and their stems and operating camshafts will fit in any one of a thousand different engines of the same size and design. All this, of course, is greatly to the advantage of the purchaser.

The standardization of certain parts and fittings began more than five years ago. Various big manufacturers agreed as to standards in tyre-lugs, rims, lamp-brackets, and various other particulars. This work has been carried on since 1904 by the oldest and most reputable of the American motor-car builders. Among the important results obtained have been the adoption of standards for screws and nuts, reducing the former multiplicity of sizes and threads to a minimum, based on the United States standard, to which carriage bolts conform. Since every hardware store and machine and carriage shop carries carriage bolts in stock, the man whose car is built to conform to this standard has no trouble in replacing a lost or broken bolt wherever he may be.

The spark plug has also just recently been standardized, and the engines of some thirty or more prominent makes of motor cars will hereafter be bored and threaded to receive plugs of ⅞ inch diameter, with straight thread of eighteen pitch. Steels and other metals purchased as raw materials must now conform to certain chemical and physical standards; and as these standards are very high, the user of a machine built from such metals is assured of a high factor of safety, provided the design is good throughout.

In the long run, standardization and interchangeability of parts will have the effect of giving us a higher grade of motor car at a lower price, but this is dependent in considerable degree upon the production of one model in great numbers and the elimination of extensive annual changes in design that necessitate the making of costly jigs, gages, and special machinery.

Meantime, nothing retards the progress of the automobile industry. Despite the financial depression in America, the demand for automobiles increased steadily. Business done in 1903 amounted to less than eight million dollars; in 1907 it was well over a hundred millions. There is over two hundred millions of capital invested, and the industry gives constant employment to 110,000 people. This is in the United States alone. In that country there are over 250 firms manufacturing automobiles, and during 1908 these firms sold over 52,000 cars. Over 320,000 cars are now in use in the various states; 64,500 in the State of New York alone. It will give a better idea of the magnitude of the industry when we point out that in California, with a comparatively small population, 19,375 cars are registered. If cars were owned in any such proportion in New Zealand, there would be an enormous growth of the motor industry And this same movement in the direction of light cars, of moderate price and power, must have its effect in New Zealand. The demand for the lighter and cheaper vehicle is proportionately as great in England as in America. The motor-car indeed, is steadily being brought within the reach of all reasonably comfortable households.

Anyone even slightly familiar with the properties of iron and steel, knows that a steel casting which when new appears to be as strong as a forging, and which makes as good a showing under ordinary tests, nevertheless weakens and becomes brittle when subjected to repeated vibration and shocks. So well is the phenomenon of "fatigue" now recognised that steel castings are used nowhere in any but the cheaper and lowest-powered automobiles, and even in them rarely save for parts not subjected to shock.

In 1901 automobile constructors thought that they had done their whole duty if they used steel forgings instead of castings. To-day we know better. There are more kinds of steel than there are kinds of cigars. Any kind of steel is good for something—if it be only for ballast—but not many kinds are good enough for the severe conditions of automobile usage. The proportionate difference that exists between castings and forgings is found also between forgings of ordinary steel and forgings of some high-grade alloy steels. A shaft of common machinery steel, which if pulled asunder in a testing machine would stretch a fifth or a quarter of its length before letting go, if used in an automobile transmission or axle will in time crystallise and break, with a brittle pipe-stem fracture, under stresses which, when it was new, would not even have "sprung" it. So it has come to pass that nickel steel, chrome-nickel steel, and chrome-vanadium steel have ousted the ordinary variety for all the more important parts of the best automobiles. All of these steels are much stronger than the ordinary simple steels, and possess in varying degree the property of resistance to the abnormal shocks of accident. Later investigation, however, has proved that these stronger and shock-resisting compound steels must be rigidly classified, as not only is it very important that the steel for such purposes should be strong and should resist a simple shock, but also that it should resist in the highest degree possible the development of that potential brittleness which is induced in all steels by prolonged subjection to repeated shock and impacts. In this respect vanadium steels have shown superiority to all others, at least as far as laboratory tests can demonstrate. The ordinary nickel steel, unless properly heat treated, unfortunately possesses the power of developing this potential brittleness almost as fast as the ordinary carbon steels that have been used in the past, hence its demonstrated superiority does not show up as great as simple physical tests would lead us to suppose. Abnormal shock due to accident may wreck the car, but it will be by twisting and bending, rarely indeed by direct fracture. The effect of collision at high speed is to crumple the framework, springs, and axles like paper; but if the wreck is not too complete they can be heated and straightened as if nothing had happened. The force required to bend such steel is almost unbelievable to one who has known only the common grades. Even transmission gears, hard and relatively brittle though they are, can hardly be broken with a sledge hammer.

The same betterment has affected every vital part of the modern automobile. Gears that used to be made of bronze or soft steel are now made of alloy steel. Instead of axles which rarely outlasted the shortest-lived car, we now find I-beam forgings which survive ditchings and upsets, the blows of cross gullies seen too late and taken at high speed—anything indeed, which the passengers themselves may reasonably hope to survive without injury. With the occasional exception of the crank-shaft, which still resists the efforts of builders to make it entirely unbreakable, because it is subject to a great many other considerations than its component metal, there is hardly a part of the modern automobile which, given proper design and workmanship, can be excused for failing in service or legitimately wearing out.

To the man who buys a high-grade car of current model, these facts convey merely the comforting reflection that he is getting good value for his money, and that there is a substantial reason for the seemingly high price of a good machine. But to him who purchases a second-hand car which has seen two or three seasons' use they mean something more important. So recent has been the general adoption and intelligent treatment of alloy steels, that the car is very likely to develop breakages quite unknown to its younger days.

Every motorist has known cars which, while of good design generally, had certain parts which persisted in giving trouble. In such a case it is a mistake to get rid of the car as useless, since almost invariably the offending parts can be corrected at much less expense than would be involved in the sacrifice of the car. If a part works loose, it is because of poor design or fitting. If it breaks, the remedy may be found in substituting a new part of stronger material, if it is inconvenient to increase the dimensions. When a rubbing part wears out quickly the chances are that it is insufficiently lubricated or imperfectly protected from dirt.

At present automobiles wear out at a great many points—slowly at some, rapidly at a few. But means are constantly being found to reduce the wear, and to render the parts easy of repair or replacement when worn. More than that, the multitudinous small joints and bearings, whose replacement is difficult and whose life is apt to fix the useful life of the car, are by degrees being made virtually non-wearing. What wear occurs is limited more and more to the essential elements of motor and transmission, and renewal of these keeps the car in practically new condition. A few years from now we shall have cars which run almost indefinitely with only periodic overhauling and ordinary daily filling and cleaning.

The Road Hog.

We take the following letter from a recent issue of the *Wairarapa Daily News*, as showing that the country is beginning to develop a nuisance:—

Sir,—Is it not time that something were done to check the "motor hog" in his wild career? At present he takes command of the whole road, and treats the unfortunate class which is obliged to stick to horses, either from choice or necessity, with the utmost contempt. One day last week, when driving into Carterton, a person of this description came tearing along the road near Black Bridge (where there is a soft part just broad enough for one trap) on the wrong side of the road, and only turned off when within a yard of my horse's nose, the animal, an unusually quiet one, all but put me in the ditch. The same thing occurred to my daughters and a lady friend yesterday, when driving between Carterton and Masterton. The "motor hog" does not care a rap; his precious tyres are of more importance to him than the lives and limbs of other people, to say nothing of their property.—I am, etc.,

A BIT OF THE ROAD.