in the earlier decades of the nineteenth century. Then the period of abeyance, when it was eclipsed, if not driven out of existence, by the railroad power, and last, the great modern revival of the past twenty-five years.

Electricity, steam, and gasoline or naphtha are the three main sources of power that do the bidding of the man behind the lever. Other sources of power, such as compressed air, liquid air, carbonic acid gas, and alcohol, have been experimented with, but are regarded as impracticable by expert authorities. In large cities, the electric vehicle was the first to come extensively into favor. It is especially adapted for all city uses, for it is without odor or vibration, and is almost noiseless; but so long as it is obliged to depend upon a storage battery it must be very heavy and can run but a limited distance—about twenty-five miles—without recharging. Therefore the automobiles run by steam or gasoline are superior for long-distance purposes.

It is not within the province of this paper to enter into technical mechanical details of the evolution of the automobile. Increased power combined with diminished weight, higher speed, with smooth-running, accurate, and simple steering gear, perfect lubrication, and absolute control, are the directions in which it is being evolved before our eyes, and it is in these directions that manufacturers have been moving during the past twenty-five years. Every day sees some superfluous part removed, some simplification introduced. Every month or so these modifications bring about a reduction of cost both of the machine itself and in its maintenance. Every day also sees some new adaptation of it to commercial purposes.

The evolution of the form and shape of the automobile is one of the most interesting features of its development. The first railroad carriages were just the ordinary coaches on flanged wheels to keep them on the track. The adaptation to conditions gradually brought about our magnificent hotels on wheels, in the shape of parlor, dining, and sleeping cars. So the first motor-carriages were built on the plan of the ordinary horse carriage, but every day sees a departure from that form and a development more in accordance with the conditions. What the ultimate type will be it is difficult to forecast, but it will

doubtless develop into a bluntly pointed front—a tendency, perhaps, to cigar shape—and a much lower body, probably within a step of the ground.

As we have indicated, the cost of automobiles is in a state of constant change. From the catalogues of the leading manufacturers, issued in 1904, it appears that an electric speed road wagon of one of the leading types can be bought for $850 fully equipped, and larger and more expensive types up to $2000. These carriages are started as easily as turning on an electric light. The brakes are simple and easily handled, and the hitching-strap is done away with by the fact that all that is necessary to secure your finding the vehicle where you left it is to take out the starting plug and put it in your pocket. Goods-delivery wagons of the same motive power, and with the same general equipment, cost from $1400 upward, according to size and carrying capacity. An electric carriage for family use costs about $2000, and an omnibus from $3000 to $4000.

The prices of gasoline vehicles range from $1000 for a first-class road carriage to $4000 for an omnibus. The cost of running may vary from fifty cents to $1.00 and more per hundred miles, according to the size of the machine.

The driver of gasoline vehicles must know something of the principle of the machine, and is often called upon to apply his knowledge. But he can go anywhere—up hill and down over the worst roads, through mud and snow, and can go at any rate he chooses. He can buy his fuel in any village street and in every city, and is not dependent upon electric-charging stations. Therefore, as we have said, for touring purposes the gasoline vehicle has great advantages over that propelled by electricity.

Steam has been more generally applied to the heavier classes of vehicles, though some pretty lighter ones have been made, chiefly in this country. They are easily started and easily stopped, and fuel and water can be obtained anywhere; but they have obvious disadvantages and have not come into general use for passenger purposes.

Records, like "promises and pie-crust," are, as we all know, made to be broken, and almost every day sees the old ones shattered and new ones made. Speed of seventy-five miles an hour, attained on an ordinary road in France, and a three thousand mile trip lasting fifteen days and two hours in this country, were two of the records for 1904.*

A last word on the evolution of the automobile should be on the subject of the evolution of public opinion with regard to it. When the bicycle was becoming popular, the prejudice against it from pedestrians and drivers was unbounded, and the automobile has been even more severely attacked, perhaps not altogether without reason. But as the driver of the automobile becomes more expert, and the public

* The latest will be found on a later page, among "One Hundred Best Events on Record."

becomes more accustomed to them, these prejudices will die out. Horses are being educated to meet motors without shying, as they were educated to meet railroad trains, trolley cars, and bicycles, and familiarity is daily breeding—not contempt, but the necessary added care on the part of all concerned, which this new method of locomotion calls for.

MOTOR-BOATING.

WHAT is more delightful to while away an hour or two of a sunny afternoon than a spin up the river at a steady five or six miles an hour, without the slightest fatigue? What the light car is to the road the small motor-boat is to the river.

To many people, especially those within convenient reach of our rivers and canals, and at seaside resorts, the attraction of a spin upon the water is irresistible. Their ambition is to be possessed of a small motor-boat, but the question of cost is so much an inscrutable mystery that they hesitate and finally dismiss their desire as being impossible, owing to the limited length of their purse-strings.

The motor-boat has so many advantages over the simplest motor-car that a great many people would much rather boast a boat than a car. There are fewer integral parts, and less liability to breakdowns. There are no change-speed gears about which to worry, nor differential gears to cause any anxiety. Moreover, there is no trouble in connection with the facilities for cooling the motor so long as the engine is fitted with a powerful pump. The driver does not have to husband his cooling medium after it has passed through the cylinder jacket, for he can discharge it directly into the water and draw fresh supplies from an illimitable source.

The fundamental components of a motor-boat are the motor: invariably a reducing gear, to reduce the number of revolutions of the engine shaft for the propeller shaft (since it is obvious that a speed of 1500 or more revolutions per minute in the engine is utterly unsuited to the propellers); the propellers, together with reversing gear —though every boat is not fitted with the latter mechanism, the propeller simply revolving in a forward drive. The reversing gear, however, is invaluable, especially when it is desired to arrest the speed of the boat suddenly or to manœuvre, and is well worth the extra cost.

A motor-boat is no more exposed to the danger of fire than a motor-car. All fear of fire can be easily overcome by the exercise of cleanly and careful habits. The bottom of the boat beneath the engine should be kept scrupulously free from all accumulation, then no fear of fire need be entertained, and the boat will be as safe from this danger as a car or a bicycle.

The great efforts are toward a practical, every-day, moderately