MOTOR CARS FOR MEDICAL MEN.

By W. WORBY BEAUMONT, M.Inst.C.E.

If we may found a judgment on the opinions of the many who have offered what they have been pleased to call "the doctor's car," it would appear that almost anything will meet the requirements. This, however, is so far from being the truth that there are but few types of car that possess the first qualification, namely, trustworthiness.

Whether it be a small car with no pretensions to elegance or luxurious comfort, the cheap car, or the more costly car of expensive finish, trustworthiness is the first attribute. Cheapness, or even simplicity, affords no compensation for the failures that should not occur.

The supreme excellence in machinery may consist in simplicity, but the simplest combination is sometimes the most expensive in manufacture, and is almost always the most difficult to invent and design. Moreover, simplicity is not in itself commendable if attained by sacrifice of convenience or of trustworthiness.

The impressions made on the minds of manufacturers a year or two ago, that the doctor's car must be a cheap one, were made before it had become evident to medical men and others that comparison in first cost between that of a horse or horses and vehicle and a motor vehicle could not be a guide as to the expediency of purchasing the latter.

The impression was made before it was realised that an extra £100 capital expenditure must not be looked upon as money expended on a luxury or upon a mere fancy for one method of transport as compared with another, but as a capital account charge costing say £5 per year, and incurred with a view to saving say £20 per year, or as a means of increasing earning capacity by that or by a very much larger amount.

The question is in most cases precisely that which a manufacturing engineer has to face when he considers the expediency of throwing out old plant quite capable of turning out excellent work, but limited in producing power, as compared with the new plant, which will cost a great deal and add largely to his capital outlay. The manufacturing engineer has, however, the advantage that he can satisfy himself as to the producing power and the probable durability of the new plant, and can estimate the profits derivable from its operation, assuming he can dispose of the product. The medical man is necessarily less certain of the good qualities of his proposed new plant in the form of a motor vehicle, though given good qualities he can estimate the advantages which may follow upon the command of an extended area, or of reduction of time required to cover a given area.

The advantages which may accrue from trustworthiness, and long-distance capacity of the new means of travel as compared with the old, will depend much upon individual circumstances, topographical and other, and upon experience, fortunate or otherwise, with horses. A man who has been exceptionally fortunate with horses will not be among the first to try motor vehicles, but, to save his time, will do so ere long.

Assuming that a medical man has made up his mind that the question to him is one of the greatest capacity for doing work or of getting work done, and that he is prepared to give to a motor vehicle at least half as much consideration and care that he has been accustomed to give or is willing to give to a horse or horses, then he must ask himself the further question, Am I likely to have the patience to turn that amount of care and consideration into the new channel? For a few months he will have to do more than merely give the time, he must also give enough thought to his car and its parts to enable him to acquire mechanical sympathy. He must learn to think enough about it to enable him to do that for his car which corresponds with ordering his horse a bran mash or some other special treatment, and see that he gets it. To some men all this will come easily, but, if it does not, then the motor vehicle owner must employ as his driver a good steady man capable of doing a little mechanical thinking as well as work.

TYPES OF MOTOR.

The available kinds of motor vehicle may be divided first into three classes defined by the propelling agent, namely,

steam, petroleum spirit, and electricity. Of the first (steam) there are at present very few types, the most successful being those of American construction, other makes not yet having been made or used sufficiently to make it necessary to deal with them.

STEAM.

The machinery of these steam carriages is less in quantity and perhaps simpler than that of most petrol (petroleum spirit) motor carriages. There is, however, a steam boiler of some form to be added, and this robs the combination of its apparent simplicity as compared with the petrol vehicle. The silent running of these steam cars, especially when new, has captivated very many observers and secured many purchasers. The ease with which speed may be varied and most hills climbed with little more trouble than turning on more or less steam, has also done much to secure purchasers. Here, however the advantage ends, and although for some purposes these steam cars meet the requirements, they do not commend themselves as the doctor's car:

1. Because they take longer to get ready for a start than petrol cars.

2. Because they use about twice the quantity of petrol required by the petrol motor car of equal mean power.

3. Because as at present made the necessary stops for water are frequent as compared with the petrol car, which may run the whole day without a fresh supply.

4. Because the employment of a boiler and its necessary accessories demands more thought while running, and more attention for cleaning out in the motor-car house at night after running a day or two, especially if the driver has had to use unsatisfactory water. Moreover, a continuance of very cold weather is likely to cause trouble with water-gauge and other connections.

As a pleasure car these objections need not weigh much, but when a car is wanted every day and often at night, and must be ready at a minute's notice, they become almost prohibitory in their importance. It must not be forgotten that a doctor may sometimes have to leave his car an hour or hours, sometimes when he has thought that a quarter of an hour would be sufficient. Having left his burner going he may not be able to return to it for half an hour or hour to put it out, and it is on his mind all the time. Then when he has put it out he has, after an hour or two, a somewhat lengthy operation to perform in getting a fresh start. When he at length reaches home he wants some rest, and does not want to be kept up to see that the boiler is blown out, and the fifteen or twenty gallons of water and about two or three gallons or more of oil filled into the tanks. Even when he has a man to drive him or tend his car he is not altogether free from these troubles.

ELECTRICITY.

Electric cars are not yet sufficiently trustworthy for the always-on-duty requirements of the medical man. Even if the batteries were always in good condition, it would be found troublesome to arrange for recharging at the time that a doctor thought he could be certain of not requiring the car. The owner of two cars could perhaps avoid this difficulty, and for town work and elsewhere in almost level districts the electric car might be adopted by those who have their own charging plant or are not far from a charging station. The smooth, quiet running and easy control of the electric vehicle is very much in its favour; but not only is the battery-driven car not yet sufficiently trustworthy for an every-day and irregular service in all weathers, it is at present much higher in first cost and more costly in running expenses than the petrol car.

PETROL (PETROLEUM SPIRIT).

The petrol motor car is made in numerous types and sizes. There are the larger cars, with three, four, or more seats, and the smaller cars of similar designs, but most of which are known as voiturettes. From the second type, the doctor's car will probably be most generally chosen.

TYPES OF MACHINERY AND RUNNING GEAR.

With respect to the machinery and under gear, these may be divided into classes:

1. The car with two belts and two or three speeds, obtained by shifting these belts and by small-toothed or spur gear within one of the pulleys. The belts are employed to drive

a countershaft, on the ends of which are chain pinions, operating chains, by which the driving wheels, which run free on the fixed hind axle are independently driven. The Benz Ideal cars, among others, are of this class, similar cars by other makers being made under various names.

2. Cars with one belt from motor to a small countershaft, carrying spur pinions, gearing alternately with two spur wheels—that is, cogwheels, on the driving axle, no chains being used. The New Orleans cars are of this class, other cars of similar design being made under different names. All these are driven by motors in which the ignition of the combustible charge in the cylinder is effected electrically. In the Benz cars the motor employed runs at a moderate speed—namely, about 400 revolutions per minute. In the Orleans car the motor is air cooled, and runs at a higher speed.

3. Cars with one belt, giving motion to change speed gear in a gear box, the gear operating a countershaft, which gives motion independently to each of the driving wheels by sprocket wheels and chains. The recent Benz designs are of this class, and the cars are known as the geared Benz. The motors run at a higher speed than in the former cars, and the power is higher. The Benz type of cars are fitted with surface carburettors; the others mentioned have float feed or other spray-making carburettors. The Turrell car is also of this type, but its design is different, and the motor is in front.

4. Cars with gear connection between motor and countershaft, the latter giving motion to the driving wheels by means of sprocket-wheels and chains. Of this type there are the new voiturette or light car of Panhard and Levassor, the Peugeot voiturette, and the Motor Manufacturing Company's light car, somewhat on Panhard lines, the Wolseley car must be included as of this type, inasmuch as the short belt by which in the original design the motor drove the speed change gear is now replaced by a silent chain, and a clutch is employed in place of the belt-slackening arrangement formerly used.

5. Cars with gear connection between motor and speed-change gear, the latter driving the main axle by a bevel gear, and a jointed connecting-rod between gear-box and the outside of the differential gear. Of this type there are several examples including the Darracq voiturette, the Argyll voiturette, the Renault voiturette, and the somewhat numerous variants of it, including the Si-rène. The de Dion and Bouton voiturette must be classed with this type, although its machinery and arrangement are different in design. In this car the motor is placed behind, and its

shaft is coupled direct to the change-speed gear, which, with its two friction clutches, is enclosed in a box, from the sides of which project the ends of the short-speed gear shaft, which are connected to short axles in the driving wheels by two jointed rods. Another type of light car in this class is the geared and chainless car of Decauville.

It will be useful here to explain by reference to a few engravings some of the details herein referred to.

THE CARBURETTOR.

A carburettor is a device for saturating a part of the air taken into the motor cylinder with vapourised petroleum spirit, or for producing a petroleum spirit mist in that air. Carburettors are made of two principal types—namely, the surface evaporation type, and the spray-making or atomising type. The former acts mainly on the principle which is brought into play when the wind is said to dry up the roads or pavements. The movement of the air carries away the film of air as fast as it is saturated by the evaporating water on the wet pavement. When the air is still the film over the water becomes saturated, and the evaporation ceases.

In the surface carburettor, the air which is drawn into the cylinder of a motor by the sucking action of the piston is caused to pass over the petroleum spirit in a vessel, and over the spirit-wetted surfaces. In some cases the air is caused to bubble through the spirit.

This form may be described with reference to Fig. 1, which is the surface carburettor of the Benz cars. It consists of a cylindrical vessel which is kept about one-third full of spirit. The spirit enters by the pipe g from a supply tank placed in a convenient part of the car at some level above the carburettor. The spirit enters by the up-turned pipe f, covered by a valve or

Fig. 1.—The Benz surface carburettor.

Fig. 2. The Daimler-Phoenix spraymaker carburettor.

stopper E at the end of a lever actuated by a float A. The suction action of the motor piston draws air from the large pipe 10, that air entering the carburettor through the gauze-covered top J of the pipe K. The air is drawn in at a high speed, and passes from the pipe K over the surface of the spirit on its way to the lower end of the pipe L at the inner end of pipe 10. During its passage the spirit is disturbed and evaporated, and to get into the pipe 10 has to enter the space between the pipe L and the petticoat pipe M which surrounds it. At the lower end of pipe M is an inverted cone with a hole at the bottom by means of which unvapourised spirit which may, by unusual jumping of the car or excess of spirit supply, have passed into the annular space between the pipes L and M, may return. The air leaving the carburettor by pipe 10 is thus highly

charged with spirit vapour or mist, which forms the combustible part of the charge entering the motor cylinder. In very cold weather, and when the air is very damp, the evaporation of the spirit does not take place so rapidly as in warmer weather, and when the air is dry. It is therefore necessary to encourage the evaporation by heating the spirit. For this purpose the bottom of the carburettor vessel is placed (c), leaving a space between it and the false bottom H. Into this space a portion of the hot exhaust products of combustion from the motor cylinder is delivered by the pipe E. These products escape through holes in the bottom (H).

Indication of the level of the spirit in the vessel is given by the top of the rod B through the boss B, the rod being attached to and rising and falling with the float A. There is no doubt that, when the car is running, the jolting and vibration of the car on the road causes the spirit to be awash in the vessel, and often a spray is made which is converted into mist or vapour by the rush of air to the motor, just as it is in a spray-maker carburettor. Other forms of surface carburettor are made on the same principle, but some are more simple.

The spray-making or atomiser carburettor is of very many forms, some employing a float, as in the Benz surface carburettor, to maintain the spirit always at the same height, and control the rate of feed of spirit into the vessel containing the float, from which it issues in the form of a jet sucked out by the motor piston, and broken up into spray and mist in its movement with the rush of air; and others have a float to control the level and rate of feed of the spirit in a tank or container not immediately adjoining the point of issue of the spirit, but connected thereto by a pipe.

These forms of carburettor may be typically represented by Fig. 2, which is a sectional view of the carburettor used in many of the Daimler motor vehicles made in England. The reader must assume that the pipe 14 is attached to the motor

cylinder, and that the suction-stroke of the piston draws air in at the opening L. In reaching the pipe 14 the air passes through the small chamber 12 n, thence through the short tube m, as shown by the arrows, and past the top of the nozzle f to 14. The suction which draws air in also draws in a small quantity of spirit from the nozzle f, which is supplied by the pipe below it, connecting it with the spirit in the vessel in which is the cylindrical float A. The spirit thus drawn from the top of the nozzle f is caught by the in-rushing air and atomised and vapourised in passing m and through 14.

When spirit is thus drawn from the vessel, the float A sinks, and with it the weighted ends b b of the levers pivoted at c. The inner or short ends of these levers engage with a collar on the valve spindle a, which passes freely through a tube in the centre of the float. The sinking of the float is thus attended by a slight lifting of the valve spindle, the end of which sits in a conical seat at d on the top of the spirit entrance from the main supply tank somewhere in the carriage. As originally made the valve spindle was fixed in the float and moved with it. This was unsuccessful, as the valve was in continual movement with the very unstable float and the valve got too much move-

ment. By means of the levers shown and the valve spindle, independent of the float, the movement given to the valve is less than half that of the float, and the float being loaded is much steadier in action on the road.

Fig. 3.—Daimler petroleum spirit engine, sectional diagram.

To prevent the admission of spirit under pressure from the main tank supply when the car is standing, a spring (99), which can be turned into the position shown, acts as a finger to prevent the lifting of the valve. The flooding of the carburettor is thus avoided.

PETROLEUM SPIRIT ENGINES (MOTORS).

It is considered desirable that a brief explanation should be given of the construction and working of a petroleum spirit engine or motor. These engines are hot-air engines.

The petroleum, or its spirit, is used as a means of heating the air in the cylinder. The air being thus heated in a closed chamber rises in pressure in proportion to the rise in temperature. This pressure is relieved by pushing away one wall of the chamber, namely the piston. In doing this with regular and rapid repetition it does work on a crank-shaft, by means of which motion is imparted to the gear of a car. Fig. 3 will make this clear. It is a diagram showing one cylinder and the connected parts of an engine of the Daimler type, but with the several essential parts shown in one plane for purposes of explanation.

In this diagram A is the cylinder in which works the piston B, to which is jointed the connecting-rod C. It is called a connecting-rod because it connects the piston (B) to the crank D of the crank shaft P. In the engraving the piston is shown in the position of half-stroke in a downward direction doing work.

On the crank shaft is a spur pinion indicated by the dotted circle G, which drives a spur wheel G of double its size, and at therefore half its speed. The wheel G is on a spindle which carries the cam M. When by completing its downward stroke the piston B has caused the crank to reach the position of the tail of the arrow D, the cam M will have approached the roller Z, which will have begun to lift. In lifting it lifts the rod X, the thin lower end of which bears on a narrow shoulder at X. This rod lifts the exhaust valve W, which permits the escape of the hot products of combustion and air by which the last working stroke or push down of the piston was per-

formed. These gases escape through the passage E, and by way of the valve W, when lifted, into the passage W, shown black, round the cylinder, and thence as shown by the arrow, they are conducted away by the bent pipe W' to a silencer, which is a cylindrical box with a circuitous outlet. In continuing its rotation the crank will have raised the piston to the top of its stroke, the exhaust valve W remaining open all the time, so as to permit as far as possible the clean sweep-out of the air vitiated by the products of combustion. The valve W then closes, and the piston commences another

downstroke under the influence of the momentum of the fly-wheel on the crank shaft. This descent of the piston gives rise to a partial vacuum, or, in other words, this is a suction stroke.

Now as there are only two openings into the cylinder, namely, the exhaust valve opening and the air valve opening F, one of these valves must be opened by the suction, or the vacuum increase in completeness as the piston descends. As the spring on the exhaust valve spindle is much stiffer than that on the air admission valve F, the latter opens almost immediately the suction stroke commences. Thus air is drawn in through the passage K, to which the carburettor is connected, the air entering at K and passing the carburettor nozzle J and thus getting its supply of hydrocarbon spirit by which it is carburetted and forms a combustible mixture. The carburettor is the same as that already described with reference to Fig. 2. In reaching the inlet port K, the air first enters at C, which is an adjustable

opening, and thence passes through the air filter H and pipe L. During all this time then the piston B has been travelling to the bottom of the cylinder, and the latter has thus been filled with a carburetted charge of air.

In continuing its rotation the crank forces the piston to the topmost position, and both valves having been closed (the air admission automatic) the charge is compressed to a pressure of from 40 lbs. to 60 lbs. per square inch. At this pressure, the temperature having been increased by the compression, the mixture is easily ignited. This ignition is effected by an

Fig. 4.—The Panhard and Levassor Daimler motor car transmission and speed gear.

electric spark between the end of a wire in an insulated plug and a metallic piece not insulated, or by means of an incandescent tube into which some of the combustible mixture enters. Such a tube is shown at *u* heated by a Bunsen flame petroleum spirit lamp at *r* (Fig. 3). The compression stroke being then completed, the charge is fired by the incandescent tube, and the air is heated to a very high temperature, probably 1800° F. This heating and corresponding increase in pressure to about 250 lbs. to 320 lbs. per square inch takes place with very great rapidity, and the piston is forcibly pushed downwards, making a powerful working stroke. Thus it will be seen there are four strokes made for one working stroke as follows:

1. Suction stroke taking in a combustible charge.
2. Return stroke compressing the charge.
3. Combustion or working stroke.
4. Exhaust or products expelling stroke.

There being two strokes to one revolution, this cycle of operations is repeated at from 300 to 800 times per minute in the motors in common use, and either one of the strokes, such as the working stroke, during a fraction of which ignition has to be effected, only occupies from 0.012 of a second to 0.05 of a second.

As the very high temperature of an explosion-stroke occurs at least 300 per minute, it is necessary to use some means of cooling the cylinder. The most effective means of doing this is to keep up a circulating supply of water in a jacket surrounding the cylinder. Such a jacket is shown in Fig. 3. Water enters the jacket at *t*, passes round the cylinder, cylinder top or head, and round the exhaust valve seat, and escapes at *t'*.

The water thus used has itself to be cooled. This is done by causing it in its circulation to pass through a cooler of one or other of several forms and kinds, consisting generally of grids of gilled pipes between the motor and a small water tank. In most cases a small pump is used to ensure the circulation of the water, so that it shall be forced through the cooler pipes, which are cooled by radiation and conduction, assisted by the passage of the cooler through the air. The cooler must be placed in an exposed part of the car, or other means adopted for securing the passage of air over or through it as the car moves along. All the coolers depend on this for their effectiveness.

In Fig. 3 a spirit supply pipe is shown at *o*, the spirit passing through a filter at *p*, and thence by one pipe (*s*) to the burners for heating the ignition tube, and by another pipe, which may be closed by the cock *q*, to the float vessel of the carburettor.

GEARING.

It would be impossible here to describe the gearing of all the cars which will be mentioned, but as the Panhard and Levassor gear is usually taken as one of the best known forms for comparison it may be here referred to as typical. Fig. 4 illustrates the form of this gear as used in the cars made by the Daimler Company and the Motor Manufacturing Company on Panhard lines. It is all enclosed in a box nearly filled with grease, and fitted with all the necessary bearings.

The motor crank shaft carries a flywheel, which also forms part of a cone friction clutch. The other part of this clutch is fixed on a shaft, part of which is seen in the engraving at 44. The two parts of this clutch are separated by a movement longitudinally of the shaft 44 of only a quarter of an inch. Inside the box the shaft 44 is square, and upon it are four spur pinions, 55, 56, 57, 58, all on one sleeve, which is movable on the shaft by a fork 59. These spur pinions gear with spur wheels above them, 64, 65, 66, 67. These wheels are all fixed upon a short shaft, on one end of which is a bevel pinion 70, which gives motion to either of the bevel wheels 71 or 72. These bevel wheels give motion to the cross shaft 69, on the ends of which are chain pinions by which the road wheels are driven.

As shown, the smallest pinion on shaft 44 is in gear with the largest spur-wheel 64, and this gives to the chain pinion shaft the slowest speed. By moving the sleeve 54 along the shaft, pinion 56 is put into gear with wheel 65, and the second speed is in gear. When 54 is moved still further, pinion 57 enters into gear with 66, and the third speed is in gear. By one movement still further to the left the pinion 58 enters into gear with 67, and the shaft 61 is driven rather

faster than the engine shaft, and the highest or top speed is in gear.

To throw the whole of this gear out of action, the lever 46 is pulled by a rod 45 by the depression of the left foot pedal. The part 47 pulls the rod 48, and thereby the shaft 44, and so pulls the main clutch out of contact, and the engine runs free. When the tire brakes are put on the driving wheels, the arm 86 is pushed towards 46, and the main clutch thrown out and kept out by the pin at the end of 86 entering the notch in 46 so long as the tire brakes are on.

At *d* is the differential gear for balancing the turning moment on the road driving-wheels for turning corners. This is driven by the bevel wheels, which, with it, are upon a hollow shaft *h h*. The gear in the box *d* gives motion to the chain-pinion shaft 69, 69, the two parts of which rotate either at the same or different speeds according to the resistance met with by the road wheels.

For reversing the direction of the car the hollow shaft *h h* is moved in the direction of its length, the one way or the other, so as to put either 71 in gear as shown, or to take it out and put 72 into gear, which being on the opposite side of 70, will be driven in the opposite direction.

Numerous variations on this arrangement of transmission gear have been made and are in use, but all may be understood by reference to and comparison with this. In cars which have no chains, but are driven by a jointed longitudinal rod, reversing is effected by different methods, and the shaft 69 becomes the driving axle, the pinion 70 being driven by the jointed spindle, a continuation of 61.

TYPES OF CARS.

Of all the cars mentioned the most largely used is the Benz Classes 1 and 3, mostly fitted with solid Conolly tyres, which, with a maximum speed of 20 miles per hour, and for use on all roads and in all weathers, are to be commended as among those giving the least trouble, and costing least in first cost and for maintenance. The car with the single belt and gear and chain transmission is an improvement on the car with two belts, the single belt being longer and more easy of access and maintenance. All the important working details are better adapted to their work than formerly, the management of the car is soon learned, the motor is of simple character, placed in the rear of the car and accessible, and repairs can be carried out by anyone to whom any motor vehicle should be entrusted. The carburettor is of the surface-evaporation type, and although not so simple as some of the spray-making type, is rarely complained of as giving serious trouble. They are generally fitted with wheels of what are known as the cycle type, but may be had with wood wheels, which for light cars and moderate speeds are not necessary, although more easily kept clean. The gear and belt are, or should be, covered in, and in some cases a waterproof or leather sheet is placed under all gear to exclude mud. The cars are of German make, but every part likely to be required is kept in stock in London. The steering is by means of a small handle on the top of a steering pillar, but is not of the locked kind.

Of Class 2 the New Orleans, and those of other names, but the same or nearly the same design, originating in the Vivinus voiturette, is representative. In these cars, which are made in England, the one belt used is of good length, the gear is simple, and is covered in as well as the belt, and the running of the car is easily learned. The carburettor is of the spray-making type, not the original wick form which cannot be used in this country, although it seems to work satisfactorily in Belgium. These cars are fitted with a double cylinder air-cooled motor, a small fan being employed. The smaller car of the same make has a single cylinder motor, but this is not sufficiently powerful for the work in view, except in a favourable locality. The motors are placed in front of the car. These cars are fitted with cycle-type wheels, and usually with pneumatic tyres. A car may be fitted with a two-seat, three-seat, or four-seat body, and like the cars already dwelt upon may be fitted with a hood. The ignition of the combustible charge in the cylinder, as in the Benz, is by electricity, either primary batteries, or secondary batteries (accumulators), being used. The steering is by a hand wheel, but the steering gear is not of the locked kind.

These cars have not been used in large numbers in this

country yet, but on the whole those of the more recent make are well spoken of, and they are among the simplest in design and most accessible of the lightest makes of chainless car.

Of Class 4, among those mentioned, the Miniature Panhard of the Motor Manufacturing Company and the Wolseley car are of English make. The first is propelled by what is known as a 5-horse power water-cooled de Dion single-cylinder motor, which runs at a high speed and is fitted with electric ignition apparatus. The speed-changing transmission gear is somewhat similar to that of the Panhard and Levassor cars, a similar main clutch being used, but the reversing is effected easily without bevel gear. The motor is placed in the front of the car, as in the larger Daimler-Panhard cars, and the combustible charge may be varied from the seat by a supplementary air valve, and the speed may, as in the other cars described, be varied by altering the period of ignition from the seat. The steering is done by a hand wheel, the steering gear being of the screw-and-nut locked kind, which relieves the hand of some shocks on rough roads and of the necessity for continuous grasp of the wheel. The body is made for two, three, or four seats, and wood wheels are used with pneumatic tyres. This is a good example of the single-cylinder high-speed motor chain-driven class of vehicle of the medium weight class. The new light car now being made by the same company will, however, be a better car.

The Wolseley car is also a car of excellent points. It is fitted with a motor which runs at a moderate speed when giving the power required for all ordinary running. It is so placed as to be easily accessible in the front of the car where it is surrounded by the water cooler. The motor drives the speed-change transmission gear by a silent chain, the changes of speed being made and the reversal effected by sliding the gear wheels into alternative positions, as in a Panhard car, with the clutch thrown out by a pedal, but no bevel gear is employed. The water is kept in circulation by a simple form of pump, and requires no renewal during a whole day. Electric ignition is employed, the period of ignition being variable whilst running, and, as with all the other cars noticed, the combustible charge passed into the cylinder may be varied to vary the speed, in this case by throttling. The body may provide two, three, or four seats, and wood wheels and pneumatic tyres are generally fitted. The car is of good design and workmanship.

The new light 5-horse and 7-horse power cars of MM. Panhard and Levassor are excellent cars of this class but are of course of French make.

Of Class 5, the de Dion and Bouton voiturette of French make is perhaps most widely known. In this car the motor is attached to the framework of the car at the back of the main seat. It has a water-cooled de Dion motor running at a very high speed, and connected by spur change-speed gear to the driving wheels through jointed rods to short axles running in bearings at the ends of a bent axle. The change of speed is effected by the alternative use of two friction clutches within a gear-box, and by varying the strength of the combustible charge and the period of its ignition by electricity. The wheels are generally of the cycle type fitted with pneumatic tyres, which are good when of the Michelin make. The steering is by a hand wheel, but the steering gear is not of the locked kind, although the cars are generally geared for rather high speeds. The water circulation is obtained by a small pump of French make. The motor is started by means of a handle at the side of the driver's seat, and this may be done when the driver is in his place [The motors of all the cars mentioned, however, start so easily, that special gear for this purpose may introduce unnecessary parts. With electric ignition apparatus the motor with double cylinders may often be started except after long stops by merely switching on the sparking current.] The de Dion voiturette is the only car of its arrangement of motor gear and axle-driving mechanism, and it is one of the few cars of which complaint is made of vibration while travelling.

Several cars of this class are made, in which the motor is in the front, as in the Panhard, Mors, and other cars, but in which the motion is conveyed to a bevel wheel on the driving axle by a bevel pinion driven by a jointed rod, which receives its motion from the change-speed gear arranged in a box after the manner of the Sirène, the

Renault, the Darracq, and the Argyll voiturettes. Most of these are fitted with a single cylinder motor of the de Dion water-cooled type, the Perfecta of the Darracq car being of the same design of 5-horse power placed in front. There is not much ground for preference between these cars, but the simplicity of the gear of the Argyll car, which is of British make, places it among those the working of which will, during the next few months, be watched with interest. It has but recently been brought out, and hence but little can be said about it. Its motor, however, is of very high speed type.

The Darracq car is of excellent and very promising design, and runs well on good roads, but will need a few improvements in detail of its bearings, some improvements for securing accessibility, and a general stiffening up to obtain durability. The car is, however, noisy and its motor runs at a very high speed.

The Decauville voiturette of the recent design, with springs to the rear axle, may also be mentioned in this class. It has a 5-horse power motor at the back of the car, and its driving axle is driven entirely by spur gearing. It can be started by gear from the seat, and is a well-tried car, but its gearing is noisy.

Of the Renault car a good many have been made. They are of Continental manufacture, and are very light in many parts, and the gearing is not so commendable as that of some of the other cars mentioned.

The time is undoubtedly at hand when a doctor may become the possessor of a car which will meet his requirements, but whether he decides upon a Wolseley car, a Benz, a light Panhard and Levassor of the new design, a New Orleans, a Peugeot, a Motor Manufacturing Company's miniature Panhard, an Argyll, a Sirène, or a Darracq, his success will depend upon the care with which the car is tended and worked, the care with which slight indications of wear or looseness are diagnosed and acted upon.

The price of all these cars is about the same for the same accommodation, power, and tyres, or at least the difference between the cost of the best and the others only means a few shillings or a pound or two more per year as the annual value of the extra capital outlay, and should not be a determining point in the selection of a car or voiturette. All the cars mentioned will climb any ordinarily stiff hill, and all are easily started, but they are not all equally good for continuous hard work on all roads in all weathers.

It is not necessary in this article to deal with the cost of the motor vehicle per year, as it has been definitely and abundantly proved that in the hands of any user who wants more service than one pony and trap can give day after day, and who will give due attention to his motor vehicle and its mechanism, the motor is cheaper than the horse.

GENERAL CONCLUSIONS.

No hard-and-fast rules can be laid down for the guidance of the purchaser. Generally it may be advised that, inasmuch as the doctor's car should be an ever ready car, as free as possible from all causes of the unexpected, his car should:

1. Have only two seats, or, if a third seat, then it should be one that does not in the least interfere with accessibility of the machinery or moving parts.
2. Not be geared to more than about eighteen miles per hour.
3. The motor should run at a moderate speed, and should be of not much less than 5-brake horse power.
4. Have ample cooler capacity, and either no pump or a good strong simple one.
5. For some time at least adopt solid tyres or compound tyres.
6. Three speeds forward are desirable, the lowest being such as will enable the car to mount the worst hills in the district to be worked, when the roads are in bad condition, at the highest speed properly within the power of the motor. Three speeds may not be so necessary in flat districts, or with a belt-driven car with a two-cylinder motor, fitted with throttle or supplementary valve and ignition-timing device. Reversing gear is desirable, although not indispensable, in a small car.
7. The gear should be of the best, proportion good throughout, not in parts only; should run in oil or grease, or be well protected, and should obviously have been made for a car and not for a clock.

8. The brake or brakes should be strong throughout all the parts and connecting rods or links, and the brake drums of some size. One good set of brake gear is better than three of the flimsy things that by luck more than wit have so often been just sufficient.

9. Electric ignition is employed on nearly all the cars mentioned, and there is not much to choose between the several arrangements used. It is doubtful, however, whether for the purpose in view the tube ignition should not be considered equally good, although it takes a minute or two or three minutes longer to get ready. This need not, however, be lost time, if matches and spirit can be systematically placed ready for use; so that, having started the lamps, the tubes are hot by the time hat, coat, and gloves are on, and the thermometers and things in the right pockets. For absolute certainty tube and electric ignition may both be used by those who care to pay for the fitting and fittings.

10. As a doctor cannot make his own car, his choice is limited to the cars that are made, and as none may comprise all he thinks he would like or looks nice, he must choose that car which comprises the most of the practical working essentials, and should not be much guided by his own preferences until he has some experience of the actual working use of a car.

No useful purpose can be served by giving engravings from photographs of the several kinds of cars mentioned, because the bodies of any of them may be varied in form, and the construction of the mechanism could only be fully illustrated by numerous engravings such as those which occupy hundreds of pages in my book on motor vehicles.

In conclusion, I would repeat that the motor vehicle is not for those who have no patience with machinery, or for those who find it difficult to discriminate between the treatment necessary for a wheelbarrow and a lathe or a sewing machine; but for those who have this patience and discrimination the motor vehicle is a source of new and health-giving pleasure and of the profit that comes to those who can utilise the working hours that are saved from the time waste of the old mode of travelling.

Every user of a motor vehicle must learn for himself how to use it just as much as he must for himself and not by deputy learn to eat or drink or ride a horse or a bicycle. He cannot learn it from an article or a book, but he can learn a great deal from the instructor sent by the makers, and afterwards from a careful study of their printed instructions. From his own examination of the parts and consideration of their functions, in which he will be assisted by a study of their principles and construction as described in *Motor Vehicles and Motors*,¹ he will learn to anticipate difficulties and prevent their occurrence.

THE PLAGUE.

PRECAUTIONS AGAINST PLAGUE IN LONDON.

THE case of "suspected plague" at St. Bartholomew's Hospital has indicated the need for preparedness for any eventualities that may arise in regard to such cases, and for clearly understanding the measures to be taken in dealing with those who have been in proximity to such infection. The London County Council has now, after conference with the Metropolitan Asylums Board, matured a plan of campaign in view of any possible invasion. Cases of real or suspected plague are to be dealt with in the hospitals of the Board, and contact cases will be watched in places provided by the County Council. The plan is not ideal, but the procedure agreed upon is as follows:

On receipt by the London County Council of intimation from any medical man that any person in London is suffering from a malady raising suspicion of plague, the Council's plague expert will be requested immediately to visit the patient.

He will decide whether the patient should be removed to one of the hospitals of the Metropolitan Asylums Board:

¹ *Motor Vehicles and Motors; Their Design, Construction, and Working by Steam, Oil, and Electricity.* By W. Worby Beaumont, M.Inst.C.E., M.Inst. Mech.E., M.Inst.Elect.E. Westminster: Archibald Constable and Co. Philadelphia: J. B. Lippincott Co. 1900. (Large 8vo, p. 652, price 42s. net.)

If he is of opinion that the patient should be removed he will communicate with the Metropolitan Asylums Board with this object, in the manner provided by the regulations of the managers, stating whether the patient is to be deemed a suspected or an actual case of plague.

He will write a certificate as to the nature of the case, and leave it in a closed envelope with the patient's friends, to be given to the ambulance driver when he comes to fetch the patient.

In the case of every patient to be removed to hospital, either as a suspected or actual case of plague, he will take material for bacteriological examination, and send it immediately to the County Council's bacteriologist.

In all other cases he will use his discretion as to whether he shall take and send such material.

He will at once report to the county medical officer of health as to every case and the course he has taken.

The County Council's bacteriologist will report the results of his examination to the county medical officer of health, who will at once inform the medical officer of the Local Government Board, the clerk of the Metropolitan Asylums Board, and the medical officer of health of the district of these results.

In the event of a case of actual plague occurring, if the removal of "contacts" to one of the Council's shelters is desired, arrangements will be at once made by the county medical officer of health for this purpose. Persons in contact with suspected plague will, pending decision as to the nature of the case, not be removed to a shelter unless the circumstances of the case are altogether exceptional.

The Metropolitan Asylums Board will not remove any suspected or actual case of plague except on the certificate of the County Council's plague expert. The certificate of the Council's bacteriologist is to be accepted for this purpose.

The certificate may be signed by the expert only, or by any medical practitioner, and countersigned by the expert.

PREVALENCE OF THE DISEASE.

CAPETOWN.

DURING the week ending April 27th 70 fresh cases of plague were reported in Capetown, and 35 deaths from the disease. The proportion of Europeans to natives affected continues to be very high; on several days half the number attacked have been Europeans. This fact may account for the small death-rate, for up to the present of 519 persons attacked but 217, or considerably less than half, have succumbed.

No extension of the disease seems to have occurred in or around Port Elizabeth; the case reported there appears to have been a solitary one.

INDIA.

During the week ending April 6th the total number of deaths from plague in India numbered 11,606, the chief increase being in Bengal and the Punjab.

In Bombay there has been a slight decrease in the plague mortality; but it only amounted to a decline of 11 in all. In the Byculla district there was a slight increase, the plague deaths going up from 76 to 104. The disease appears to be disappearing much more slowly in Bombay this year than during previous epidemics. In the city 707 fatal cases of plague occurred, against 769 during the week ending March 30th, and in the Bombay districts 586 against 728.

In Calcutta the deaths from plague during the week amounted to 859, being a decrease of no fewer than 266 upon the previous week. During the same period in the Bengal districts the numbers increased from 7,077 to 7,381, the highest figures yet registered. The worst district in Bengal is Gya, where the mortality rose from 1,576 to 2,281. In the Patna district the epidemic seems to have reached its maximum during the last week in March, as the number of deaths declined by some 250 during the first week in April.

In the south of India plague seems dying out, the Madras Presidency returning only 39 deaths from the disease, compared with 69 during the previous week. In Karachi, however, the epidemic maintains its virulence, 176 deaths having occurred during each of the weeks ending March 30th and April 6th.

ASIATIC TURKEY.

Bagdad.—A telegram from Bagdad by Laffan's agency, and published in Paris, is responsible for the statement that 2 cases of plague have been officially notified there.

Bussorah.—A telegram also from Constantinople, dated April 28th, through Reuter's agency, intimates that 3 cases of plague have occurred at Basra (Bussorah), and that ten days' quarantine is accordingly imposed on arrivals from that port.

It would appear from these telegrams that the towns along the valleys of the Euphrates and the Tigris are the seat of plague, for the two cities are over 400 miles apart.

We have no means of confirming or contradicting these announcements; that plague should reach Bagdad seems in every way possible, but the fact of its being there may imply its reaching the northern part of Asiatic Turkey, and seems to be the worst menace to Europe yet notified. It is by way of Russia and Turkey that Europe has to dread the inroad of plague; for it seems from experience gathered in Alexandria, Oporto, Hamburg, Glasgow, and a number of English ports that a localised infection may occur which is not epidemic in its tendency. Plague when it comes to stay seems to advance gradually, to push forwards its frontiers in a widened circle, and although outposts occur here and there in the van of the disease these seldom cause more than a local scare and a temporary inconvenience.

MAURITIUS.

During the week ending April 25th no fresh cases of plague were reported in Mauritius, but 2 deaths from the disease were recorded.

The Indian papers take exception to the system of quarantine in vogue in Mauritius. Mauritius has always been noted for its adherence to quarantine regulations, and the ancient régime appertains until now. Plague is endemic in Mauritius, having been imported thence from Madagascar, it is stated, yet the twenty-one days' quarantine against Indian ports remains in force. Plague has been so virulent in Mauritius that it is more than likely the health officers who came on board the vessel from India were the means of infecting the passengers and crew rather than the ship or its freight being a danger to Mauritius.