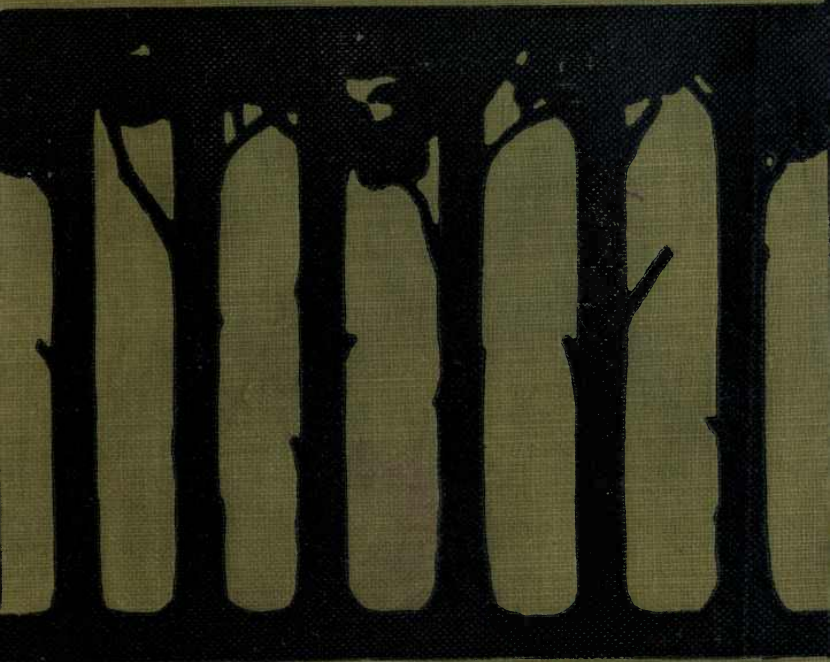
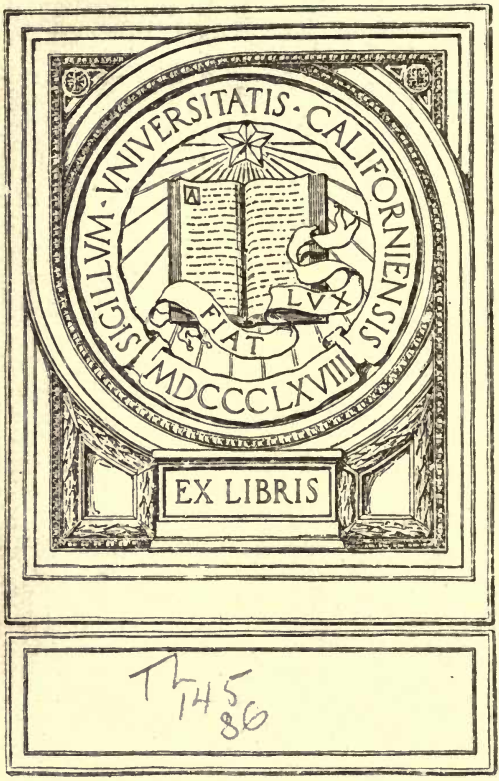
The AUTOMOBILE
Its Selection Care & Use

BY ROBERT SLOSS

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THE AUTOMOBILE

Its Selection Care
and Use

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Its Selection Care and Use

By ROBERT SLOSS

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BUYING AN AUTOMOBILE

THE AUTOMOBILE

CHAPTER I

BUYING AN AUTOMOBILE

CHOOSING a car is by no means so esoteric a task as choosing a wife, since, of course, there could never be as many nice cars in the world as there are nice girls. But there are enough of the former to quite bewilder any one who approaches the array of them for the first time with serious intentions. I venture to put it thus because of an apt illustration furnished by an acquaintance of mine who chose his wife and his automobile at the same time.

He had driven considerably in hired or borrowed cars before he met the lady at the New Jersey seashore home of a friend who was entertaining both of them for the summer. When the host saw how things were going, he turned over to the young folks a light runabout which had been prac-

tically constructed for himself the year before. It was built for two, and the young lover soon became expert enough to manage it most of the time with one hand. At any rate, he finally persuaded the girl to marry him then and there and to spend the honeymoon in touring back to his home in Pennsylvania, using that very automobile, which he induced his host to sell to him.

Benedick spun along the level New Jersey roads with the exhilaration that can be felt only by a man in love with a girl and an automobile at the same time. But when he reached the hill country of his native State he learned that love at first sight is a safer guide in choosing a wife than in choosing a car. The smart little runabout did not spin any more, and as it ran more and more slowly and laboriously, his enthusiasm ebbed.

The car became more and more reluctant to take the steep, loose-surfaced roads of Pennsylvania. It was "stalled" repeatedly on steep hills, and when finally, on a particularly rough stretch, it broke a front spring, Benedick, with a sigh of relief, took his bride the rest of the way by rail and left the car to follow in the same way.

At home, the car was repaired, and after some months of similar unsatisfactory experiences, young Benedick sold it, having learned how to observe the three cardinal rules in choosing a car, in accordance with which he subsequently pur-

chased another. It still gives him and his young wife the delights which he anticipated from the first one.

To be sure, two of these cardinal points were negligible in Benedick's case. In the exalted frame of mind in which he purchased the car, he did not care how much it cost, nor did he dream of ever needing an automobile built for more than two. He did not, however, pause to consider the work which the mechanism would have to do on the roads where he wished to use it. Neither its gearing nor power was suited to road conditions in Pennsylvania, though both would have been perfectly adequate on the exceptionally good New Jersey highways. The car itself, though built like a watch, was so lightly constructed that its range was practically confined to the vicinity of the country home of the man from whom he bought it.

Our friend's experience suggests a word in passing in answer to the question whether it is better to buy a used car instead of a new one. If used carefully and not too long, presumably a car has a record to its credit, but it is only the experienced motorist who knows how to discriminate here.

Even if the amateur can induce an expert machinist to look over the second-hand car and assure him that it is not defective or badly worn, he is likely to fall into the fallacy of purchasing a heavy touring car simply because he can get it

second-hand at the price of a new light car. Of course, he forgets that the cost of upkeep in the case of the former will be greater than should be proportionate with the first cost he has decided upon.

Cost is the first thing he must decide. "How much do you want to put into a car?" is the first question that an automobile salesman asks you. He means how much money, of course, but he will also want to know how much weight. If you make the average reply, "four passengers," and if he is conscientious, he will tell you that you must reach about the thousand-dollar mark before you will find an assortment from which to choose at all.

You can buy an automobile from $125 up, the whole length of your pocketbook. If you will make a list of the cars of the present or coming year you will find that, beginning with ten horse power for $425, this detail will range almost in direct proportion with the price, provided you eliminate unusually expensive bodies and equipment.

Fortunately, though there are spring fashions in automobiles just as in millinery, these are really quite extraneous to the root of your problem—what you can get for your money. That is much more easily answered to-day than four or five years ago, when the automobile industry in America began to be standardized. Hence the automo-

bile exhibition of to-day cannot possibly prove as puzzling to you in essentials as was the first exhibition in America, held in Madison Square Garden during the fall of 1900. That exhibition was made up mainly of imported cars which members of the Automobile Club of America either owned or induced their friends to loan. In the decade since then the American industry has made such strides that not only do the foreign manufacturers now hold an exhibition of their own, but there are actually more American cars sold in Europe than there are imported cars sold in this country.

This is a significant fact for the man who hesitates to spend the price of the heavy American touring car, plus forty-five per cent. duty for its foreign prototype. That is a millionaire's game, and the fact that one prominent Italian firm of manufacturers is already prepared to construct their cars in this country so that they may escape the duty indicates the passing of the shibboleth of the foreign car in automobilism.

The day is no more when the salesman can offer you infallible proofs that the foreign car, weight for weight, and horse power for horse power, is better constructed than its American rival. He can truthfully tell you that foreign manufacturers first brought the heavy touring car of high power to its present state of efficiency and that American manufacturers began and ended with the light

car as their *chef d'œuvre.* It is this American light car which sells so extensively abroad and has caused at least one foreign manufacturer to market a type to compete with it.

If you are partial to those who have the longest record for successful manufacture of the heavy car and if you do not have to count the cost too carefully, you may conclude, if you want to carry seven passengers, to buy the foreign make as against the American. But you will find plenty of experienced motorists and an army of salesmen to argue you out of that course if you submit yourself to them.

But to return to the matter of cost—what you can afford to pay—which is after all the main consideration with the majority of American purchasers. There are more medium weight American cars, costing from $1,200 to $3,000 and rated at from twenty-four to forty horse power, sold in this country to-day than any other type. That, of course, is no reason why you should buy one until you have convinced yourself that it is what you want. You may be content with a $425 single-cylinder runabout, but if you have not carefully considered where you want to use it, you will not be content, and like our friend Benedick, will either get another car better suited to your needs, or, if you feel that you can't afford it, you will quit experimenting with the horseless vehicle.

That is why, next to your pocketbook, you must carefully scrutinize the character of your automobile ambitions and ask yourself unequivocally what you want an automobile for. That is not so foolish as it sounds. You will probably think, in approaching the subject of choice of a car, that you ought to know all about types of motors, transmission systems, and structural materials. Such knowledge, if you take the trouble to familiarize yourself with the text-books, will be useful when you come to care for your own car, but it is not essential in making a wise selection of it.

The vitally significant fact for you to remember is that the development of the American automobile industry, especially in recent years, has been toward a standard type of medium-weight gasoline car, the ever-increasing demand for which is the secret of its prevalence.

Manufacturers have practically ceased to vie with each other in turning out surprises, "something absolutely unique in motor-car construction." Their effort is now confined to perfecting, even by the smallest increment, the details of mechanisms of practically standard excellence. The arrival three years ago of the double ignition system—magneto with auxiliary storage battery—is an instance of this. Though it is a sound principle, likely to become more and more gener-

ally adopted in the construction of medium-priced cars, it is not a sufficient reason in itself for your choosing a high-priced car, unless it is necessary to do so in order to meet your motoring requirements. Likewise you may study carefully the relative advantages of the planetary and the speed-gear systems of transmission. But if you find that you require a certain degree of power with three speeds forward, you will have eliminated the former system from your calculations altogether. Thus it is with mechanical details of cars in general, and it is safe for you to conclude that reputable manufacturers of the present day have equipped the type of car you may eventually choose with a mechanism the details of which are admirably suited to do the work required of them.

In fact, as an authority said to me recently, "sometimes the best thing you can say about a car is that it has no talking points." In other words, the more closely your mechanism approaches the type which manufacturers are developing along standard lines, the more comfort and use will you get out of your selection. It is but common sense to avoid freak construction, for which the claim may be made that it will accomplish more easily what is already being accomplished in a way which experience has taught the skilled mechanicians of the industry to be the most reliable and worthy of dependence.

Furthermore, most of the parts of cars of standard types are now interchangeable between different makes, a fact that will save the owner time and trouble in obtaining quick repairs from any machinist. The freak car may be out of commission for extended periods, while parts are being obtained from some remote factory.

It is this consistent development and standardization of the gasoline car that makes it the only type about which it is necessary to offer special advice to the prospective purchaser. If he incline toward an "electric" or a "steamer," he can safely be left to discriminate among the representations of salesmen. In the case of the electric vehicle, care of the car is reduced to a minimum for him, though its uninterrupted use will be confined to a radius of thirty miles, which may not be a disadvantage in the city where charging stations are fairly plentiful.

For the steam car greater flexibility of power will be the chief advantage urged. In the spheres of both sport and service the "steamer" has many records to its credit which have shown it quite capable of all the performances of the gasoline vehicle. It is also true that purchasers of the former rarely abandon it for the latter. But the fact that the chief manufacturer of steam cars entered the gasoline field with a new model in 1909 and has ceased to push the "steamer" is but another

indication that popular favor is responsible for the predominance of the gasoline car in the development of the industry.

The real reason for this is, of course, that it has been found possible to secure greater power with less weight in the gasoline-driven car. In its construction there has been a more or less steady advance during the decade in which the limitations of the single cylinder have been learned and methods of combining it into groups of two, four, and latterly six have been evolved, all for the purpose of giving you the most power for your money with the least weight.

Remembering this, and the experience of our friend Benedick, you may return to the question, "What do I want to use my car for?" If you are sure that you will never want to drive it anywhere but on the well-paved city streets or smooth, suburban roads, you will be content with an electric or a light gasoline runabout, according to your purse.

If you are sure you can confine your radius to short spins in level sections of the country, where the roads are as exceptional as in New Jersey or Massachusetts, you can get along with less horse power, supplemented by higher gearing for speed. Even here it is better to err by allowing a greater margin of power, which will add greatly to your

complacency in negotiating stretches you did not anticipate.

The topography of America is so varied, within comparatively small radii, that even a moderate ambition to tour will make it necessary for you to have abundant horse power and low gears in order to feel comfortable in hilly country. The additional power will more than make up for the loss of speed which low gearing would otherwise entail on level stretches.

This question of gearing can be safely worked out by you with the salesmen of the various cars you may fancy—once you have carefully thought out the conditions under which you will want to use the car. It is determined by the weight of the car—which depends somewhat on your special needs—the nature of the country over which it is to be used, taken in connection with the size of wheels, engine speed, and horse power.

In hilly country you will not be very comfortable if the weight of your car, loaded, is more than seventy-five to one hundred pounds per horse power. The manufacturer has these ratios figured out for the stripped car, and has only to add to it the weight of the body you may fancy and the number of passengers you wish to carry. A five per cent. grade more than doubles the necessary draft at a speed of eight miles per hour.

A rough average test for hill-climbing ability is to compare the piston displacement with the weight of the car loaded. By multiplying together the number of cylinders, the square of the bore in inches, the stroke in inches, and the constant .7854, you may ascertain the piston displacement in cubic inches. Cars giving less than eighteen cubic inches of piston displacement per hundred pounds will not be very good hill-climbers.

The above hints are given to enable the prospective purchaser to calculate approximately for himself the relation between load and horse power which he may require. It is the problem of the average American road which has confronted the automobile industry in America from the start, and manufacturers have solved that problem by producing the average American car of medium weight and power. Abundant records made under all the varying conditions of use stand to the credit of all reputable manufacturers, showing that the problem has been solved for all careful average uses. This means that a wide margin is left beyond this point for special exigencies.

In the light of the foregoing the selection of the style of body for your car is the only remaining element in answering the question: "For what do I wish to use the car?" Though a confusing and alluring variety of body designs is the first thing

to confront the prospective purchaser who visits an automobile show, it is the element which should be considered last in order, as it is here.

The two-seated car with comparatively short wheel base, rated from ten up to twenty horse power, is ordinarily classed as a runabout, but you will see two-seated bodies in great variety of design and fitted with many styles of tops employed upon cars up to thirty and even forty horse power, just as you will see the three-seated and the four-seated runabout body on lower-powered cars. Here again it must be remembered that not the body but the chassis is what really makes of the car a runabout or a tourer, from the standpoint of use.

If you are impressed with the obvious advantages of one or two extra removable seats, you must be careful to take into account the additional load they will involve and to make sure that you do not attempt to employ them on a low-powered and lightly constructed chassis. In other words, you must not attempt to make a runabout do the work of a touring car. The attractive "toy tonneau" body, for example, will prove a disappointing toy, indeed, unless you are sure that you have power and weight enough in your chassis to carry your four passengers uphill and down dale through the country where you intend to use it.

With a chassis of medium-heavy weight and with

adequate power, you may choose between the regular tonneau, carrying from five to seven passengers with doors at either side of the rear section and with or without one of the various styles of folding tops as a protection against weather, or the landaulette, which can be used as a closed car or opened, leaving the front standing after the manner of the average taxicab; or for exclusive town use you may prefer the permanently closed limousine. The range of use of these different styles is quite obvious, the regular tonneau being the most generally useful for touring.

The "close-coupled" body is one of the new types in which the two rear seats are set forward of the rear axle, at some sacrifice of room, but securing easier riding over rough places. The "torpedo" body is another new design, both front and rear seats being inclosed and reached by doors, and the body in general tapering, front and rear, like a torpedo boat, the object being to eliminate dust as much as possible.

You may consider the advantages of these and many other special designs, but remember that when you depart from the type of body in average use it will cost you more for some special advantage and proportionately reduce the range of uses to which a car may be put provided it has a good average relation between chassis, body, and possible passengers.

MECHANICAL TIPS FOR THE BUYER

CHAPTER II

MECHANICAL TIPS FOR THE BUYER

THE case of the two cars of identical make and model, one of which turns out to be a perfect comfort, while the other is always developing "trouble," has been cited frequently enough. Unfortunately, it does not exist solely in the realm of imagination, and further on are considered the points of personal care, upon the observance or neglect of which such discrepancy always depends, unless the manufacturer has bungled. But in a sense all cars look alike to the prospective motorist, as he admires them in their brightly painted bodies at the show or salesroom. The makers' catalogues and the "proofs" of demonstrators convince him that each model is the best of its class. Even were all the different makes in the same class stripped and set before him, he would see no superiority in the chassis of one make over that of another.

The day has gone when superiority can be *seen*. No longer does its depend on some specific piece of mechanism, present in one and lacking in oth-

ers. The chassis of 1911 will be so nearly identical with that of 1910 as to readily convince the amateur that progress in automobile building has reached its limit. Nay more, he will find the chassis of five years ago and that of to-day so materially alike in their physical features that he will wonder if it is worth while to pay for the "latest design."

Yet anyone who can drive at all would get instantly a different "feel" from a new car of 1905 and a new car of 1910. The touch of the expert could tell all the refinements of the 1911 car—or the lack of them—over that of 1910. Nor does the tyro, after he has driven long enough to know his own machine, want the disagreeable experience of trying the other fellow's—apparently perfectly similar—and finding that his is "not in it."

How then is he to tell the difference, in advance? Since he cannot trust to seeing it, he must take time to figure it out. Wise is he if he does so, for then he will come somewhere near knowing what he pays for. He may easily spend $1,000 and get only $500 worth of actual value in the mechanism—not to speak of comfort and convenience,—when he might spend $2,500 and get $2,000 worth of the same things.

That is because his money must go for something of each of the following: Material, design, labor, overhead charges, profit, commission,

In the present state of the trade, agents' commission and manufacturers' profit vary so little that they can be safely figured as fixed percentages of the selling price of all standard cars. The buyer can hardly hope to effect any saving in these regions, except in an occasional instance where a manufacturer shades his margin sufficiently to embody some unusual feature of excellence. When this occurs among standard makes, it is at once obvious in the immediately increasing sales.

The cost of skilled labor varies only in the amount put into the machine, which again is about the same throughout the trade. Nor does the base cost of materials to standard specifications have much influence on the selling price. It is possible for the manufacturer of a low-priced model turned out in great numbers, to save by buying in quantity. He need not pay the premium exacted of the builder of a few high-priced cars, buying in small lots. It is advisable, however, not to assume that the former always uses the same grade of materials as the latter.

Overhead charges—all the operating expenses short of material, labor, and shop costs—are an important and variable factor in the selling price of the car. But here, without an examination of the manufacturer's books, the purchaser can but guess at the amount of clerical and managerial salaries, office and selling expenses, advertising, re-

placement losses, and the like for which he must pay. His own business judgment will tell him that the sum will be inversely proportionate to the number of cars turned out, and also that a large, unwieldy, and extravagant organization will greatly increase it for each car.

So far, it seems that materials are the only element in price upon which the purchaser can assure himself with any degree of certitude. There remains one other, and it deserves his most careful attention—design. Here it is possible for engineering subtleties not only to effect great saving in material and labor, but also, through the achievement of simplicity and convenience to eliminate much subsequent time-and-trouble expense for the owner. The right material in the right place, without useless frills, is what the purchaser must look for if he would find a first-class car of low price and upkeep.

It is comparatively easy for him to ascertain that the structural materials are as represented if he will take the trouble to familiarize himself somewhat with the principal grades. Any reputable manufacturer will afford him every facility to ascertain which are used in his factory. In the matter of design the purchaser must make up his own mind—or get his own experience.

His car may prove perfection in every respect except that the motor never seems able to "take

it easy" on any but the low speed. Again he may be enthusiastic about everything till he finds that he can never drive quite slowly in comfort. He may find also in the latter case that all the liveliness is taken out of the car whenever it carries its full complement of passengers.

This brings us to the first question the uninformed purchaser usually asks: "How much speed can I buy for so much money." It is easy for the demonstrator—if he is that kind—to take him out in the car he fancies and convince him that engine speed (revolutions per minute) can readily be translated into road speed by means of a high gear ratio. There seems further corroborative evidence in the undoubted fact that the modern small car can often, when skillfully driven, better the running time of a larger and more powerful machine with the same complement of passengers. That, however, is only part of the evidence.

Let him remember that the small car by very virtue of its lightness can be accelerated and retarded very quickly on the level, and also that the modern tendency in designs of this type is to under-gear rather than over-gear them. If he studies the connection between these two facts, he will be led to the discovery that this very under-gearing—theoretically a defect from the speed standpoint—is exactly what has enabled the small

car sometimes to beat the large one home. Low gearing has made it necessary to provide for rapid running in the small car by the presence of a motor that will turn steadily and develop power in excess of its normal rate of revolution.

All of which should lead to the further discovery that you cannot buy speed separately, but a suitable combination of power, speed, and weight. To obtain the car that satisfies, you must figure out the proportion of each that you require. Since the amount of speed and of weight that you can have depends upon the amount of power that you do have, you must begin your calculations with something deeper than revolutions per minute and gear ratio. And that is "horse-power."

Now, if "a horse is a vain thing for safety," a "horse-power rating" is still vainer, unless you know how to verify it for yourself. Otherwise you may find that it is all horse and no power, by the frequency with which you have to employ that humble animal to tow you to a garage after stopping your engine on an overload.

One "machinery horse-power" has a theoretical working ability equal to 4½ horses. Thus a 6½ H. P. motor should be able to work as hard as nearly thirty horses, and keep it up long after the animals would become exhausted. Thirty horses, starting at the rate of one mile per hour, would exert a steady pull on your wheels of 11,250

pounds. It only takes 4.55 pounds of pull per 100 pounds of load to increase your speed one mile per hour per second. So if your car weighs 1,000 pounds, in four minutes you would be going 240 miles per hour.

Obviously before the car could attain anything like that speed it would overrun the horses and make it impossible for them any longer to "work their pull." But why cannot the 6½ H. P. motor develop something like this speed in the vehicle on which it is itself being carried along? For a precisely similar reason.

A motor's "horse-power rating" means, commercially speaking, "brake horse-power" (B. H. P.). Manufacturers usually determine this by means of a Prony brake or a dynamometer which registers the number of pounds of "push-off" the motor is able to furnish at the road tires of the rear wheels. That of the 6½ B. H. P. motor, owing to losses in transmission, would be shown to be about 1,220 pounds. But there is even more difficulty in the motor's working its push than in the horses' working their pull. With a car weighing 1,000 pounds the rear wheels would not bite the ground hard enough to utilize a greater "push-off" than 375 pounds, without slipping. So your 6½ B. H. P. motor in your 1,000-pound car, starting at the rate of one mile per hour, gives less available power than would

one average horse, since the beast is capable of increasing his muscular effort tenfold momentarily when necessary.

Of course, better adhesion at the road tires can be obtained by increasing the weight over the rear wheels. That is practically what happens when driving up hill; otherwise it is possible only by increasing the weight of the load carried or of the car itself. A 2,000-pound car, for example, will admit of a 750-pound push-off by a 6½ B. H. P. motor, starting at one mile per hour.

Once started, however, if speed and power increase in direct proportion, it requires no more adhesion at the road tires to go forty miles per hour than to go one. To hold your 2,000-pound car up to a speed of 10 miles an hour, a push-off of less than three per cent. of the car's weight is needed. The remaining power is available for acceleration, provided it is not suddenly increased above the limit of adhesion, 750 pounds. The following table will fix this matter more clearly in the mind:

To develop							lbs. is needed.
1	H.P.,	when	traveling	at 1	m. p. h.,	a pull of	375
10	"	"	"	" 1	"	" "	3,750
10	"	"	"	" 10	"	" "	375
20	"	"	"	" 20	"	" "	375
30	"	"	"	" 30	"	" "	375
40	"	"	"	" 40	"	" "	375
40	"	"	"	" 20	"	" "	750
40	"	"	"	" 1	"	" "	15,700

The above considerations should make it plain to the prospective motorist that he must first determine what he wants to do. Let him calculate the maximum weight he is likely to carry in the car and add to it the weight of the car itself. Let him consider the character of the roads over which he must travel—whether smooth, increasing traction, or rough, decreasing it. Then let him think well on the nature of the locality—whether level or hilly, remembering that a five per cent. grade more than doubles the necessary draft at a speed of eight miles per hour. Then he will be in a position to figure out how much brake horse-power he must buy to meet his peculiar conditions. Then he can tell how much speed he can make with it.

Naturally he will want to satisfy himself that he gets the quantity of power, and therefore speed, for which he pays. Fortunately the B. H. P. of any four-cycle single-acting motor depends upon very definite mechanical facts and for purposes of comparison may be readily calculated by the purchaser for himself. Without here going into a discussion of formulæ in detail, the investigator will see at once that the number of cylinders, their bore and stroke are facts that can be readily ascertained about any motor.

"Mean effective pressure" and "mechanical efficiency" are more obscure. But for all calculations the Mechanical Branch of the American Licensed

Automobile Manufacturers recommends that the mean effective pressure be taken as an average of 90 pounds per square inch of piston head surface, and the mechanical efficiency as 75 per cent. of the "indicated horse-power." These assumptions obtain in all A. L. A. M. ratings and are well within the limit of accuracy. On this basis the formula is: Take the square of the cylinder diameter (bore), multiply it by the number of cylinders, and divide by the constant 2.489, approximately 2.5.

This constant contains the further assumption that all piston speeds are 1,000 feet per minute. This, however, is only warranted in the case of motors where bore and stroke are practically of the same length, and is only accurate for comparison between two motors whose bore-and-stroke ratios are identical. Piston speed (the number of feet the piston travels up and down in a given time) is of prime importance in calculating B. H. P. since it determines the limit of speed at which a motor can safely operate. The following formula provides for the introduction of this factor accurately, and is therefore the best to employ: Cylinder diameter in inches squared, multiplied by length of piston stroke in inches, multiplied by number of revolutions per minute, multiplied by number of cylinders, divided by 14,920, equals B. H. P.

It will be convenient to be able to assign values to any of the factors in this formula and then determine the values of the remaining factors without tedious calculation. A printed chart is obtainable in which the values have been worked out diagramatically in accordance with the formula for a wide range of bores, strokes, and revolutions per minute. This will prove a great convenience in instituting comparisons. For instance, if you decide that you want a motor that will develop a certain B. H. P. with a certain bore and stroke, you will find at a glance on the chart the number of revolutions per minute necessary. If you want a certain B. H. P. developed at a certain number of revolutions per minute, you can likewise find the several combinations of bore and stroke with which this can be accomplished, and so on. The chart is also arranged so that the A. L. A. M. rating can be easily read for any motor.

A proper understanding of this important question of horse-power will enable the motorist to judge for himself of the other points at which design puts value into the automobile. When he has figured out what power he requires—or rather what power he can afford to buy—he will realize that the lower the power, the greater the number of gear speeds necessary to make it effective. A low-powered car cannot—or rather should not—have speed "on first," as a high-powered one may

have conveniently. In the low-powered one, "first" must be a crawl, because the power has got to be in that speed to get the car started and over tight places such as hills.

With but two speeds forward, the driver of the low-powered car is likely to form the habit of shifting back as little as possible, and he is likely to drive "on the high" at stretches which, even if he gets through, mean heavy wear on motor and mechanism. Even with three speeds forward the gaps between them should not be over-wide. The clever designer knows that often a slight difference in gearing marks the points between where the motor will slow and where it can turn fast enough to deliver the power needed for ordinary purposes.

For instance, with your low-powered car and few gear speeds, or wide intervals between them, you may be "rushing" a hill which you might get up "on the high." Then if you have to shift back to ease the car over a hard place, you may find the interval too great to shift again into high, which is placed just beyond the limit of necessary power, and you will have to finish the ascent at a crawl. On the other hand, with several speeds not too far apart, you can frequently employ a higher speed than first for quick starting, and will find it comfortable and convenient to drive a good deal on second if it is placed right.

Many speeds are of course quite as desirable in the high-powered car to furnish flexibility, but their position is not so important, since at any sane speed there is always sufficient reserve power on the level for use on grades, lessening the necessity of shifting gears so much. Numerous gear speeds cleverly placed at close intervals are essential if the low-powered car is even to approximate the convenience and comfort of the high-powered.

Again, an understanding of horse-power will teach the tyro that it is not necessarily advantageous to have a four-cylinder motor on his low-powered car. In cars of less than 20 H. P. rating, the chances are all in favor of your getting a better motor for the same money by choosing a two-cylinder horizontal opposed rather than a four-cylinder vertical. On the score of simplicity the former has just half the number of parts. On the score of cost of construction there are half the number of parts to machine and fit, which should make possible better material and workmanship at the same price.

Even on the score of vibration the advantages are with the two-cylinder of the type mentioned. It vibrates in a plane parallel to the plane of the car frame, while the vibration of the four-cylinder is in a plane perpendicular to it. Even though the latter should run the more smoothly, more

vibration would be felt from it at high speed, owing to the cross strain. As a matter of probability it will not run more smoothly, because the presumption is in favor of better inherent balance and better workmanship at the same cost in the two-cylinder.

Its lubrication is accomplished by the oil being forced in against the upper surfaces of the pistons and flowing down around the sides, thus reaching the whole of the cylinder walls evenly. The tops of all valves and valve seats being in a vertical instead of a horizontal position, they do not so readily retain carbon deposits as in the four-cylinder. There is also much less wear on the moving parts in the two-cylinder, because it accomplishes the same work at lower speed. Its longer stroke likewise gives more power on hills. A four-cylinder motor with cylinders 3¾ x 4 inches must make 1,500 revolutions per minute to be rated at 20 H. P. A two-cylinder horizontal opposed with cylinders 4¾ x 6 inches need attain only 1,000 revolutions per minute for the same rating.

As for the operative mechanisms of the chassis, other than the motor, there is very little choice on the score of reliability among equipments provided in standard cars. Most of them will do the work for which they are intended about as well as

it can be done. On the score of convenience, there are a few things worth looking out for.

The best transmission is of course that which passes on the most power most readily from motor to driving wheels. There is little question in my mind but that this is best accomplished, in heavy, high-powered machines, by the chain drive. The more nearly the car approaches extreme lightness, the more successfully may the claims of direct shaft drive be urged. The chain drive will still have flexibility to recommend it, however, and the fact that it will not be so likely to protest against abusive driving. As the clutch is a crucial point in passing on the power, and the keystone of correct and comfortable driving, the motorist should give careful consideration to the claims of the multiple-disc variety.

Brakes, too, should be wisely chosen. Whether of the "contracting" or "expanding" type (both are present on most cars), see that they have large and not small surfaces. Large surfaces not only give the same result with less effort at the lever, but do not "burn up" nor need to be replaced as soon as small ones. Avoid if possible a "transmission brake" and choose a car where your excess of vigor at both foot and hand levers will be passed direct to the rear hubs. If you must have one braking system not of this type, choose that which

applies an equal force to two points on the countershaft, one on either side of the differential. The braking will thus be done through the side chains. and danger of damage to the differential be avoided. Should that occur, loss of braking power or serious skidding might follow.

Beyond being able to assure himself of adequate materials, power, and mechanical devices of desirable efficiency, the buyer may well judge also of those elements of design which bear directly on his economy of time in the care of his own car. It is possible to buy a high grade of reliability and general excellence in the major points of construction and find that the designer has neglected to provide for such things as oil cups on the spring ends, ready adjustment of brakes, effective lubrication of the steering gear, and the like, the absence of which will soon eat up all the bargain features of the purchase.

When we include all minor parts requiring lubrication, there are not many cars in which there will be found less than thirty to forty individual points to be oiled or greased. If half of these have no oil-retainers provided, the motorist must go over that many with a squirt can every time he drives the car. Even should he achieve this unheard of record the oil will likely not go where it is needed, because of exposed oil holes filled with dirt. Hence give preference to the car provided

with the largest number of liberal-sized grease cups and oil caps at wearing surfaces, other things being equal.

Adequate protection from dirt is an important thing to look for in design, as it is worth its cost many times over in reducing the labor of cleaning. Inside fenders connecting the mudguards and running boards with the frame reduce splashing to a minimum, but this arrangement should be so achieved as not to render inaccessible the springs, brake adjustments, main gasoline valve, etc. Where necessary small doors in the fenders should give access to parts that must be frequently reached. Likewise a metal dustpan with doors admitting readily to the crankcase pet cocks is desirable; as are leather "boots" enclosing the loose or jointed couplings between the clutch and the gear box; a leather hood for the magneto; adequate but readily removable covers for the bevel driving gears, the differential, and the transmission gears; a readily removable engine hood; and mudguards that may be quickly detached both front and rear.

These are a few of the more important points in this particular sphere of design which will save time for the motorist if considered in advance. He should bear in mind that a nice balance between adequate protection and ready accessibility is the thing to look for here.

EQUIPPING THE CAR

CHAPTER III

EQUIPPING THE CAR

YOUR newly purchased car, like your newly erected house, requires considerable fitting out to make it a comfortable and convenient home in which to enjoy your particular road activities. It is true that the car usually comes from the maker with some assortment of accessories—lamps, a horn, a kit of tools. It is true likewise that there are plenty of concerns to which you can turn over the car with a blanket order to have it fitted with every modern convenience and necessity, just as you would turn loose a firm of interior decorators in your new house. Even if you can afford this, the result will not be so gratifying as if you personally study out and build up the equipment which is most likely to meet your individual needs.

Scarcely any two veteran motorists will agree upon the same equipment in its entirety. That is simply because no two have had exactly the same experience, even in the same make of car. Furthermore, careful personal attention to this sub-

ject should be part of the education of every fledgling who intends to run and care for his own car. Even if his equipment is selected for him by some one else, he must himself know at least what is the importance of each item and how to use it when the occasion arises.

Any representative auto-supply emporium that makes pretension to completeness is obliged to carry an adequate stock of about six thousand distinct items, inclusive of sizes. You need not be terrified by this variety, however, as it has arisen chiefly to meet exigencies of individual taste rather than those of necessity.

Take the question of horns, for instance. The salesmen will show you an assortment variously operated and emitting sounds ranging from a sweet old bugle call of coaching days to the vicious snarl of a bear robbed of her cubs. You can strike a happy medium by choosing one which you can be sure will always respond to your hand with a toot loud and authoritative enough to arrest the pedestrian, without throwing him into panic, at the precise moment which gives him time enough to see and avoid his danger—and you time to avoid him if he does not act as you expected.

Among lamps also you will be shown many makes. Here, too, the viewpoint of utility settles everything but your personal taste. In the first place, if you purpose touring ever so little, you

need five lamps; two side lamps showing red to the rear and white forward; two good headlights low down on the frame in front of the engine hood, capable of throwing a strong beam on the road ahead; and a tail light showing red to the rear and white to the side on the license number.

Since the headlights should burn gas preferably, they will require either a generator or a storage tank of acetylene gas. The latter demands more attention and forethought to insure its always containing a sufficient supply; the former gives less trouble where much driving is done at night on country roads.

If the roads on which you are likely to travel much by night are hilly, winding, or poorly surfaced, a good swivel searchlight, set in the middle of the dashboard, is almost a necessity for safe driving. It also will burn acetylene gas. As the searchlight is inconvenient and unnecessary in city and most suburban driving, you will not be inclined to substitute it for the two headlights, and you will add it to your equipment only in case you intend to tour considerably in addition to using the car in town.

For the simple reason that there is always the off chance that your gas supply will fail or your headlights be disabled unexpectedly, they must be backed up by the sidelights, which, like the tail light, burn oil. In a great many States sidelights

are required by law. One of them will take the place of a lantern in case you need to inspect the car by the roadside. A wise addition is one of the varieties of pocket flash lamps or an electric candle attachable to the batteries. It will enable you to see parts upon which you cannot bring the larger lamp to bear.

This suggests the possibility of road repairs, and your equipment for this purpose is of primary importance. In general you can fall into either of two egregious errors, both of which are exemplified with sufficient frequency by amateurs; you can practice the false economy of adopting some meager list or accepting the maker's equipment as complete, or you can overload your car with accessories, only to find in either case that you are confronted on the road with some trouble for which you discover that you have omitted the one thing needful.

It will not be possible for you at the start to be omniscient as to your future needs. Much road experience is the only thing that can teach you how to be absolutely forearmed. The experience of others, however, is a valuable guide to appreciating the essentials in an equipment which should be adequate for all ordinary happenings.

The tools you cannot omit fall naturally into two classes: first, those required most frequently, and they should be kept rolled in a canvas kit

under the driver's seat or somewhere where they will be instantly accessible. Among these a pair of fair sized double-grip pliers will come into frequent use for unscrewing tank caps, extracting and inserting split pins, and for tightening nuts, etc. In addition, a pair of ordinary small pliers will be handy in such operations as twisting wire or holding a bolt while the nut is being tightened by the larger pair.

It will be a time-saver if the large pliers have a screw-driver end, but a small screw-driver should be provided to reach parts whose situation precludes the use of the pliers. Right here it should be said, however, that combination tools are best avoided. They will rarely do the work so well or so quickly as the single tool for a specific class of operations.

To this emergency kit should be added a small screw wrench—a bicycle wrench will do—a small hand-vise, and above all a good stout jack-knife. This last will be useful for a score of things, such as cutting the insulation from the end of a wire and scraping it clean, or cutting an asbestos joint or a piece of hose for the water system.

The more extended list of tools necessary for more serious work may be placed in a leather hand-bag and put with the spare parts into a tool box affixed to the foot-board on the driver's side. Among these a prime essential is a reliable ham-

mer, one head thin and flat, the other thick and round, with about a ten-inch handle. I have seen motorists try to make the pliers and the monkey wrench do the work of this tool.

You can use it with the cold chisel to cut a bit off the end of a valve-spring to secure better adjustment, or to wedge off a tight washer or bolt. With a blunt punch, of which you should have several, the hammer will budge a nut otherwise unyielding, and with a hard copper rod interposed you can hit a bolt on the threaded end to get it out safely. A ten-inch screw-driver will be useful here for holding bolts notched in the head, or for turning them into the nut till it is tight enough for the spanner. The upper part of the shank of this screw-driver should be squared so that it can be held by the monkey wrench when necessary.

You cannot be too careful about including an adequate set of box spanners—several long ones to take a different sized nut at each end—and at least one short and bent for getting at nuts inaccessible to the long spanners. Preferably these all should be of steel tubing. There are also a number of convenient designs among the more expensive varieties, such as the kind with a universal joint and a set of interchangeable boxes of different sizes.

Include six-inch files as follows: Flat, half-

round, triangular, and small round, all fairly fine except the half-round one, since it is used only in preparatory work to be finished by the others. You will need files to cut steel wire, to ease a damaged screw thread, to fit rivets, to open out round holes, etc.

Add to the above a key-driver, some tool steel, a small brush for cleaning spark plugs, an assortment of fine needles both curved and straight for cleaning out carburetor needle-valve and spray holes, and a pair of flat cutting pliers for wire—and you have a tool kit which will serve you in all ordinary emergencies. You can elaborate on this list considerably by adding special tools which may or may not assist your inexpertness. It is far better, however, to learn how to use standard tools well than to accumulate a mass of implements, each supposed to do some one thing superlatively. You will waste as much time choosing among these as you would in figuring out how to utilize a smaller array to accomplish the same ends.

There are other larger tools which must not be forgotten. A strong jack, a reliable air pump with pressure gauge, scissors, etc., belong in your tire kit. The contents of this will be considered in detail when we take up the tire problem in a later chapter. You must not forget a good sized funnel with a strainer as fine as you can get. It is wise

to supplement even this with a wad of cotton batting or wool to be inserted each time you fill your gasoline tank.

Add a folding canvas pail and two squirt guns, one for kerosene and one for lubricating oil, with a straight and a bent nozzle each for reaching parts readily. A valve-grinding tool with a tin of fine emery paste may save you much annoyance on tour and takes little room. Also, if your car has a chain drive, a chain-repair tool will save much vexation in case you find it necessary to insert a new link, several of which should always be carried with you.

I know a man who for the need of this simple little tool abandoned in disgust what promised to be a pleasant day's outing. Loaded with a party of four, his car was halfway up a mile grade when a link in one of the chains broke. Stopping the car with some difficulty, he recovered the chain and, not being very resourceful, was in a quandary to hold the chain in place when adjusted over the sprockets while he inserted a link. He had a dozen links, but no chain-repair tool. He could not keep the ends of the chain together long enough to make the repair.

The little tool was the one thing needful in this case, and after working himself into a passion he finally coasted down the hill, drove slowly four miles on the level road with his remaining chain,

and reached the nearest repair shop. When he saw how readily the machinist inserted the link with the aid of the tool above mentioned, he was so disgusted that he abandoned the trip.

It is highly advisable to carry, in a special box, one duplicate of every kind of bolt and nut used on the car. It is very easy to lose a nut in making some adjustment on the road, and the constant vibration of the car is diabolically potent in working things off without your knowing it. Other important spare parts to carry with you are three or four spark plugs with extra porcelains for them, two or three extra valves and valve springs, as well as valve-stem keys.

Whether you have a magneto as the main arm of your ignition system or not, a current-indicator for testing your batteries is indispensable to ascertain when the extra set of batteries, which you should always carry fully charged, should be switched on or connected up, as the design of your car may necessitate. Several yards of the best insulated copper wire, as well as a complete set of ignition connections with terminals, will help greatly to forearm you against ignition troubles. It is highly advisable also to carry several spare platinum-tipped screws for tremblers or contact breaker.

Above all things do not forget a dozen lamp wicks and a tin of kerosene for your side and tail

lights, nor to provide extra burner-tips for your headlights and a reserve tin of calcium carbide for your generator if you are making a run of any length. In that case an extra tin of gasoline will pull you out of many a hole where you might be stalled for want of that precious liquid.

A gallon or two of cylinder oil and one of lubricating oil and a pound can of gear grease are obviously indispensable. You will need also an assortment of washers, one duplicate of every asbestos or rubber joint ready cut, a roll of rubber tape, some annealed iron wire and some steel wire, copper wire and a little sheet copper, an assortment of cotter pins, some emery cloth, some asbestos card and asbestos string, and plenty of cotton waste and a cake or two of some good soap or a box of compound for removing grime and grease from the hands.

This may seem a somewhat staggering enumeration to the new motorist and may suggest to him that a great deal of time must be spent in making repairs on the road, but the object of carrying all these things is to provide just the right one or right combination to make it possible to overcome a road trouble quickly whenever it occurs. This, with reasonably careful driving, will not be often, but when it does arrive unexpectedly without the proper equipment to meet it,

an exhilarating outing is inevitably turned into a doleful period of profane inactivity.

In the matter of other accessories, such as hoods for your lamps, foot-rails, bumpers, trunk-racks, side-baskets, tire-cases, lunch baskets, you may be left to the eloquence of salesmen, modified by your own taste and common sense—and the capacity of your car.

A good speedometer, however, must not be forgotten. There is a tendency in England and on the Continent—slowly making itself felt here—among magistrates to take the reading of speedometers of standard make as evidence in cases of arrest of motorists for speeding. The tale the speedometer tells is quite incontrovertible, if you choose the variety fitted with a registering hand which remains at the speed at which the car was last going.

The choice of a top for your open tonneau or runabout is also a question likely to come up if you do much driving in wet weather, for though the occupants of the car may be thoroughly protected by the use of rubber shirts or other clothing, comfort is not thus so readily attained, especially when the inside of the car becomes thoroughly soaked. If that happens you will appreciate a good sized sponge with which to mop up.

The most serviceable form of top for protection

against wind and rain is one of the extremely foldable variety. Some may be collapsed to almost inconceivable dimensions. The top should be so constructed that at either side curtains may be let down to suit the needs of the occupants for protection against a quartering wind when driving slowly. When entirely folded, the top should be so arranged as to form a shield against the dust sucked up behind. A folding wind shield of glass attached above the dashboard adds greatly to the comfort of the person who drives.

There still remains the question of automobile apparel, and here you will find a bewildering elaboration of styles suited to taste and pocketbook. The sensible plan is to fit yourself out for the season in which the car is first used and to add to this wardrobe subsequently as occasion may demand.

Goggles, of course, should be worn by the driver on all but the shortest runs, and the other occupants will find them always a great comfort. Not only do they protect the eyes against dust, but also from the chilling and drying wind, and in summer they are almost indispensable because of insects. I know several cases where a driver has been so blinded by a gnat that he was rendered incapable of managing his machine just long enough for a serious accident to occur.

It will pay to tuck a humble pair of overalls

and a jumper in with the repair kit. They may seldom be needed, but they will save clothes and complacency if you ever have to make an extended exploration of the machinery by the roadside. The rubber rain shirt is an excellent thing to keep always aboard the car for emergency. Drawn snugly about the neck and wrists it is large enough to go over anything except a fur coat. It is fastened in such a manner as to shed water completely and is very light and capable of being compactly stowed. On days which turn suddenly cold it is usually quite sufficient to supplement ordinary wraps effectively in excluding the wind, and is even serviceable for ladies' use.

In summer the men of the party require no special garments other than dusters, caps, and a light pair of ventilated gauntlet gloves for the driver. At least the palms of these should be of the durable but very soft deerskin. Driving gloves for whatever weather should be drawn snugly about the wrists.

Women's wear in summer, beside goggles, should include a veil, a small hat, linen or silk duster, lisle thread gloves, and, for rainy weather, a raincoat with a hood large enough to cover the hat. Contrarywise, the hat should never be too large to be covered thus, even in fair weather, since a twenty-mile breeze is not compatible with the Gainsborough style of millinery.

In the colder weather of spring and fall a man can get along nicely with an old overcoat, knitted muffler, a sweater, and perhaps a chamois vest for emergencies; also fleece-lined gloves and woolen cap. A raincoat, felt hat, together with gloves, muffler, sweater, and chamois vest, are equally suitable for ladies.

When the temperature drops below 35 or 40 degrees, especially on long rides, furs are indispensable. These differ in essential respects from those worn afoot or in carriage driving, since the speed of the car will rob the body of its heat more quickly than any other form of locomotion. These garments must be very full, and the fur affords better protection outside than inside, the lining being of quilted cotton batting. A wide turned-up collar buttoning closely at the throat and roomy sleeves and skirts are essential.

It is unnecessary to buy expensive furs as their beauty is soon spoiled by the inevitable dust. The same fortunate fact applies to fur robes, which it is advisable to provide for all seats but the driver's. Since he must have his feet free, he must depend upon some sort of heavy over-pants, which will be necessary only in the coldest weather. Ordinarily he will find extra heavy underwear and puttees sufficient. Fleece-lined overshoes may add to the comfort of the feet, and all but the

driver may use some variety of the many charcoal-burning foot-warmers.

For prolonged exposure, especially in a fast car in winter, a face-mask is desirable for ladies, but the veil and goggles may suffice. They will have their own muffs, of course, to supplement wool-lined gloves. Either a fur cap or a thick felt hood is the most sensible head-gear for them. The driver will now require fur gloves and a fur cap, the gauntlets of the former being big enough to go easily over the sleeves of his fur coat and strap to the wrist.

TAKING CARE OF YOUR OWN AUTO

CHAPTER IV

TAKING CARE OF YOUR OWN AUTO

IF YOU have just bought your automobile, or are thinking of it, and if you mean to be a moderate motorist to whom upkeep cost is a vital consideration, the question inevitably presents itself: "Is it possible to run a car for a year and confine expenses to fuel, oil, batteries, and a few extra tires?" There is a mistaken impression that it is not, and the growth of this opinion is largely due to the truthful accounts of the many who rush into possession of a car and heedlessly hurry in its use.

When their ardor has been cooled by a deluge of machinists' bills, embarrassing breakdowns, and the final realization that the car is fitter for the junkheap than for use, they rush out again with voluble testimony that it does not pay to keep your own car unless you can afford fabulous sums as the price of having it on hand and in a condition to be used when you want it.

The man in moderate circumstances who has neither the time nor patience to devote a reason-

able amount of personal attention to his automobile had better stay out of the game. The same sort of attention is meant that a lover of horses would give to the well-selected cob or span he can afford to keep. One can learn to drive an automobile even more quickly than to drive a horse, but that is far from knowing either animal or machine and how to get the most comfort out of each.

Talk with any automobile enthusiast—a real one, who has driven many cars of many makes—and if you stir him to the true mood of reminiscence, he will reveal little intimate acquaintances with machines, which will convince you that every motor has its own personality, like every horse—even as between two identical models from the same manufacturer.

He will convince you, likewise, if you are a judge of men, that getting acquainted with a car is largely a matter of personality, or at least of attitude, in the man who uses it. After the very briefest experience, of course, you can "crank her," climb aboard in the most businesslike fashion, adjust your throttle and spark somehow, throw in the clutch, and wobble along a country road. Soon you will boldly negotiate a city street, make hairbreadth turns and sudden stops, and change speeds with some understanding of the responses your car will make to these operations.

Alas, you are still far from realizing what your

digital expertness with steering wheel and levers and your foot play on the clutch and brake pedals are doing to the car. Unless you take pains to learn this, before a year is out one of those sudden unaccountable things will happen, which will mean that you do not motor for at least a week and that there will be a doctor's bill for services to you or the machine or both.

A young physician of my acquaintance illustrates aptly the attitude which it would be profitable for every moderate motorist to cultivate. A year and a half ago he got the automobile fever —or rather it was merely a slight rise in temperature taking the form of an average gasoline town runabout. He was only a few years out of medical school and was struggling to build up a practice, but he thought he could save money in the end by possessing an automobile.

From the first he was as attentive to his machine as if it were one of his patients. To-day he is one of the best amateur drivers I know. He is careful and speedy, and during the many times that I have ridden with him I have never seen him fail to get a satisfactory response even to the somewhat difficult demands a physician has to make upon a car.

The secret is not far to seek. His scientific training makes him want to know all the whys and wherefores of his machine. Furthermore he is

proud of its condition, just as of the scrupulous care he devotes to his surgical instruments or to the diagnosis of a difficult case. He doesn't do everything about the car, because he hasn't time, but he knows exactly what ought to be done. When he sends it to the garage or the machinist, definite instructions go with it. When it is returned, he is able to determine for himself whether the order has been properly filled.

The attitude of my friend the doctor should be emulated as far as possible by everyone who counts the cost of owning an automobile. Its keynote lies in knowing your mechanism, especially the parts where personal knowledge and care are absolutely necessary to insure dependence upon its capabilities.

It would be impossible to write here a detailed manual of the myriad varieties of motors on the market. Many such manuals exist, and from them, as well as from the maker of your model, you can get a good idea of the anatomy of the machine you buy. Armed in advance with this theoretical information, the fledgling motorist will do well to keep in mind some vital considerations which will aid him in applying what he thinks he knows to the car in use.

The novice is pretty sure to begin by overlooking the very A, B, C of the experienced driver's creed of efficiency. He learns a lot before he re-

alizes that the motor is the heart of his car, the fuel system its digestive tract, and the ignition apparatus its nerves. Consequently he does not concern himself with the sort of food that should be provided for this sensitive organism. Even if he troubles to obtain a good grade of gasoline in which the percentage of moisture is minimized, he does not think it necessary to strain the fluid each time he fills his tank.

As a result he is likely to have to send his car to a hospital for an acute case of appendicitis in the feed pipe, in whose narrow bore, as well as in the carburetor, the gasoline deposits any impurities it may carry in suspension. One motorist of my acquaintance had trouble in this way despite the fact that he was a crank on straining gasoline. Now he is more of a crank than ever, and instead of using the ordinary strainer he almost filters the liquid through a wad of cotton gauze stuck in his funnel, to keep out the "germs of trouble" as he calls them.

It may seem unnecessary to remind anyone possessing a water-cooled car to use as clean water as possible in the radiator, but I have known motorists, who knew better, not only to use dirty water more than half the time, but to crack a cylinder through forgetting, until it was too late, to give the radiator the supply of water for which it had been famishing.

Of all the trouble makers that can percolate through a feed pipe into a cylinder, minute particles of corroded metal do the most subtle harm. A fruitful source of these is moisture in the gasoline so common to the cheaper grades. One of the cleverest and most economical ruses to prevent the recurrence of such trouble came to my attention recently.

An experienced motorist after some "trouble" diagnosed it as an "obstruction in the feed pipe." He disconnected it, blew it out, and discovered a fine sediment of corroded copper. With a stick he scraped around the bottom and sides of the gasoline tank. The stick when pulled out gave evidence of corrosion of the tank walls due to moisture in the gasoline. He washed out the tank, filled it with cyanide solution, suspended some blocks of tin in this, connected up his batteries—positives to tin, negatives to tank—and soon had the inside faces of the tank thickly electroplated with pure tin. Now he does not worry so much about small percentages of water in his gasoline, nor did he have to buy a new tank.

The third important item of diet for the motor is oil. Cylinder lubricants are mineral oils, hydrocarbons. The criterion of their value, aside from their lubricating quality—"body" and "wearing value" chiefly—is the amount of carbon developed by their combustion in the cylinder. It will not

take long with a poor grade of oil to acquire a deposit of carbon on the inside of the cylinder and on the piston head as deep in some places as 1-32 of an inch. All sorts of engine troubles result from this.

The motor will "knock" or pre-ignition will occur—always that form of motor heart failure occurs which automobile doctors call "loss of power." In the finely adjusted modern cylinder carbon deposits not only impair efficiency, but if neglected do irreparable harm, sending the car with extravagant frequency to the repair shop to have the engine "taken down."

Various brands of oil are advertised as the best on the market, and the thoughtless motorist tries one of these after the other without knowing their criterion of excellence. The simplest test is color. The more nearly "water white" the mineral lubricant is, the less carbon will it deposit when burned. The more limpid it is, the more it has been filtered and refiltered to free it from all matter foreign to its essential composition.

An oil, however, should not be judged by its color alone. Having satisfied himself as to its color, the motorist must judge of its lubricating value by noting its effect in use upon the parts whose working it is intended to facilitate. A great saving in wear is likewise achieved by knowing at all times just how much oil to feed the

mechanism. It is the easiest thing in the world to get too much or too little oil into the cylinders, and the motorist must learn by practice what quantity gives the best results, air-cooled motors requiring more than the water-cooled kind.

Having acquired the habit of scrutinizing his oil, his gasoline, and the water for his radiator, and having thus set before him the cardinal Pure Food Laws of Automobilism, the successful motorist must, in general, keep his car scrupulously clean, both inside and out, with approximately the same care that he gives his own person. The body, the chassis, and the running gear must be freed from the ordinary dirt picked up in travel—and the sooner the better.

This is most readily done immediately after returning from a trip by turning the hose on the exposed parts (carefully, of course, so as not to hit the engine), or by washing them with a wet sponge. It is much easier to get rid of travel stains in this way than to depend upon an elaborate occasional cleaning. By the time you get around to that, the dirt has worked its way into the bearings where it will do the costliest damage. No harm will come to the bearings from the daily hose treatment, inasmuch as the oil with which they are provided—or should be at frequent intervals—is an absolute safeguard against rust.

If it is worth while to devote some time to the

car after returning, it is far more so to make a careful examination of the machine before starting out. This does not take long. It may be confined to the radiator and gasoline tank to see if they are properly filled; to the feed system; to the motor and its connections; and to the ignition system—especially the cleanliness and adjustment of the spark plugs.

The ignition system should receive the most careful inspection. When the motor stops on the road, it is almost certain to be due to trouble with either the ignition or the fuel supply. The general rule is that if it stops suddenly, perhaps can be started again, and again stops, it is an ignition trouble. If, however, the motor gradually dies down and refuses to respond to throttle, spark, or even the crank, the trouble is likely in the gasoline supply. You can be sure of this indication only by careful inspection of the ignition system before starting out.

I recall one case where the motor stopped in a very puzzling way, with every evidence of trouble in the carburetor or its adjuncts. The driver, however, seemed to have a knack in cranking it into life again—only to repeat the operation after a few miles' progress. The flow of the mixture was found to be all right, and after finally reaching home it was decided to go over the primary wiring. The battery wire was found in contact with the

brake-rod. The insulation had been worn through, so that, in driving, the current was short-circuited at frequent intervals. The trouble could have been avoided by vigilance before the start.

The throttle, which controls the spray of gasoline into the carburetor, is the master-key to driving with the least strain and wear upon the mechanism. Most new motorists, and a far too large proportion of older ones, rely mainly upon the clutch to control the speed of the car. They are constantly and suddenly throwing it in and out, thus subjecting the crank-shaft, the chains or propellor-shaft, the axles, and the tires to serious and unnecessary strain. The clutch should never be thrown in suddenly, whether starting from rest or while the car is in motion.

It is easy to acquire the habit of letting the clutch-pedal come up slowly, thus permitting the contact surfaces to grip gradually. The clutch itself is another point in the anatomy of the car to be inspected regularly, especially if it is of the cone variety. If this grips too quickly, oil it, using castor oil if the lining be of leather. If the cone shows signs of wear, take it out and scrape it down so that the outer or larger part will engage first.

In short, the careful driver sums up his creed thus: "Never do anything suddenly with an automobile." Only so can wear and tear on the car

be minimized—not to mention accidents. Suppose you are confronted with the necessity for a sudden stop. Your amateur impulse will be to jam down the clutch-pedal, grip the emergency brake lever, and clamp the wheels into cessation of their revolution.

The motor, thus relieved of its load, will begin to race; the fly-wheel will spin around with increasing velocity; and you are lucky if, especially on wet asphalt, your car does not skid around like a top, hit the curb, and turn turtle with you underneath. The wear of this sort of stop on the tires should be a sufficient consideration for you to refrain from cultivating it.

If, on the other hand, you first close the throttle, then throw out the clutch, and apply the brake just hard enough to allow the wheels barely to revolve, your car will come to a safer and speedier stop without strain. The motions to accomplish this must, of course, be practically simultaneous, but they are no more difficult than the ones required for the wrong sort of stop. Once at rest, you open the throttle instantly and advance the spark if necessary to start the engine. The clutch can then be thrown in gradually when you wish to advance.

Make up your mind, from your earliest attempts to drive, never to use the clutch to control speed when you can possibly avoid it—which you

can do nine times out of ten by skillful manipulation of the throttle and spark. When you understand their respective functions and know how to utilize them, your technique in driving will have reached top-notch, and the wear on your car will have been reduced to its lowest terms. On the dashboard of every new motor car might well be inscribed this couplet:

> The spark advanced will give you speed;
> The throttle, power as you may need.

In taking corners, for example, instead of throwing out the clutch and braking slightly, slow down the motor with the throttle until halfway around, then open the throttle slowly and if necessary advance the spark until momentum is regained. Skidding, when it occurs, with its peculiar strain on the tires and mechanism, can be overcome most readily by closing the throttle, then throwing out the clutch, and keeping the wheels straight ahead.

The car will right itself thus more quickly than in any other way. Shutting off the fuel mixture stops the engine and eliminates the gyroscopic effect of the fly-wheel, which is the root of the skidding evil.

Furthermore, the driver should always keep the steering-wheel as still as possible, going straight ahead and not turning out for every pebble or

rut. Every time the front wheels are turned a severe side strain is put on the tires—a far greater danger to their life than possible punctures or wear from the ordinary roughness of the road. Incidentally the tires should not be pumped up too hard. Always employ a pump with a pressure gauge, and see before starting that the tires are inflated up to, but not beyond, the point recommended by their maker.

If you have driven your car for a season and have learned how to profit in some measure by all of the foregoing advice, you will have covered, in all probability, between five and ten thousand miles, and whether you lay the machine up for the winter or not, it should have a thorough overhauling before you attempt to use it a second year. It is hardly to be expected that you will undertake to do this for yourself unaided, especially the first time. It would be well for you, however, to take the time to be present during the operation.

If you live in the city, you will likely send the car to a garage. There it will take about a day, on the time slip, to overhaul the carburetor, adjust the vibrators of the coil, clean the timer, and perform such other similar preventive measures as you should learn to do for yourself. After a test run of a few blocks, the car is returned to you; as it is likewise if you send it to a machinist who

actually "takes it down," cleans and reassembles all the parts, and puts the car together again.

In either case the final "tuning up" is left to you. That is why it is advisable for you to have at least something to do with the overhauling yourself, in order to see just where and how much the parts are affected by the use you have been giving the car.

The ideal way, which is quite practicable if you live in a small town, is to induce the local machinist to go over the car with you, taking her down and putting her together while you try to help and learn what it is all about. In the city such an arrangement is more difficult, but it is well to describe briefly the essentials of the process, as they will reveal a number of important things the motorist can learn to do for himself.

First the body must be got out of the way—either hoisted up with block and fall or slid carefully off the rear of the chassis by means of inclined planks. All the water pipes are then to be disconnected and laid on the floor with the radiator. The bolts holding the cylinder castings to the crank case are next unscrewed, and after making sure that all connections with the exhaust, the inlet manifolds and the ignition wiring, are properly released, each casting is lifted by block and tackle, the chassis rolled from under, and the part lowered to the floor, a definite portion of

which has been selected for each—under an overhead beam, of course, where a perfectly vertical pull on the lifting tackle can be insured.

To attain accurate reassembling, each part should be marked in accordance with some definite system, and the small components of a complicated element, like a cylinder casting, should be laid out in orderly fashion on the portion of the floor dedicated to it during the entire overhauling. It is particularly important to see that the pistons and connecting rods are returned to their respective cylinders.

After seeing that the clutch is thrown out, if of the cone type—or, in case of the multiple-disc sort, that the clutch-shaft is disconnected from the shaft of the gear set—the crank shaft and fly-wheel are hoisted out and laid in their respective places on the floor, which is now sufficiently full of trouble to make it wise to give minute attention to the parts already laid out.

The radiator should be filled with water and any leaks then apparent should be marked for repair by an expert solderer. Both back and front should be examined to detect any part so damaged or worn as to be likely to give way, and such parts should be re-enforced. (The expert machinist will not neglect to make this sort of an inspection of every part of the car; it is the best insurance against wasteful wear, sudden breakdown, and ex-

pensive replacements.) With a strong solution of washing soda and hot water the radiator and the water pipes should be flushed, the solution being shaken in them and drawn off and the process repeated till no more dirt comes away.

The valves should next be taken from the cylinder units; their springs and seat should be examined, and they should be ground in. Every trace of carbon deposit should be removed from the valve ports. Cam faces, rollers, and other contact parts of the cam-shaft must be carefully examined for wear and necessary replacements made. There is no more fruitful source of loss of power in a motor than the interference with perfect valve adjustment which wear and dirt deposits inevitably cause. The water-jackets of the cylinders should be cleansed of dirt or rust to remove all impediment to the water circulation.

The cylinder bores should be examined carefully to see that their surfaces are uninjured. If they are badly scored, they will require reboring. The piston heads must be scraped clear of carbon deposit, and the piston rings carefully examined to see if their surfaces are intact. If not, they must be replaced, as the slightest gas leak resulting from imperfect contact between the rings and the cylinder surface reduces the efficiency of the motor.

Cleaning out the grooves of the piston rings

should not be neglected, nor should applications of the soda solution to the inside of the piston heads to remove all traces of old oil. All bearings in cylinders and cam shafts should be examined for wear, and thoroughly cleaned with gasoline—especially the end bearings of the connecting rods—and if your machinist cannot take up the wear in these the boxes must be relined. The gear of the cam shaft must be carefully timed, as this is a crucial point in the proper working of the motor.

This and most of the attention required by the motor, as indicated above, the amateur will be glad to have the machinist take off his hands, but if he has carefully watched what is done, he will gain a liberal education about the most important part of his car. As the work proceeds from this point he will learn to dismantle the carburetor and give it a thorough cleaning, and it is extremely desirable that he should know how to do this himself, should the occasion for it arise when the car is in use.

The gasoline tank and tubing are parts which he can himself thoroughly flush out with the soda solution; the tubing should be gone over carefully for signs of injury, displacement, or wear. He should also learn from this taking down of the car how to go over the entire ignition system and examine it for insulation defects or other wear

and to replace the entire length of wire in which these occur; it is the quickest and safest way.

He can readily learn also to examine contacts, bearings, and connection of the timer and to take up any undue looseness in these; likewise to readjust the vibrators of the coil, and after the car is reassembled and the motor running, to test the coils for consumption with an ammeter. The contacts of the interrupter of the magneto (if there is one) should be adjusted; if the ignition is of the make-and-break type, defects in contact and insulation of the igniter must be remedied.

The cleaning of the crank case and the oil pump with gasoline is another thing the amateur may learn from this experience. In the case of force-feed lubrication the fine-bore tubes must be painstakingly flushed with gasoline and persistent obstructions removed, preferably by blowing them out with live steam—though the motorist should be able to accomplish this in time of need with either an air pump or a length of wire.

It is not difficult to learn how to go over the transmission system of the car, beginning with the cone of the clutch and its spring (where replacements should be made, if necessary), and to test the alignment of every part of the system, especially in the gear box, which should be thoroughly cleaned out; so should the universals, the slip-

joint on the propeller shaft, the bevel drive and differential, where any lost motion must be taken up. The wheels of the car must, of course, be removed, and it is simple enough to do this, thoroughly cleaning hubs and axles, boiling the chains in the soda solution or soaking it in gasoline, cleaning and examining the sprockets, and replacing them if badly worn. The entire running gear and the brake system and steering apparatus should receive the most rigid examination and a thorough cleansing. Any loose adjustments should be taken up by competent hands.

What he learns from this course of sprouts, if he is wise enough to take it, will make the motorist competent to do many things about his car, because it will give him the necessary confidence to undertake the simple repairs and adjustments and desirable cleanings, which, if frequently resorted to, will enable him to keep wear under control. It is a knowledge also which should enable him to be forewarned when anything shows a tendency to go wrong.

DRIVING WITH BRAINS

CHAPTER V

DRIVING WITH BRAINS

IT IS a comparatively easy matter even for the veriest tyro in motor car driving to acquire an apparent facility with his hands and feet, which is based on nothing deeper than a knowledge of what the various controls of the car will do when you touch them. It seems the simplest thing in the world, for example, to get your motor going by turning the starting-handle on the front. Yet the prevalence of sprained thumbs among even licensed chauffeurs shows pretty clearly that, granting they know enough, they do not always use their brains to the extent of *not* grasping the handle with the thumb when cranking the machine.

This one primary step toward driving your car illustrates aptly the difference between driving with brains and driving without. A slight woman has brawn enough to turn over a starting-handle, but a prodigiously powerful man may do it wrongly, to the point of spraining his thumb or wrist, if he does not apply his brains sufficiently

to be always aware of the purposes of the movements through which his arm is going.

The orthodox method is to stand directly in front of the handle, grasp it with the four fingers of the right hand, but not with the thumb, which must lie along the handle. Raise the handle to its highest point, press in, and turn down from left to right. When the handle has passed the lowest point and you begin to pull upward, you should feel a resistance caused by the compression of the mixture, as one or more pistons rise toward the cylinder head.

The theory is—and you will have to concern yourself with theory if you wish to drive with brains—that, when you have turned on the cock admitting gasoline to the carburetor, opened the throttle somewhat so that a fairly rich mixture may flow into the cylinders, and pushed your ignition-advance lever back as far as possible (*and not forward by mistake*), then as you pull upward you will feel a resistance due to compression of the explosive mixture. You should reach a point just before you have made a complete revolution of the handle when a spark in one of the cylinders will ignite the mixture, start the motor, and jerk the handle out of your fingers—harmlessly if your thumb lies along it.

This will probably happen if the compression of your cylinder is of the best. But the compres-

sion of cylinders deteriorates with use, and you may not feel the full resistance till you are at the very top of your upward pull or beyond that point. The instinct of brawn is to push on down over the compression. It is the cardinal rule of brain *never* to push down over the compression for the reason that, in case you have left your spark lever forward, the spark will go off in some cylinder before the piston has passed dead center, driving the handle violently backward against your palm. The safe and rational way, when you feel the resistance of compression increasing on your upward pull but you are unable to pull over it before reaching the highest point, is not to pass that point, but, releasing the handle from engagement, turn back and pull upward again, when you should turn over the compression on the up stroke.

This may seem intricate enough to the motorist who wants to do things without thinking them out. If he is inexperienced enough not to have formed any bad habits in cranking, or if he has "got away" with them, escaping a serious sprain of thumb or wrist, he can convince himself thus: Let him set the switch of his ignition circuit at "off," turn over his starting handle several times, thus compressing a fresh charge in each cylinder, and then simultaneously switch on the ignition and push the spark lever sharply forward to the limit.

If this does not cause ignition in one of the cylinders and start the motor, he may switch off the ignition, *push the spark lever back*, turn over the crank several times, switch on the ignition again, leaving the spark lever as it is, and then pull the crank upward over the resistance. The motor should start before he can push down on compression. This process will teach him something of the feel of compression just before the point where he can pull over it.

A whole chapter almost could be written on cranking a car for those who desire to master the ultimate finesse of driving. It is obvious that finesse of any kind is impossible without the application of brains. Rudyard Kipling once aptly summed up the situation in which the driver of a motor car finds himself as regards brains:

"A horse," he said, "in most harnesses does the work for which his driver is paid; and when the man is more than usual drunk, the beast will steer him home. Not so the car; she demands of her driver a certain standard of education, the capacity of unflickering attention, and absolute sobriety."

It does not require a temperance lecture to make plain that there can be no "driving with brains" that are fuddled by drink—even to those who have but a primitive notion of what the management of a car in motion involves. But that "cer-

tain standard of education" demanded of the automobile driver must be based on some native intelligence and considerable careful study to supplement a knowledge of what the controls of a car will do, by an understanding of how they do it and why they are needed for the work they are designed to perform.

For example, you know perfectly well, without ever having seen an automobile, that the brakes are intended to stop it. But when you begin to drive you discover two brakes. One is operated by a foot pedal and usually exercises a drag on the countershaft; the other responds to a hand lever which you soon learn to distinguish from the change-speed lever and the reverse lever, all three being situated conveniently to your right hand. It does not require much investigation to learn that this hand brake operates band-friction on one or both rear-wheel hubs.

But you must go farther in the use of your brains and learn that the foot-pedal brake on the countershaft puts a frictional strain on the transmission system of the car. This is quite acute on the countershaft and its bearings where an excessive strain is likely to do costly damage. The obvious deduction is that this transmission brake should be applied only when driving in a crowded street or when your car is traveling not more than eight miles an hour. Then by brief and

gradual application of this foot brake you can safely bring it down to a slower speed or a gradual stop.

The action of the hand brake is to reduce the revolution of the rear wheels, and its frictional force is confined almost entirely to them and the tires. It is therefore to be applied whenever you want to bring your car to a full stop from some fair degree of speed, or to a sudden stop necessitated by danger, or in controlling speed on long, heavy grades.

Even when you realize all this, you understand but the fundamental principles of braking the car, and the alert brain must always be in communication with the sensitive hand till they learn to work together automatically; in other words, until you have acquired the "feel" of the amount of pressure you are putting on the wheels, which should be no more than enough to check their speed up to a point just short of dragging the tires. Through experience—and experience is doing things consciously; that is, with brains—your arm will learn to apply a steady pull, which you will ease off a little just before the wheels begin to drag and then reapply with progressive force till the car stops in the shortest possible space without undue strain or wear on the tires.

There is not space in a single chapter to go into the minutæ of every operation in which the mo-

torist must use his brains, in the sphere of driving alone. Mixing experience with gray matter is the essential whereby he must perfect his skill and satisfaction in the use of the car. But before that experience, and always back of it, must be that right attitude of mind, the brainy attitude, as a talisman of success. Just as one cannot get the best use out of his own body without understanding as much as possible of how its various functions perform their work, so the motorist must know not only the anatomy of his car, but also the functioning of the mechanisms which go to make it complete.

For example, in starting you know that the first thing to do is to open the throttle so as to admit the mixture to the cylinders. When you exercise your brains in the operation, you will seek to determine how far to open it. If you have a light-powered car, you will require a fairly rich mixture in order that the fly wheel may be sent around at a good rate, thus heightening the power which the clutch must absorb when it is let in. In a low-powered car, unless the motor is started pretty strong, the load thrown upon it by the clutch may stop it with undesirable strain.

On the contrary, in a high-powered car the full force of the motor is more than is needed and the throttle should be but moderately opened. Here, too rich a mixture will start your motor off on a

race, and when this happens by mistake, the brainy driver will throttle down at once and get it just right before letting in the clutch. His object is to avoid the strain on the transmission which would otherwise occur.

This sort of driver does not leap into his seat, jam in the clutch, and go off with a jerk. He gets the proper "feel" of his throttle. The ear of experience tells him when his motor is running smoothly with sufficient power, and he lets it run for the moment or so necessary to obtain complete lubrication of the cylinders. Not till then does he let in his clutch—gradually; nor does he advance the spark or change the speed gears till the car is in full, equable motion.

Likewise in stopping, in addition to what has already been said about the application of brakes, the brainy driver remembers that in pulling out the clutch he is relieving his motor of a heavy load, and when he does so he is careful to forestall racing by retarding the spark and throttling down. Neither will he take chances on wearing the motor unduly by letting it run for more than a minute or so while the car is at rest, but will switch off his ignition, and will in either case set the change-speed lever at "neutral" so that the gears are nowhere enmeshed and the clutch is kept automatically out of contact.

Perhaps there is no phase of driving in which

brains are less frequently used than in changing speed. Of all the operations to which the cardinal rule of driving—"Do nothing suddenly"—applies, this is the one. And yet any day in a walk on city streets your teeth will be set on edge constantly by the harsh, strident "growl" of gears jammed into engagement by motorists who should know better.

The temptation is, of course, to yank the lever the moment the idea of a change of speed occurs to your mind. The thing to remember is that, theoretically, the gears should be traveling at the same speed before being shoved into engagement. Likewise the clutch should be thrown out or nearly so, to the point of slipping readily, to avoid undue strain on the shaft.

In changing from low to high, by throttling down somewhat, you make the motor act as a brake on the clutch shaft, which is tantamount to accelerating the speed of the wheels. It would be necessary to do this latter to bring the high gear up to the speed of the shaft. Since this cannot be done, slowing the shaft is the alternative.

In changing from high to low, obviously the wheels should be slowed and the clutch shaft accelerated, then released from the motor as aforesaid. The gears then being approximately at the same speed, it should be possible to throw them into engagement by a steady, firm shove of the lever.

They should be thrown in sharply or else not at all.

If they grind against each other, release the lever and try again. Expertness in changing speed is well worth the patience and thought expended in acquiring it.

Driving on gradients is another art which calls for the use of brains. The uninitiated, while admitting perhaps that going up hill involves some difficulties, can see no great education required for coming down. Yet it is quite easy to damage the car seriously by doing the latter thoughtlessly. The general practice is to use the motor as a brake, which is done by cutting out the ignition and throttling down or off altogether, leaving the clutch in.

The pistons are now being forced against the compression by the clutch shaft, instead of vice versa, as in normal running. This tends to slow the shaft and consequently the wheels. The danger is in coming down so fast as to overrun the speed at which the motor is designed to work to capacity, thus seriously injuring it. Hence the hand-brake must be used to keep the speed of the car down below this point. On steeper grades employing the low-speed gear increases the braking effect of the motor.

There are some long, easy gradients down which it is safe to coast—with due attention to having

the hand-brake ready—with the clutch thrown out and the speed gears at "neutral" the ignition and throttle being "off." On reaching the bottom, estimate the momentum, set the change-speed lever at the speed which corresponds to it, open throttle, and switch on ignition, letting in the clutch slowly, when the motor will take up its cycle. Thus occasionally you can relieve the strain on the various bearings and allow them and the motor to cool somewhat and become lubricated. The driver must use careful judgment in determining whether the grade is long and easy enough to permit of this. Never coast down a steep grade, but keep the car fully controlled by the brake and the motor, as explained above.

In driving up hill, the object is, of course, to secure as powerful a "push-off" as the motor can put upon the tires of the driving wheels against the road, without causing them to slip and thus lose traction. The usual practice is to take an up grade on the high speed and, when the motor begins to slow as it feels the extra load gravitation puts upon it, to change to the lower speeds progressively. The brainy driver must become familiar with the degrees of flagging in his motor to know when it is necessary to make the change and when not. The general principle is to change as little as possible on an up grade.

In other words, the idea is to suit the speed to

the load, and not change needlessly simply because the car is running a little slower, so long as the motor is taking the load comfortably. The brainy driver retards the spark in that case to the point of best efficiency, and goes up a little more slowly, that is all. On the other hand he is careful not to let the motor flag too much before changing, and he changes *quickly* at the proper moment so as not to let the momentum of the car fall below the point where the speed will prove effective. If he did he would have to change almost immediately thereafter to the first speed, and perhaps as quickly to the hand brake to keep from going down backwards. Above all things in changing speed on an up grade he lets in the clutch very gently so as not to overload and stop the motor.

In suiting the power to the load, intelligent throttling and manipulating the spark will give you a range of speeds, with the power of which on gradients experience will make you familiar. You may even find that your reverse speed will help you out on some hill where you have to turn around and "crab it". This should only be done by making the turn, and holding the car at full stop with the hand brake before throwing in the reverse. Reversing when the car is in motion should never be attempted as it is almost certain to do damage to the shaft.

If you find that the reverse speed will not start you up the hill again, you will have to go down and either try again or abandon it. Of course you should know enough not to attempt to use the reverse in hill-climbing unless its speed is lower than the lowest forward.

It may not be often that the motorist is called upon to drive backward, but it is worth his while to practice it till he can steer with equal facility in either direction and can run backward a couple of hundred yards, knowing all the while exactly what he is about. This ability is extremely valuable sometimes in extricating the car from a traffic tangle, and an occasion may arise when it will be the means of avoiding positive danger.

In judgment as to how and when to apply or control speed the driver must use his brains as actively as in any other motor matter. The rudiments of speed control lie in the throttle and the spark lever, and the reader may well review what was said of the manipulation of these in a former chapter.

Remember that the throttle controls the proportions of air and gasoline vapor compounded in the carburetor, the alembic of the automobile. It is better to err on the side of too much air than too little. On the warm, dry days of summer more air in the mixture is advisable than when the atmosphere is cold and humid. Too rich a mix-

ture, one containing a preponderance of gasoline, lacks the oxygen to insure complete combustion, and is the secret of excessive carbon deposits in the cylinder, of overheating and loss of power.

Many cars have either automatic air valves or automatic carburetors, and in those that have not, some means should be provided for regulating the air inhalations of the carburetor so that the driver may acquire skill in obtaining the right mixture for all occasions. The only time the driver should allow himself unusual liberty in opening the throttle is when an emergency requires unusual power which the highly explosive property of a rich mixture provides.

The spark lever controls the time at which the mixture is ignited in the cylinder head. No matter at how many revolutions per minute the motor is running, to give the best results this ignition should occur when the piston is within ten to five per cent. of its full upward stroke of compression. Within these limits early ignition accelerates the speed by giving a more powerful explosion. So in going uphill, as the force of gravity slows the revolutions of the motor per minute, the spark lever should be set back gradually notch by notch, so as not to explode the mixture before due compression in each cylinder has been obtained. On topping the grade on to a level stretch or slight

decline as the engine begins to pick up again the spark must be advanced to meet the moment of proper compression.

It shows an utter lack of brains to run with the spark lever always at a fixed point, since with a slow running engine the mixture is exploded before being properly compressed, and when the revolutions per minute are near their maximum, the firing is too late. In both cases the cylinders become overheated and a strain is put upon the crank shaft, while power is distinctly lost.

Never retard the ignition in order to slow the engine and check the speed of the car. You will burn away the seating of your valves, overheat your exhaust pipe, and perhaps blow out the asbestos washers near the cylinder wall. The throttle or the switching off of the ignition altogether are the only legitimate means of cutting down your engine's speed.

These are but a few of the basic operations in motor driving and indicate how the automobilist can study things out for himself, if he has the laudable ambition to drive with brains. The subject opens up a wide field of study and thought for the careful driver, and no driver can afford not to be careful if he desires long life for his car and himself. Once the motorist has assumed the brainy attitude in his driving he may be safely

trusted to acquire for himself a wealth of knowledge which will make him indeed an expert, capable of adding satisfaction and exhilaration to his own use of his car and to his guests' experience of it.

HOW TO FIND THE MOTOR TROUBLE

CHAPTER VI

HOW TO FIND THE MOTOR TROUBLE

THIS must needs be a practical chapter and you must needs be a practical person if you contemplate running your own car and caring for it. If you are blessed with a turn for mechanics, so much the better, but if you are one of those unfortunates who cannot run an ice cream freezer without something going wrong with it, there is all the more reason for your learning how to run down troubles to their source in a workmanlike way—unless you are content to let automobiles severely alone. In other words, unless your purse is deep enough to afford a chauffeur or to buy a new machine every time your ignorance and neglect put the old one out of commission, you must study to acquire the degree of Doctor of Automobiles.

To that end it is quite as important for you as for the medical doctor to become a good diagnostician as early as possible. The first step in that direction is an accurate knowledge of automobile anatomy, and the acquisition of this is no light task, since, in the last analysis, there are

about five thousand separate parts entering into the construction of the average car.

A recent careful count by the makers of a standard type of gasoline car shows that in the motor, including magneto and carburetor, there are 1,508 pieces; in the transmission system 126; in the rear axle 166; in the steering column 158; and so on, forming a total of 4,983 separate parts assembled to co-ordinate and co-operate with one another in producing a healthy automobile. Furthermore, any one of these parts is quite capable of becoming the seat of an automobile disease which, if neglected, will result in serious complications requiring the taking down of the mechanism in the machine shop.

Determining which of these thousand and a half parts is the cause of a disorder requires a science of automobile diagnosis, by no means beyond your reach if you work honestly and intelligently to master it. Text books will give you reasonable familiarity with the principles of automobile construction, and the maker's manual will tell you how these are employed in your own car. Even with this preliminary understanding the formidable array of parts will fall into groups that will relieve your bewilderment.

But it is not until your eyes have seen and your hands have handled that you will gain a living, practical appreciation of how the parts are

employed and how they should be adjusted to do their work properly. Therein lies the great educative value of at least seeing your car taken down and overhauled when this first becomes necessary. Indeed, it is an excellent plan, when you have settled on the purchase of a car, to visit the factory, if possible, and gain some visual experience of how the elements are put together to form the mechanism you intend to run.

In the field of actual trouble finding your case again is parallel to that of the physician. It is easy for him to discover a broken bone or a surface contusion. But when some ailment manifests itself in a vital organ, he shakes his head and summons all his skill in tracing it to its source somewhere in the complicated internal organism.

So you will have little difficulty in finding which of the few possible causes is the one, when a tire goes flat. If a chain begins to rattle or jump, it is easy to find out whether it is too loose or whether the sprockets are out of alignment. If the car does not answer her helm properly, you know the trouble lies somewhere between the steering wheel in your hand and the steering cranks on the stud axles. Indeed, external troubles of this character are so readily detected and easily remedied that most of them can be forestalled by the excellent habit of briefly inspecting the car before starting out.

When the motor stops, however, the automobile doctor has an emergency case of suspended animation on his hands, and whether or not he succeeds in quickly restoring the mechanism to consciousness depends very largely on how he goes about it. Hence, what are known as "engine troubles" are not only the most immediately obvious and frequently manifested of all, but require the most accurate and specific knowledge to set them right.

It takes many volumes to set down this knowledge in detail, and since such volumes exist, and are quite comprehensible by the motorist who will take the trouble to study them, nothing more than guidance in that effort need be offered here. What the tyro trouble-finder must realize first of all is that diagnosis is a process of elimination. Only by employing this intelligently will he learn how to apply his general knowledge of the car's anatomy quickly and effectively in remedial measures in which he can soon become competent, if he does not have to waste time in discovering just where the remedies should be employed.

If, for example, the engine stops with the clutch in, it may be due to a sudden overload from an effort to start too quickly, or to some difficulty with the transmission system or running gear. But, obviously, before suspecting this and wasting time looking for it, throwing out the clutch and

attempting to start the engine is the scientific thing to do. If the engine starts and then stops again upon a slow, gentle engagement of the clutch, it is fair to assume that the power system is not at fault. It is equally logical to assume the contrary if the motor repeats the same stopping symptoms with the clutch disengaged.

But even then there are two hundred possible "troubles," any one of which may be the cause of the disorder, and the task is to find the right one at once.

To simplify this the first thing to remember is that, with the clutch out, the cause of engine troubles must lie in one, perhaps more, of the following four regions of the mechanism: (1) ignition system; (2) lubrication system; (3) fuel supply system; (4) the motor itself. Again, the problem is still further simplified by the fact that engine troubles are almost invariably manifested in one of three ways: (1) motor stopping suddenly; (2) misfiring, evident either in difficulty in starting or gradual stopping; (3) perceptible loss of power without misfiring.

While this classification of engine ailments and the regions of their cause makes possible a scientific arrangement of the trouble-finder's task, it also indicates his need of a system in accordance with which he may thread his way through the permutations and combinations possible among

these three broad motor symptoms and four regions of cause.

As a compact analysis of such a system the tables of engine troubles in the appendix have been arranged. They enable the inexperienced motorist to comprehend almost at a glance the logic of trouble-finding, and furnish him with a safe guide in accordance with which he may expand his study and experience to a detailed system of his own in trouble-finding. In order that he may use the tables in this way it is necessary to call attention only to their salient points.

It is the assumption throughout that the indicated symptom occurs or repeats itself with the clutch out of engagement. In practice, naturally, the stoppage of the engine will almost always occur while you are driving and will first be detected by your ear from a total absence of explosions in the cylinder. You will throw out the clutch, bring the car to a standstill, and attempt to crank the motor. If you feel no compression, the logical assumption is that the trouble is one enumerated under that head. If you do feel compression and yet the mixture fail to ignite despite the existence of a strong spark, it is not yet fair to blame the ignition system. But with good compression and no spark it is equally obvious that the ignition should receive first attention.

With no compression the trouble narrows down

to the lubricating or cooling system, or to some mechanical defect in the motor mechanism itself. With compression and spark the fuel system lies under suspicion. But with these primary distinctions in mind it must be said that most engine troubles are due to faulty ignition, and in running this down your earliest expertness will probably be acquired.

Having satisfied yourself as to compression by cranking the motor, you eliminate it by opening the pet cocks of the cylinders as the first step in running down an ignition trouble. This enables you to turn the motor over easily by hand while noticing whether the vibrators "buzz". Suppose your motor is of the multiple-cylinder type with separate coils for each cylinder, ignition being of the jump spark variety; it is safe to conclude that ignition would not cease simultaneously in all the cylinders unless the trouble lies in the primary circuit. If, on turning the motor over, none of the vibrators buzz, you may be sure this is the case. If they do buzz, the trouble may be in the ground connection of the secondary circuit.

In case they do not, therefore, you can be pretty sure that the fault is somewhere in the primary circuit, or that the supply of current is in some way cut off at the batteries or magneto or the switch. If you are careful in habit you will have eliminated the last named possibility by ex-

amining the switch before dismounting, after the motor stalls. I recall one very laughable case where fifteen minutes were wasted on a hurry trip to a ball game, before it was discovered that the coat sleeve of an extra passenger, seated on the floor in front, had brushed the switch to "off".

In case the motor stalls suddenly, therefore, the first thought of the motorist should be not only to see that the switch is on, but that it is not bent and that its parts make perfect contact. If this is the case the wire connections to batteries or magneto should be tested for security and contact. Even if tight, the surfaces must be entirely free from dirt or corrosion of any kind. The connecting wires between the battery cells must be tested for connections and possible breaks beneath the insulating covering. The latter can be felt by bending the wire slightly but rather sharply between finger and thumb along its length. Ascertain that the connections of the grounding wire are perfect and likewise those of the wire from battery to switch.

After going over the whole primary circuit in this way and making sure that the timer is perfectly connected, that its rotor is not loose or its contact against the stationary portions infirm, it is safe to assume that the batteries are at fault, which can be ascertained and remedied at once by switching on the reserve set if the car is arranged

for this. Otherwise, each cell should be tested, preferably with the ammeter, and new ones connected in to bring the current up to proper strength.

In the more modern system where magneto and batteries are interchangeable, if the switching on of the batteries remedies the trouble, it is obvious that it lies somewhere in the magneto or its connections. The advantage of this system lies in the fact that the correction can be made after completing the trip with the batteries.

Where the stoppage of the motor is immediate with total absence of spark the above method of going over the ignition system should reveal the trouble. Elimination is somewhat more intricate when the stoppage occurs only after a series of misfires or when the engine starts with difficulty or continues to lose power. Since it indicates the presence of at least partial ignition, misfiring puts the burden of suspicion upon the ignition system, although it may less frequently be due to the fuel supply, or to motor adjustment. Loss of power without misfiring is more likely to be due to trouble in one or both of these two regions.

If the motor dies down after misfire, or starts after prolonged effort with misfiring, we must suspect the secondary as well as the primary circuit. The procedure is to turn the motor over by hand as before described. If none of the vibrators buzz

the primary circuit between timer and batteries or magneto should first be looked to. If, on the other hand, one or more of the vibrators act, but all do not, examine the primary wiring between the coils of the inactive vibrators and the rotor of the timer, with special reference to their connections and any breaks beneath the insulation.

The proper working of the rotor and its contacts should be examined, and likewise the adjustment screws on the vibrators to see that none has worked out of contact with its vibrator spring. If no faulty adjustments are found in this way, there may possibly be a break in the primary winding within the coil, though this is the last thing to suspect in either circuit.

If all the vibrators buzz, after stoppage with misfire, the secondary circuit may be suspected. Disconnect the wires from the spark plugs and arrange them so that the ends are about a quarter of an inch from the outer cylinder walls, without touching them. If on turning over the motor, a spark jumps from one or more wires, but not from all, look for a poor connection of the inactive wires with either the coil or the ground cable.

Look for possible short circuiting between the coil and the plug, either due to worn insulation or to oil rotting the insulating rubber. If this is suspected, move the end of the faulty wire nearer to the outer cylinder wall. If a spark will jump

across a shorter gap than a quarter of an inch, there is pretty certain to be a short circuit within the length of the wiring.

If, on turning over the motor, sparks jump from the ends of all the wires, placed as above described, you will have to go after the spark plugs. First see that the ends are clean and the points at the right distance apart. Then, connect them with their respective wires, place them with the porcelains far enough away from any metal to prevent the current jumping directly to the cylinders, then turn the motor over. The plugs that do not show a spark under these conditions must be replaced.

Such, in skeleton outline, is the method of procedure which the motorist may adopt in running down ignition troubles in accordance with the tables. Experience will enable him to improve his technique along these lines, and also along those indicated for cases when he is convinced that the trouble lies in the fuel system or the motor itself. The two latter classes of troubles are more infrequent, particularly in the case of the car that is regularly examined.

A good carburetor, with proper care, should rarely be a source of trouble. Should the fuel system fall under suspicion, the tank should first be examined to see that it is not nearly empty and that the air vent is not stopped. The fuel pipe

and valve should next be examined, and then the carburetor for any evidence of leakage. If there is none, perhaps the float valve is leaking, or the throttle adjustment loose, causing flooding.

If these adjustments prove correct, the air valve may be clogged. In either case, too much gasoline or too little air, there will occur persistent smoking at the exhaust, and if this is allowed to continue misfiring will ensue from sooting of the spark plugs, which will add an ignition trouble which must also be remedied in connection with the fuel trouble.

The converse is too weak a mixture which likewise causes misfire and usually manifests itself by explosions in the muffler. Insufficient supply of gasoline or excessive supply of air is to be suspected. If it takes longer than usual to flood the carburetor by depressing the float, look for an obstruction clogging the jet or in the inlet pipe. Open the drip valve near the carburetor, and if the gasoline flows slowly or with difficulty from the cock, it indicates that the pipe and not the carburetor needs cleaning. Otherwise the jet needs cleaning, or the inlet valve is not properly seated or is not adjusted to close automatically with reference to motor speed. Again the strainer gauze may be clogged with impurities or a small particle may have slipped through and into the opening of the needle valve.

If the trouble is not with the gasoline supply, bad adjustment of the automatic air valve or weakening of its spring should be looked for. Whenever engine troubles are thought to be due to the fuel system, it is well to begin the search by removing the muffler and noting the color of the flame from the exhaust. If the mixture is right the flame should be bright blue. Too much gasoline gives a red flame, and too much air a yellowish green one.

If you have narrowed down the sphere of trouble to the motor itself, the first thing is to examine the valves. See that no spring or stem is broken, bent, gummed, or otherwise impaired. Make sure that the seatings are perfect and the springs not weakened. Note whether valve stems and cam-followers are in perfect contact.

If the trouble does not lie with the valves, search for obstructions in the muffler or in the exhaust pipe. If these do not exist, and you find no overheated bearings, no lack of oil or water supply, and no loose or stripped gears or pinions, no nuts worked loose from imperfect pinning or locking, then you may be pretty sure that the trouble with the motor is within the cylinders and means sending it to the shop for a thorough examination of pistons, piston rings, and cylinder walls for wear and scoring.

All too meager, as limited space must neces-

sarily make these hints, they are sufficient to indicate to the motorist methods of procedure in the main regions of trouble finding. In connection with the table in the appendix they should enable the fairly patient and persistent tyro to shape his study and experience so that in the briefest possible period "troubles" will have the minimum amount of terror for him. He will save much of his own temper and increase the life and usefulness of his car in the process.

TAKING CARE OF YOUR TIRES

CHAPTER VII

TAKING CARE OF YOUR TIRES

THE moment you announce proudly that you have acquired an automobile of your own, you are bound to hear from your wiseacre friends some form of the query: "Have you duly considered the tire problem?" With pitying shakes of the head at your inexperience, they will give to the burden of their remarks an emphasis calculated to convince anyone that "the tire problem" is the only serious one with which the motorist has to contend. Everyone has heard of "the tire problem". Many expert amateurs—and some professionals, for that matter—have heard of it so often that they are finally settled in the belief that tires are bound to blow out or go to the bad generally, without the slightest provocation.

As a matter of fact, there is no tire problem for the motorist willing to devote as much attention to the feet of his car as he should to its other members. It is true that early in the history of automobilism tires were the most uncertain item

in upkeep costs, as well as in the realm of annoying troubles that may confront one on the road. Unfortunately, this early record of the pneumatic tire—for that is the only variety in which "the problem" is supposed to lurk—has fixed the notion firmly in most minds that the motorist must be ever spending fabulous sums for tires. Meanwhile, the manufacturers' skill has reduced the "problem" to such definite terms that not only are pneumatic tires, with proper care, no more likely to get out of order than is any other part of your machine, but their upkeep should cost you less per mile than your necessary supplies of gasoline or oil.

This statement will provoke, perhaps, quite a little whirlwind of denials. They will come almost entirely from motorists who have not learned how to give their tires decent treatment, or else will not take the trouble to do so. Wise is the amateur who gets down to the facts before the incubus of tire tradition—weighted with a few disagreeable accidents due to his own lack of foresight—begins to press heavily upon him and make him a firm believer in "the tire problem".

Not long ago nineteen automobilists kept accurate records of the tire history of their cars, which were in commission throughout the whole season. They devoted only a reasonable amount of attention to the care of their tires in connection

with the general care of their cars. At the end of the four months' use, when they averaged up their tire expense, they found that it came to exactly one cent per mile per car. They had covered in the aggregate 38,000 miles—an average of 2,000 miles per car. That is a fair distance for a car to travel during a summer season.

Here is a strong hint for the ordinary motorist, that, if he will observe the far from onerous precautions of these nineteen gentlemen, his tire bills for a season should be in the neighborhood of $20 to $30. Your gasoline will cost you from 15 to 25 cents a gallon, according to its quality and the quantities in which you buy it. A gallon ought to run you about eleven miles, perhaps more. Thus a 2,000-mile season would cost you from $28 to $45, or an average of 1 8-10 to 2 1-2 cents per mile for gasoline.

High grade cylinder oil will cost you from 80 to 90 cents a gallon, which quantity will run you about 160 miles. Here again your 2,000 mile season will cost $10 to $12 for cylinder lubrication alone. You will about double that figure if you add the cost of oil for bearings, gear grease, etc., for the same distance. Hence, if you are game to take as much trouble as these nineteen experimenters—and it was not much trouble they took—the "tire problem" may lose its terrors for you at the very start.

Getting the most out of motoring depends much upon temperament. The tire end of the game is no exception. It would be a good introduction to this subject for you to re-read the chapter on "Taking Care of Your Own Car," simply because intelligent care of your tires begins with the general care of your car. Then if you have acquired the attitude of trying to prevent trouble, rather than of taking chances on remedying it when it arrives, you will understand the importance of the statement that a very great proportion of avoidable tire wear begins and is fostered by improper adjustments of the running gear and by carelessness in driving.

You need not be told that the standard type of modern pneumatic tire consists of an inner tube of pure rubber, protected by an outer "shoe" or "casing" composed of heavy alternate layers of rubber and fabric, especially re-enforced at the "tread", or point of contact with the ground. It should take no argument to convince you that anything which tends to drag this tread, even over a surface so smooth as asphalt, subjects it to the swiftest sort of deterioration.

Yet if you will observe the manner of driving employed by the majority of motorists, especially in city streets, you will learn what to avoid if you wish to save your tires from a large proportion of

this kind of wear. Sudden starting and violent stopping are the rule, not the exception. Sometimes these faults are due to imperfect adjustment of the brakes, or to the fact that the clutch grips too suddenly—conditions which should be detected and eliminated at once by any reasonably careful motorist. In the great majority of cases, however, these habits are due simply to the grossest carelessness.

Perhaps the most instructive driving for you to watch in order to learn what to avoid in the interest of long life for your tires is that of the chauffeur to whom is entrusted the ordinary city taxicab. He is supposed to know how to care for his car. Once in a thousand times he may exercise that knowledge conscientiously. Generally he takes the attitude that the company can afford a few extra tires, so long as he can get many extra fares. It is quite true that a multiplicity of fares goes far toward salving any soreness the company feels at paying the enormous tire bills presented annually, but such a viewpoint is denied to the private motorist.

You will see taxicabs bowling along above the speed limit, grinding to a stop at crossings, jerking forward when the policeman blows his whistle, skidding around corners, turning sharply and sinuously among slower vehicles, swinging into the

curb and scraping the tire shoes against it for ten feet or so. All of these faults, if you are wise, you will take the time to avoid.

There is one more warning which the taxicab chauffeur may give you if you are observant. Almost invariably, when he has to back up to make a turn in a narrow street, the first thing he does, after throwing off his reverse lever, is to put the steering wheel hard over while the car is standing still. Then he jams in his clutch and goes forward with the blandest indifference to the severe grinding he has given one small spot in each of the treads of his forward tires.

The thing for you to do in a case like that is to let in the clutch slowly and, with the first gentle headway, ease over your steering wheel quite as gently throughout the turn and as gently back again when you attain the desired direction. You will find very few streets too narrow to permit this.

No matter how carefully you drive, an intelligent attitude toward your tires must begin with the elimination of faulty adjustments of your running gear. These are almost never found in new vehicles, but are sure to develop to a greater or less extent with use. The imperfect alignment of the steering wheels is a fruitful source of trouble to the front tires. It may be due to a slight bend in one of the steering arms, or in the connecting

rod which runs between the wheels. However caused, it makes it impossible for the planes of direction of the wheels to be parallel with each other or with the direction of the car when driving straight ahead. One of the tires is bound to drag and grind the tread over the ground, causing undue wear, cuts, and abrasions.

The greatest care should be exercised in locating any maladjustment of the steering mechanism. If you find that a steering arm is bent, do not be satisfied with bringing the wheels parallel by altering the connecting rod. That will only help by giving you parallelism of the wheels when traveling straight forward. Every time you make a turn, dragging and consequent wear on the tires will occur. Let the steering arm receive your first attention, for, if the connecting rod is not bent, the straightening of the arm will bring the wheels into their normal position for all directions, by restoring the correct steering angle which is essential to the life of your tires.

Again the front axle may have shifted slightly on the springs so that one end is nearer the front of the car than the other. This makes it impossible to bring the wheels parallel when driving in a straight line, and wear on the tires will be constant and inevitable. Not only must this condition be watched for and corrected, but it is even more important that the rear axle should be al-

ways at right angles to the median line of the car. If it is not, the rear wheels will not track with the front ones, but, moving obliquely, will cause a continual slight dragging or skidding of the rear tire treads over the road surface. Also if the alignment of the rear wheels is not true from this cause, the pressure of the brakes will not be simultaneous, and one wheel will drag before the other can be brought to a stop.

If you have a chain drive, with distance rods at either side of the car, great care should be exercised in taking up or letting out both rods to the same length. Otherwise the alignment of the rear axle may be thrown out. With a bevel-gear drive the clips over the springs sometimes become loosened so that the rear axle shifts along the springs unevenly. This should be watched for in cars of this type, and any shifting carefully corrected whenever the clips need tightening.

Assuming that you go over your car at regular intervals with intelligent appreciation of what adjustments are needed to take wear off the tires, your understanding of the general tire problem begins with the proper balance between the size of your tires, on the one hand, and the weight of your car and power of your motor, on the other. This is usually, but not always, calculated correctly for you by the makers. It is well, nevertheless, to be able to check it up for yourself.

You can weigh the car by running it on any platform scales, such as those of your coal dealer. Get enough of your heavy friends to occupy all the seats, have all your fittings and accessories and the equivalent of all possible luggage aboard, and then take the total weight of the car. Run the forward wheels off so that the middle of the running board is over the end of the platform and weigh again.

Back the car till the same point is over the other end of the platform and weigh once more. These two latter weights, allowing twenty to thirty pounds for error, should equal the first weight. Then you have the data of the maximum weight to be borne by each axle, and knowing your maximum motor horse-power, you can compare intelligently the size of your tires with those listed for various weights and horse-powers in the tables issued by all reputable tire manufacturers.

This question of size obviously depends upon the desirable resiliency that must be secured between the car and the road, not only for comfort in riding, removal of damaging shock to the mechanism, etc., but, reasoning in the opposite direction, for the removal of undue strain upon the tires. Hence the matter of air pressure is the next in importance for you to consider. A tire should be pumped up to the precise point where it

will neither flatten out of shape nor be so hard as to transmit all small jars to the axle.

All the tire manufacturers issue pressure tables for their various sizes of tires. These will be useful to you for a tentative guide until, by intelligent observation of how your car rides at various pressures, you have acquired the knack of judging the right pressure by the feel of your hand. You will not be able to do that all at once, however. Hence you should begin by always pumping up your tires in connection with a pressure gage, until you have learned how to depart from its recommended readings to advantage.

Suppose your car weighs 3,700 pounds, with heavy, non-skid-tread tires, 36 x 5 inches in size; jack up one rear wheel and pump up to 61 pounds pressure to the square inch, by the gage. Let the tire down to the ground with gage still connected. It will run up to about 73 pounds pressure. That extra 12 pounds is due to the weight of the car.

Jack up the wheel again and pump it up to 80 pounds pressure. When it is lowered the gage will scarcely reach more than 81 pounds. Obviously a pound leeway is not enough to take the shock off of either car or tire. With 12 pounds leeway the tire can act with the springs, but with only one pound it is so near a solid body that it will not only transmit every minor shock along the frame, but will itself be capable of little resistance

to the cutting and grinding of ordinary irregularities in the road.

By following the hint given by this experiment and noting carefully the action of the car in use, you will soon get the "feel" necessary to enlighten you as to the most desirable pressure you should employ. Generally speaking, when the car is loaded, the tires should flatten about 2-5 of an inch and never more than 3-5. A rough means of judging the amount of flattening is to measure the track left by the tire on some smooth surface; this should not be more than an inch and a half wide for tires 2½ inches in diameter, 2½ inches for 3 and 3½ inch tires, and 3¼ inches for 5 inch tires.

In pumping up tires take full, even strokes, not too fast. Stop on a down stroke and hold the pump. The hand of the gage will then fall to a point where it stops. That indicates the true pressure. Make sure always that the gage hand not only stops oscillating but settles into a position of rest before you take the final reading. Inflate your new tire frequently, as the shoe must be stretched to its final capacity by use. Unless you find a leaky valve or a puncture, it will scarcely be necessary to pump up "broken in" tires more than once a fortnight.

If the car is not taken out often, it is well to remove its standing weight from the tires by means

of a wooden wedge under each axle. When you lay up the car for any length of time, not only wedge up the wheels but deflate the tires until just enough air remains to keep the inner tubes in shape. If the car is to be out of commission for several months, the tires should be removed. Those which require it should be sent to the factory for repairs. The others should be wrapped in canvas with the inner tubes inflated just enough to prevent kinks. They should then be stored in a dark, cool, and above all dry place where no oil can possibly get at them.

Light, heat, water, and oil are the four enemies of the tire, and toward them all you should never relax your attitude of eternal vigilance. New tires especially must be kept where the light will not get at them. If, therefore, as is the common practice, you carry an extra "shoe" on the car, it should be either enclosed in an inner wrapping of canvas and an outer one of waterproof material, or else kept in one of the varieties of tire trunks designed for this purpose. Above all see that it is located on a part of the car where it will not be exposed to the heat of the engine.

The same caution must be observed with regard to the three or four inner tubes which you should always carry on the car. These should be folded very lightly and tied very loosely with wide tape. It is best to keep them in a roomy,

rubber-lined bag the inside of which is liberally provided with French chalk. Never let the slightest weight rest on this bag.

Whenever you read recommendations for the liberal use of French chalk, remember that you can have too much even of a good thing. Chalk is essential to make your tire fitting easier and to lubricate the friction between inner tube and cover, but be careful not to let it accumulate within the tire. Little surpluses of it there become compressed into solid masses and cause wear.

Keep several pounds of chalk in a box in the motor house and a plentiful supply always aboard the car. Before fitting an air tube roll it round and round in the chalk until each part has been through it. Then shake the tube thoroughly to remove excess. If it is convenient to do this on the road, your best plan is to throw plenty of chalk into the cover, turn the wheel around slowly several times, patting the exterior to distribute the chalk thoroughly, then hold the cover open at its lowest point and brush out all superfluous chalk.

Whenever you remove a cover entirely from the rim you should make sure that all extraneous substances, no matter how minute, are entirely removed from its inner surface. Never wash chalk from the inside of the cover with water. Such obstinate particles as you cannot get out with a

dry brush will yield to a little wood alcohol on a rag. In fact, a good brush and dry rags should be part of your tire repair kit, and you should never put an inner tube into its cover without a careful wiping out of the entire inside of the latter. Proper attention to the inside of a shoe, to guard against dampness and dirt, will eliminate a large proportion of inner tube troubles.

Besides the items already mentioned, your tire kit should include a good jack, a pump, preferably with gage, a set of "quick-detachable" tire tools or levers, tire cement, half a dozen insides of tire valves, several valve caps and dust caps, some patches of assorted sizes, a roll of tire tape, emery paper, scissors, a couple of gaiters with laces, and a tire fork if your tires are clinchers. A small vulcanizing outfit will also be a great convenience. It is possible to obtain this in very compact form with a special heating device within the vulcanizer, regulated by a thermostat so that it may be set at any desired temperature. Heat is generated by connecting it with the batteries.

It is unnecessary to take space here to tell you how to fit on tires and remove them. Voluminous instructions are issued by all the tire manufacturers and may be found in the various automobile handbooks. They are as good a guide as you need for acquiring expertness. There are several precautions, however, which you will do well to lay

to heart and observe every time you have to make a tire adjustment.

Even more important than removing any dirt or grit you may find between the tube and the inner surface of the shoe is the prevention of the entrance of such foreign substances. Hence, whenever you fit on a shoe, make sure that the bead is thoroughly hidden by the rim on both sides all the way around.

In washing a car be sure that the tires are well inflated and the wing nuts and valve nuts tightly screwed up. Do not even then turn the full force of the hose along the edges of the rim. That will assist particles of dirt in working down between it and the tire. It is best to wipe off mud and dirt from the tires with a cloth or sponge well wrung out. Dry the tires afterwards with another cloth.

In fitting on tires be particularly careful that neither the bead of the shoe nor the inner tube itself is caught by a security bolt. It is equally important to be always sure that the lock-nuts of the valve stem and of the security bolts are kept tight enough to prevent water percolating through their holes into the rim, there to rot the rubber and fabric and rust the metal, causing serious friction. Loose retaining bolts may also be responsible for the most serious trouble of all.

If the beads of the shoe are not clamped se-

curely into the rim, the entire shoe will "creep" gradually around the rim, causing a severe strain on the valve stem. This may result in a leak and perhaps in tearing the stem from the tube, which, of course, means a blow-out. The tires of the driving wheels require particular attention in this respect. The tractive effort to which they are constantly subjected makes it specially necessary in their case to see that the retaining bolts are always tight and the tires properly inflated to prevent any looseness which would enable even a small portion of the bead to work out.

A thorough periodical examination of the rims is a practice that cannot be urged too strongly. Rust or other particles must never be allowed to adhere to their surfaces. When the least rust appears it should be removed at once with emery paper and the spot thoroughly lacquered.

Dents and bends in the rims must be straightened out at once, as they make it impossible to attach the bead effectively where they occur. Even a slight dent means extra wear against the bead or the delicate inner tube. One little spot where the bead is unduly pinched by the rim or where it is held so insecurely that it may work part way or all the way out means an ultimate blow-out. Such conditions should be avoided or corrected immediately they are discovered.

It remains to mention, last but not least, the examination of the surface of the tire itself. It is not to be expected that the rubber and fabric of which the outer shoe is composed can run over even a good road without acquiring a few cuts and abrasions. These are often too small to obtrude themselves upon your attention. Frequent examination of the tires will reveal them, and you will be well rewarded for the trouble you take in remedying them at once. Even a very small cut neglected allows dampness to lurk within it or dirt to become bunched there beneath the outer rubber and slowly to work its way through first one ply and then another, until it eventually cuts the inner tube and a blow-out occurs.

When these cuts are discovered they should be thoroughly cleaned out and "filled" by applying one of the various cements or fillings furnished by tire manufacturers. Larger cuts should be vulcanized. The motorist who makes this a regular practice will add surprisingly to the life of his tires.

The more serious cuts and tears which may occur on the road without causing a blow-out are best dealt with by sending the tire to the factory for repair. Slight punctures in the inner tube you may patch and vulcanize yourself—when the sting of the delay they have caused you has worn

off. If the size of your wheels makes it possible, always use repaired tires on the front wheels instead of the driving wheels.

We might fill a whole volume with tire "don'ts," but the entire "problem" depends upon common sense and the "stitch in time". The experience of the majority of motorists may be contrary to that of the nineteen cited above. With reasonable understanding of the known conditions under which rubber deteriorates, the common mistakes of driving, the avoidable mal-adjustments in the parts of the car affecting the tires, and the dangers to be avoided in the keeping, fitting, and regular examination of tires, you can prove to yourself that it is cheaper to join the minority. In other words, if you exercise the same degree of care as you should give to your ignition system, your carburetor, and the other vital elements of your car, the "tire problem" will become to you nothing but an avoidable bugaboo.

HOUSING THE AUTOMOBILE

CHAPTER VIII

HOUSING THE AUTOMOBILE

TO the man who is sure he is in motoring "for keeps"—that is, who has passed the "first fever" stage and settled down to get the most pleasure out of his car at the least expense—the possession of his own garage becomes an important desideratum. It is the way, *par excellence*, most readily to effect the policy of automobile economy, that has been constantly preached in these pages. Not only does it save the $10 to $30 a month rent for the mere storage of a car in a public garage, but by keeping the motorist in constant personal touch with his machine it enables him to form habits of care and attention that will save many dollars and disappointments in the long run.

Fortunately for the average motorist about eighty per cent. of the automobiling population of the United States lives outside of the great cities where the cost of ground space is so high as to preclude a private garage for any but the independently rich. Fortunately, also, even a

fairly spacious garage is not so large that room cannot usually be found for it on the average town lot or country place already in the possession of most motorists.

The first thing to do, therefore, in planning your garage is to determine the amount of floor space you will require, and your first caution must be not to underestimate how much you can get along with for the proper and convenient housing of your car. It is far better to err on the side of too much than too little, for as your automobile experience grows, your paraphernalia will likely grow with it. You must have not only room to work around the car in comfort, but also to store supplies and accessories not in use.

If you have a small car, you will find that with the top folded it will measure at least three feet more than its wheel base, perhaps thirteen to fifteen feet over all. It is the part of wisdom to allow for the possibility of purchasing a larger car later, and a length of sixteen feet by a width over hubs and mud-guards of five or six feet is not too much to allow for the actual floor space taken up by the car itself. If you intend to provide a separate room for a workshop, and if the approach to the garage is ample enough for the car to be turned in its own steering angle or on skids, you must calculate about eighteen by eight feet as sufficient floor space for each car.

If, therefore, your object is merely to provide a shelter for your machine, and you intend to do all cleaning and repairs outdoors, a room eighteen or twenty feet long by eight or ten feet wide is the smallest you can count upon. This will permit of only a limited amount of supplies and accessories being stored along the walls. On the other hand, if, as is more likely, it is your intention to provide a single room in which the car may not only be stored but washed and repaired, you will require at least three feet on each side with room around the ends to get at the car conveniently. This would make the minimum floor space for a single car twelve by twenty to twenty-two feet.

To this must be added at least four feet for a tool bench at one side and two feet for lockers and general storage rooms at the other. This would make the width of your floor eighteen feet. Thus a room eighteen feet wide by twenty feet deep is the minimum with which you should attempt to get along if you are to do any considerable repairs or storage. If you consider it more convenient to have your bench at the far end so as to be handy to the engine, leaving the storage space at the side, the dimensions become fifteen feet wide by twenty-four feet deep. To comfortably house and wash a second car an additional ten feet must go on the width. Obviously, if the

available ground space will permit, it is wise to add three feet or more each way to these minimum dimensions.

Even if you intend to equip your garage at first in a meager way, provision for additional convenience, such as inside gasoline pump, heating and toilet fixtures, should be made if possible. You will never be embarrassed by too much room, and the additional cost of construction of a roomy over a cramped garage is negligible. With but one car it is extremely likely that you will wish occasionally to remove the body in order to work on the chassis. In such a contingency you will need at least eight feet additional width.

You may wish later to install a turntable with its added convenience. Hence the far-sightedness of providing the additional ten feet width for a possible second car should commend itself to you in any case. A one-room garage twenty-five feet deep by thirty-five feet wide should be roomy enough for your requirements till you can afford to multiply your motor cars.

Having settled upon the dimensions, your next question for decision is the method of construction to be employed. Portable garages, ranging from a good substantial tent to a complete wooden or galvanized iron structure which may be quickly bolted together, are obtainable in varying degrees of size, elaborateness, and price. While these may

do very well for the seashore cottage or the summer camp or the lengthy sojourn in some garageless locality, it would not prove economical in the end to choose this type for permanent instalment on the home grounds.

The first consideration in a permanent garage is fireproofing. It is here that Portland cement and its possibilities come to the aid of the wisely economical motorist. By its use even a more or less dilapidated frame stable or carriage-shed may be made into a practically fireproof garage at moderate expense. The windows of such buildings will usually have to be greatly enlarged or increased in number to make repair work possible. In the case of a stable, if chauffeur's quarters are not required upstairs, it is most practicable to cut out the loft and put a sizeable skylight in the roof.

Metal lath may then be attached to the studding of the inner walls and roof and this covered with cement plaster. The metal lath is stapled on rather loosely to the studding to allow some play between them which is taken up by the plaster. Asbestos board may be substituted for the metal lath and the cement plaster imposed upon this. Add a concrete floor and you have made your building essentially fireproof on the inside, the source of the greatest danger.

If it is desired to beautify the exterior, all the

loose boards should be nailed up and metal lath stapled loosely to them. Upon this two coats of cement plaster may be troweled, giving the appearance of a stucco garage and providing complete protection against weather.

If the loft is to be made over into a room, its flooring should be sheathed beneath with asbestos board and plaster. It would be safer, if the structural strength of the side walls permits, to lay a new floor of fire-tiles supported by iron beams or one of re-enforced concrete. The stairway, if within the lower room, should be separated from it by a fireproof partition (at least stucco and metal lath on studding) and access is best provided by an outside door.

Converting an existing available outbuilding, provided it is not so large as to involve too much labor, is the cheapest method of getting a garage for yourself. Next to it comes a new structure of wood-stud frame covered with stucco on metal lath. Your local carpenter can design and put up the frame to your specifications, and your local plasterer can readily be inducted into mixing and working with stucco if he is not already familiar with it. One coat of finishing stucco may be used on the outside, but it is more satisfactory first to apply a "scratch coat" to the metal lath and then a smooth or pebbled final coat upon this.

The inside may be finished by applying one

smooth coat between the studding. It is more satisfactory, sightly, and fireproof to finish the inside with metal lath and at least one coat of stucco after the manner of the outside.

Slightly more expensive, but as fireproof and permanent almost as stone or brick, is a framework of galvanized iron pipe the uprights of which are set into a concrete foundation. The necessary lengths of pipe, angle irons, etc., are readily obtainable, not expensive, and easily put together. A man who is half-way handy can soon learn to put up such a structure for himself. The pipe framework is re-enforced with flatiron studs to which metal lath is laced with wire. The finish is two coats of cement plaster without and a single coat within. The possibilities of this construction are remarkably varied from an architectural and decorative standpoint and it commends itself as probably the wisest choice for the man of limited means who wishes a neat, serviceable, and safe garage.

Unless the materials for mixing concrete (clean hard sand and screened gravel or broken stone) are not readily available in the locality, a garage of either concrete blocks or monolithic concrete construction commends itself as the most satisfactory type obtainable without putting money into purely architectural adornment and elegance. You can build a beautiful little garage of Parian

marble if you can afford so to please your eye, but it will not be so permanent nor any more suitable for its purpose than one of concrete.

The employment of concrete construction has grown so that there are now within easy reach of most localities manufactories of either concrete hollow tile or solid concrete blocks. The former can be laid by any bricklayer in precisely the same manner as bricks, which though slightly cheaper do not afford so satisfactory a garage building. Concrete blocks are somewhat cheaper than stone and are laid in the same manner by the mason. Their outer surface is usually finished in some imitative "rock face" pattern. Hence they do not require an outer finish, while concrete tile is generally stuccoed on the exterior for appearance sake.

A fairly large garage intended to be permanently complete for all the owner's possible requirements is most wisely built by mass concrete construction, whether with solid or hollow walls, either being re-enforced by iron rods. The hollow walls preclude dampness. The moulds for either variety and for various architectural forms can be constructed at small expense by any competent carpenter. Ordinary labor properly supervised can be employed to mix and pour the concrete into the moulds. If you have the patience and the time to spare and enough of a

mechanical bent, you can readily acquire sufficient knowledge to enable you to superintend the job of building your garage in this manner.

Men with no more previous experience than yours have managed the building of habitable houses for themselves out of concrete. Instructions as to how to work with concrete are purchasable or obtainable gratis from most of the Portland cement manufacturers and will repay careful study by the motorist who contemplates possessing a substantial garage of his own. If you do not feel up to bossing the job yourself, a varied assortment of architects' drawings and plans for garages of concrete in varied sizes, shapes, styles, and adornment exist, and by making your selection from these and probably being able to rent the moulds used in existing examples of the type, you can effect considerable saving.

In general the criterion of your selection of structural material for your garage should be the size and permanency you desire, coupled with the tensile strength of your pocketbook. If you have determined upon a large and complete building, and can afford it, by all means choose concrete. If building with the idea of subsequent additions, concrete tile or blocks are a wise choice. If you feel sure that you can put up with a moderate sized garage and that by the time you outgrow it you will have more money in the bank

than at present, stucco on galvanized pipe or even wooden frame will meet your needs. Full information as to the relative merits and possibilities of all these structural methods can be obtained for the asking from the concerns who are anxious to sell you Portland cement for the purpose.

Having determined the size and material for your garage, there are several important considerations which you must not overlook in planning it. In the first place spare no pains to insure an abundance of light. Do not count on being able to work by the light of the open door, for you will want to use your car in all kinds of weather, and the very time that a serious repair or adjustment confronts you is likely to be on a gloomy day when without ample window space you cannot see what you are about.

The best insurance against finding, after your garage is built, that the window space is insufficient, is to plan for a skylight. If one side of the roof faces north, the skylight may follow its slope. Otherwise the glass should be raised to prevent direct sunlight from falling upon the varnished body of your car. The glass of the windows should be of the "rough rolled" variety used for factories so as to scatter direct sunlight, for the same reason and for the additional comfort of working in a diffused light. The advan-

tage of white-finished walls and ceiling is also obvious.

If artificial lighting is required for night work, the fire risk makes electricity a necessity. If you cannot rent current, you will have to get a small gasoline engine and dynamo with which you can illuminate both your garage and your house. For the former a couple of tungsten lamps hung near the ceiling on each side of the car will save you the annoyance of getting in your own light. In wiring the garage, provide sockets at suitable intervals along the walls to which extension lamps, caged and shaded, may be attached, so as to enable you to illuminate any remote part of the mechanism of the car.

Heating must also be provided in the garage which is intended to house a car used the year round. If you build against your steam-heated house, laundry, or stable, it is a simple matter to add more piping to the system already installed. Otherwise the best plan is to provide a small cellar under a portion of the garage and have an outside entrance to it. There a steam or hot water heater may be installed with pipes running through openings in the floor that are carefully sealed.

A somewhat cheaper method is to provide a wing for a small heater separated by a partition

through which the pipes run. This also should be entered only through an outside door. By constant care and proper precautions it is possible to maintain a heater even in the corner of a one-room garage farthest from the shop end. In this case kerosene and not gasoline must be used for cleaning and fire extinguishers and pails of sand should be provided for emergencies. Where the garage has a separate shop-room the heater may safely be placed in the storage room.

Do not forget to provide for a repair pit so situated that the car may be readily placed over it. Three and a half feet are wide enough, with a length at least two feet less than the wheel base of your car, and a depth of about six feet. A short flight of portable steps, to enable you to sit or stand while at work in any part of the pit, are essential to comfort. The pit when not in use should be covered by a sectional trap, of iron preferably, sunk at the edge so as to be level with the floor.

For the floor of the garage, wood cannot be considered because of its rapid tendency to become oil-soaked. Concrete is the best material yet available, though it has the disadvantages of being cold and absorbing oil. The latter can be obviated by placing a drip-pan under the car, and mats may be used to lie on when working under-

neath in an adjustment too moderate to require the pit.

A pit is most economically provided for in laying the floor. A turntable may be added later by making the slight excavation needful and lining it with concrete. Though not a positive necessity, a turntable is a great timesaver and convenience in shifting the car to various portions of the garage. Where space is limited it may be constructed in the form of a ring around the pit or it may be designed in the form of a circular platform with a trap door giving access to the pit.

Whether this form is adopted or it is allotted floor space of its own, in calculating the dimensions of the turntable, you must add at least ten inches to the wheel base of your car to allow for the lengthwise flattening of tires and about two inches to the tread. Plot out the resulting rectangle on the garage floor; its corners, plus a couple of inches clearance, will represent the outer points of contact of the tires with the floor. The diagonal of the rectangle is then the diameter of the turntable.

The floor must be so constructed that washing water will drain off, and separate drain pipes must lead from the pit and turntable spaces. Instead of having the floor slope from all sides to

a central grating, it is better to drain toward the door. In order that the car may not have any tendency to roll when the brakes are off, draw a line from the center of the doorway lengthwise of the garage and let the floor slope from two sides toward this which should be depressed into a channel leading to a grating at the door where a drain pipe must be provided. A cross channel of concrete just outside the door may be constructed to catch any water that may spill over the entrance and lead it to the drain.

The best method of removing oil and grease from the garage floor is to swab it with a saturate solution of common washing soda. A barrel of this solution should be kept on hand and the floor cleaned pretty frequently. Regular and thorough cleaning of the floor is a precaution against fire not to be neglected. Fill a barrel with water and stir in as much soda (at about four cents a pound) as will dissolve. A pailful of this, brought first to the boiling point, will clean down the floor of the average small one-car garage.

By all means, if there is side room, have a sliding door to your garage. Swinging doors must be hooked back when open and though cheaper are a nuisance. The most satisfactory door for a small garage is a roll-up iron shutter. A moderate sized two-car garage may have two

overlapping sliding doors, each wide enough to admit a car.

As for the arrangement of the interior, common sense will dictate the placing of the bench near a window or windows and the location of all tools conveniently near. To your shop equipment belongs first of all the touring tools, or duplicates of them, described in another chapter. You can spend more than the cost of your car in special tools for your garage, but the wise way is to build up the equipment gradually.

Never buy a tool unless you are sure that by using it you can save time and money in the long run. Provide for the work you know you can do and have the major special repairs done at a regular shop, till you become enough of a skilled mechanic to do them yourself. Get a good heavy work-bench and the following to begin with:

One or two iron vises
Soldering torch
Heavy hammer
Two large monkey wrenches
Large pipe wrench
Copper mallet
Hacksaw
Assorted augurs and brace
Breast drill and bits
Assorted twist drills
Assorted taps to fit threads used on car
Tap wrenches
Assorted thread dies and die stocks
Assorted cold chisels, flat, round, and half-round files

If you have installed a small gas-engine for lighting purposes as described above, you need only a shaft and belting to have power at your hand. You may then acquire machine tools in the order of their usefulness about as follows:

Emery-wheel stand
Bench drill-press
Speed lathe
Power hacksaw
Small shaper
Medium sized engine lathe
Small universal milling machine

You will not need the last two unless you intend to become skilful enough to be independent of the automobile repair man. If you have power, an arbor press and a wheel puller for removing wheels and gears from their shafts will be conveniences. A large rivet forge with smoke pipe to the outside, an anvil, and a sledge or two, with tub of water, will enable you to straighten bent axles and harden or temper small steel parts. The average garage owner will likely omit this heavy equipment, finding enough to fill his available time in the ordinary cleaning and care of his car and in simple repairs and adjustments, and will leave serious work to the nearby machinist.

The possession of a garage enables you to buy your supplies in bulk at a saving of from twenty-five to thirty-five per cent. in cost. You can store quantities of gear oils, greases, polishing

compound, cotton waste, carbide, oil soap, and the like, and a half-barrel of cylinder oil will last you for an average season. Shellac, white lead, emery, graphite, and other sundries will suggest themselves from experience as to what to keep on hand.

Do not fail to provide a galvanized steel can with spring cover, and don't fail to throw your oily waste into it. Pans and brushes for "washing down" with kerosene or gasoline must be handy. Keep the small quantities of these liquids needed for cleaning in one of the reliable types of small safety can.

Never consider for an instant storing gasoline in quantity anywhere within the garage. The potential energy of this useful but dangerous liquid is just forty-nine times that of dynamite, and one cannot be reminded too often of the extreme ease with which it ignites in the form of vapor mixed with air. The motorist's familiarity with this phenomenon taking place under proper control tends to make him careless.

Sink a large galvanized iron tank several feet below the ground at least a rod from the garage. Run a pipe from this tank up to the ground level and provide it with a screw-cap, removable only with a wrench, for filling. Run another pipe from the bottom of the tank into the garage. To this attach a pump provided with flexible hose for fill-

ing the car's tank. Have a cock in the pipe near the floor and see that it is turned off at all times except when you must draw gasoline. Only thus can you eliminate three-fourths of the gasoline danger in your garage. Even then watchfulness is required to detect drippings due to a leaky car-tank or filling-hose.

When testing the motor indoors, a length of flexible re-enforced rubber hose should be on hand to connect with the muffler outlet and lead the exhaust gases directly to the open air. Experience tempered by your pocket book will suggest many wrinkles and conveniences in making your garage complete. A power air-pump with storage tank or a small air compressor belted to your shaft will save time and energy. But the thing to do first is to get your own garage and get to work in it with what time you can spare, leaving elaborate fussings and fixings till ripe experience and familiarity with what you most often need to do to the car have taught you with what you can best do it.

THE AUTOMOBILE IN TOUR AND CAMP

CHAPTER IX

THE AUTOMOBILE IN TOUR AND CAMP

TO the confirmed automobilist there are but two kinds of vehicle—the touring car and the others. Nor will you come fully to regard your machine as a pleasure car until you have sped along for miles, with your motor humming sweet and low, the song of the open road. "For miles" means not merely a run of a hundred or so, "there and back," but on and on, stopping at country inns, through country so unfamiliar that each curve ahead holds always a surprise in store, so new and interesting that the egotism of the ancient explorers tingles in your blood.

On a journey of a thousand miles or so by motor you learn far more of the limitations and resourcefulness of both yourself and your car than you could by any other means. You will learn how the machine takes certain kinds of road. You will have to bring your ingenuity and experience into play in many little roadside adjustments and repairs. You will get over the temptation to

throw up your hands and be towed to the nearest garage, for on tour often at best you can but ferret out the country machinist, and then you must be wise enough to tell him just what you want done.

If you are wise enough, however, to know your car and acquire the experience of caring for it yourself, the little mishaps when you take your first tour will be no more frequent or serious than to make the long stretches of exhilarating going all the sweeter by comparison.

The unique advantage of the automobile in travel is that you can always fare on with it. If you get into a town you do not like, you can get out again forthwith, without the dismal wait for the next train. If the country through which you are passing is dull and uninteresting you can speed away to fine stretches that will compel you to dally along, or stop to pick wild flowers, or dabble in the brook, or explore the mystery of some quaint old farm house.

You cannot do all this, however, by launching out into the country as the old Norsemen did upon the sea, trusting only to the stars to guide them. From the standpoint of the touring motorist, the best charts of the country's roads are as yet none too good. But even these must be most carefully studied in order to find out how you are going and what you are likely to meet along the

way. The man who attempts to tour by "dead" reckoning" is bound to have experiences that his vocabulary will never be lurid enough to describe.

The ordinary atlas or map is worse than useless in planning a tour. And yet motorists, in their first touring enthusiasm, have not infrequently been known to start out for parts unknown, with no better guide than this. They get along very comfortably so far as they know the route out of their home town. Then their troubles usually begin shortly after they have to ask some "native" to point them the way.

The "native" is a notorious miscalculator of distances. If you ask him if the road is in good condition, he answers you from the standpoint of the ordinary country farm truck. Roads which he calls "fair" are likely to be quite impassable for the automobile without dangerous strain. He will involve you in vague pointings out of directions, and still vaguer descriptions of forks and turnings which you must take. If you do not break down as a result of his advice, you are pretty sure to get lost somewhere with an imperative need for gasoline, and find yourself miles from any point at which it can be obtained.

Therefore, unless you wish to benefit your fellow motorists by becoming an automobile explorer —and there is much gratitude awaiting those who have the patience to do so—you will not attempt

to blaze your own trail, but will confine your touring to trips for which the most complete route books and road maps have been prepared. You will not attempt to rely on even these if they have been published more than a year ago.

There are a number of publishers who issue route books giving information about what the motorist is likely to meet along the way, and some of these are interlarded with sectional maps of the roads to be passed over. Other publishers issue maps alone. Both are as reliable as changing conditions along the roadway will permit. If recently published, they are the best available means of planning a tour in advance and on tour furnish a fairly reliable, if not always complete, warning of what to expect.

Even then the motorist must keep his weather eye open for the unexpected. For instance, a stretch of road designated in the route book as "excellent macadam" may have just been torn up for the laying of new trolley tracks, water mains, or what not, and this may necessitate a detour of several miles. On the other hand, you may be looking for a stretch of road which your book describes as "bad," but which has recently been repaired. When you do not find it you will conclude that you are on the wrong track.

It is in connection with the route book and road map that inquiries of the "natives" may be of

use to you, provided you use your common sense in putting the two sources of information together. You can use your "native" and the innkeeper in the town where you may stop to check up the route book's description of what you may encounter. They will tell you, if you are a good cross-examiner, of any changes that may have been made in the roads, and, if you are clever at picking out the stretches to which they refer, you may be able to revise your route book in advance to some extent as you go along.

The route book is accurate in one particular, however, and that is as to distances. Still, exact mileage is of minor importance to the motorist. What he wants to know is the kind of road he is to encounter and where he is to turn off. The map gives him a general idea of direction and the route book tells him which way to turn. And by-the-way, he should always carry with him a pocket compass, unless he has a wonderful nose for direction. When the book says "turn northeasterly" it is well to know precisely where northeasterly is.

After all, neither route books nor road maps nor "natives" are to be implicitly trusted by the tourist, who should dilute them carefully with common sense, particularly before he starts out on his tour. Many a route book becomes so confusing in places, where it attempts to give an ex-

haustive array of specific directions, that, if its meaning is not pencilled out on the margin before starting, it will serve but to confuse the driver who scratches his head over it for the first time en route.

The millennium for the automobile tourist in America will not come until our roads are thoroughly equipped with the sort of guide posts which the two great motoring associations of France have placed throughout that country with fine completeness. Big as is our land, the Bureau of Tours of the Automobile Club of America has done noble work already in attempting to follow the example of the Frenchmen. Their ambition is to sign-post every good road in the country so that route books will become unnecessary. As a beginning they have nailed to telegraph poles and trees, along most of the good routes through the Eastern States, little yellow metal arrows which bear numbers corresponding to route numbers in the book of routes issued by the Bureau.

For instance, when a tourist wants to go from New York to New Haven, he finds that in the Bureau's route book the roads are described in Route No. 13, and he follows yellow arrows numbered 13, without having to look at his book again until he reaches New Haven. If from there he wishes to go to Springfield, Mass., he simply follows the arrows numbered 110. From Springfield

to Boston, 119 is his lucky number. If he passes an arrow bearing a different one he knows that he is on the wrong road. At all important road junctions the Bureau is also trying to have set up large square yellow sign-boards bearing the names of cities and their distances from that point.

This Bureau of Tours has been appealing to all the automobile clubs throughout the country to co-operate with them in the placing of these arrows and sign posts, and they will gladly furnish arrows to any club that will take charge of putting them up on through routes in accordance with their plan and instructions. In the interest of the ever-growing tendency to tour, every automobilist should see the advantage to himself of becoming better acquainted with what the club is doing and to help it in every possible way.

In fact, it is well worth the while of any motorist who becomes enthusiastic about touring to invest the small sum necessary to secure an associate membership in the Automobile Club of America. It will save him much trouble and expense in the end. Its Bureau of Tours is constantly collecting up-to-date road information and publishing it in guide books and route cards, as well as designating official hotels where such a membership would insure the best of service. It also plans from time to time ideal tours such as the Scenic Tour, the Salt Water Tour,

etc., which the motorist can take with assurance of pleasure, convenience, and comfort.

There are two other national automobile associations which supply to their members the most reliable touring data that can be obtained. These are the American Automobile Association, whose headquarters are in New York, and the Touring Club of America, in the same city. Both offer peculiar advantages of membership at moderate cost.

The latter organization has hit upon an extremely convenient scheme for making touring easy to the motorist. It not only maps out on application any special tour desired by a member, but has facilities for issuing and obtaining licenses from many of the various States through which it may be necessary to pass. It can render valuable assistance to those who contemplate a foreign automobile tour.

Its unique feature, however, is in having adopted and placed at the disposal of its members a clever device which tells the tourist at a glance exactly where he is and what to do. This is accomplished by means of a circular card on whose rim one hundred miles of road are divided to scale into 170-yard sections. This card is set upon a metal disc connected with the front wheel by a long flexible driving shaft. The card, being set under a stationary pointer at the place where

the trip begins, revolves slowly in exact accordance with the progress of the automobile.

By glancing at the pointer you read concise directions and can tell where you are and what to expect or do, every half mile or so. At the end of one hundred miles a new card is substituted which carries you farther. For the routes over which these cards have been carefully prepared the device undoubtedly reduces the uncertainty of touring to its lowest terms.

The motorist will not make many tours before he realizes the advantages of belonging to one or all of these associations. They put him in touch with his fraternity, for every true automobilist is a tourist at heart. The purpose of the Automobile Association of America, for instance, is the uniting in one national body of the automobile clubs of the country and through them the individual automobilists, so that all matters in which they are interested may be given a national character.

These include legislation, good roads, and many subjects of vital importance to tourists. The reciprocal club privileges of such a membership have cheered the heart of many a tourist. After days upon the open road, there is no ear like that of a fellow automobilist into which to pour your account of the joys and vicissitudes through which you have just passed.

Membership in this and the other organizations of national character quickens your sense of responsibility to your fellow motorist in touring. It furnishes a medium for the exchange of ideas and repository of information, to which you can contribute as well as resort in times of preplexity. Even if you do not become a member of these associations you will find it worth your while to send to the chairmen of their various touring committees any information of value that you have acquired in your own wanderings. There is the greatest need for the intelligent and immediate interchange of reliable data among tourists, and any effort in this line will be met by the existing associations in the most fraternal spirit.

The tourist who promises himself at least one trip each year—and who will not, after his first well-planned jaunt?—cannot do better than form the habit of collecting the fullest accounts he can secure of every individual or organized tour of which he hears. By studying the reports of endurance runs, hill climbs, and reliability tests, he can settle in advance many questions as to how well his machine will negotiate any route of whose conditions he has gained a fair idea. He will naturally avoid those which give promise of straining his car beyond its margin of reserve power and strength. It is extremely important to know the location of repair shops and garages, and what

supplies can be obtained along the road, and where. If there were no other reason for studying out beforehand what is to be expected, the present non-uniformity of automobile regulations throughout the country would furnish a vital one.

The law committees of our foremost automobile associations are urging at this time more actively than ever the adoption of a Federal automobile law which will do away with the necessity for obtaining a separate license in each State through which the automobilist desires to pass. Until their efforts are successful, the tourist must depend upon familiarizing himself with the varying regulations with which he will be required to conform. Most of the route books give information on this point. The official annual Blue Book of the Automobile Club of America contains the automobile laws of the various States. A digest of them is also published by the Automobile Association of America.*

Enough valuable information as to the progress of road building in various localities is contained in the reports of the United States Department of Agriculture to warrant the tourist in receiving them regularly. Those ambitious spirits who are determined to venture into parts about which no specific automobile information exists will find the

*"Road Rights for Motorists" (Outing Publishing Co.), is a complete manual of motor vehicle legislation, and contains also the Rules of the Road in condensed form.

maps published by the United States Geological Survey a necessity in planning their routes.

As for what to take aboard the machine on tour, the criterion is "as little as possible." It is the tendency of inexperience to overload the car with a lot of unnecessary things. The tyro, on his first tour, has an inordinate desire to stow personal baggage in every nook and cranny of the car, frequently to the exclusion of things which he soon learns would have added far more to his comfort in travel. Except on routes where comfortable stopping places are few and far between, a suitcase should hold all the personal necessities. A trunk packed with changes of clothing and other like desiderata in places where you may settle down for a little stay can be readily shipped along in advance from point to point.

Even the space taken up by a compact automobile trunk would, in most cases, be better given over to an extra supply of gasoline, oil, and such vital requisites, unless your car is a very large one. Vital parts of the motor, carburetor, and ignition system, which cannot readily be obtained en route, must invariably be taken.

In rough country a single and a double wood pulley, with sufficient good strong rope to form a block and tackle, are advisable. Likewise two jacks, since with these a car can often be gotten out of a hole where one jack would be insufficient

to do the work. Throughout localities where there is no likelihood of being able to obtain shelter for the machine, either from storms or the dampness of the night, it is well to take along a rubber cover for the car. Tire chains, even if your driving tires are of the studded non-skid variety, should be taken along when there is the slightest prospect of encountering soft or muddy roads where additional traction may be required to get through.

What was said in the chapter on Taking Care of Your Own Auto applies with even greater force in touring. Unless the machine has been recently given a thorough overhauling, it should receive one before the time comes for you to start out on your extended journey. Each morning, en route, you should inspect the important parts, going over them even with greater care than you would exercise at home. At every stopping place where you possibly can, you should devote some time to cleaning off the worst of the travel stains from the machine. Above all, keep all parts well oiled throughout.

Not the least important caution is to be as considerate as possible of the teams you meet and of the towns through which you pass. Even if you never expect to go over the same route again, and think you can get away with any violation of the local speed law, you bring the whole

fraternity of tourists into bad repute, and in the long run deprive yourself of many helpful courtesies which might otherwise be yours on tour.

But touring is not all of motoring, and therefore not all of this chapter. There still remains for the motorist a seventh heaven of automobile happiness, of which motoring on the road is but a foretaste—and this is no other than motoring mostly off the road altogether. For the car has proved that it is capable of penetrating into the wilds and bringing its owner into speedy touch with primitive nature, where he may be the outdoor man God made him. And the car gets him back again before he has dropped any of the necessary threads of our complex civilization.

Suppose you could jump aboard your car some Friday night after dinner, whisk over good roads a hundred and fifty miles or so, through bracing air lustrous with autumn moonlight, sleep soundly at a country inn, and next morning, with a good breakfast under your belt, chug away to the pine woods where grouse, woodcock, quail, and rabbits abound. Gun in hand you forage for your noonday meal, which you yourself cook over a camp fire. Then, just before early twilight, miles away on the edge of a great sea bay, you are waiting for a chance at canvas-back, mallard, teal, snipe, and perhaps goose.

You drive back into the woods to some nook

that shelters you from the cold sea wind, pitch camp, sup royally, and after a pipe or two, sleep in your tent as only men can sleep after a day in the open. The aroma of brewing coffee on the crisp air awakens you in the morning, to find your guide getting breakfast. After a day of delicious idling in camp among the pines you make the swift run home at dusk for a dreamless sleep in your own bed, from which you go, clear-eyed and invigorated, to work again on Monday.

It all seems a flight of fancy, yet this and more does the car make possible, even at the very gates of the biggest and busiest city in the Western world. In order to open up such delights to himself it is only necessary for the car-owner to acquire the know-how. Once he has that, he may trek across the continent and never once sleep in a hotel. He can live for six months in and alongside his car, touring on business and pleasure all over an entire State. He can go for a few weeks' fishing or shooting in the Maine woods, or in the wilds of Canada, covering more territory and having more fun than would be possible without the magic help of the car.

Annihilator of distances that it is, the automobile makes possible many things to the outdoor man that would be beyond his reach if he had only "Shank's mare" to depend upon. If he camp in an unfavorable spot, in ten minutes from the time he

realizes its discomforts, he can be up and off again —ten, twenty, thirty miles in a jiffy, to find the sheltered nook where he may spend the night in peace, or to seek new cover for the day's hunting. If he need milk and eggs and fresh supplies for his larder, a spin of a score of miles or so down the road to the nearest farmhouse is nothing. If he has taken a road whose environment proves a disappointment, he can speed back and try for better luck on another, while his pedestrian contemporaries would either press wearily on to no purpose, or retrace their steps, footsore and disgusted, incapable of further activity for many hours.

All this and myriad more things can the motor camper do, but, let him remember, it is of even greater importance to plan a cruise carefully than a tour. When one bids his car take him all over the uncharted outdoors, emergencies must be forestalled with as much preparedness as the captain of a tramp ship can boast.

An example or two will serve in explanation. Some summers ago, five enthusiastic outdoor men started in three motors from Portland, Maine, to hunt and fish across the State. Little information is available about such of the roads and towns of Maine as best serve the sportsman's purpose. He usually ships his canoe and himself to some

distant point and hires a guide to paddle him over the streams and lakes where game abound.

These pioneering motorists, therefore, provided themselves with block and tackle, four hundred feet of ⅝-inch rope, four axes, a pick, a shovel, and a crowbar, together with two extra springs and a liberal number of duplicate parts which might be needed to replace those damaged by the rough driving they anticipated. Each car carried an extra tire shoe and the usual supply of inner tubes, besides its regular tool kit and extra tins of gasoline and oil. In addition to the usual paraphernalia never absent from a well-kept car, there were stowed among the machines four silk tents, an aluminum cooking outfit, a small flat-folding stove with telescoping pipe, a folding oven, folding lanterns, besides rifles and fishing tackle to provide both sport and forage.

At Oldtown they took aboard two guides, not only for pilotage through the happy hunting grounds, but because the outlander cannot legally discharge a gun or build a fire in the Maine woods from May to November unless accompanied by a licensed guide. They also purchased here a two weeks' supply of flour, cornmeal, coffee, sugar, salt, cereals, beans, rice, and evaporated milk. These were put separately into canvas bags and packed in a regular waterproof duffle bag ten inches in diameter and two feet long.

You can trace on your map the party's route from Oldtown to Mattawamkeag, practically along the line of the Maine Central Railroad. Here they turned off and proceeded north toward Patten, along a road on which an automobile was a rare curiosity. Arriving at Patten only after an exciting dash through smoke and sparks from forest fires, they abandoned the road shown on the route maps—the one leading to Houlton through eastern Maine. Taking a direct northerly course, they pioneered it up to Riviere du Loup on the St. Lawrence.

Thence they proceeded to Masardis, where they were obliged to fall back upon their camping outfit for the first time. That was the end of hired lodgings for them during the rest of the trip. Everyone was more than willing to do his share with the axes, making a clearing for the camp, or cutting tent poles and pegs and wood for the fire. The axes came pretty frequently into requisition now, for the trail to Ashland and beyond was through dense forest where fallen trees often had to be chopped away to give passage. Their outfit and food supply made them independent of the sparse settlements where French Canadian was practically the only language spoken.

At Fort Kent they dismissed their guides and forded the St. John River, which was unusually low. Thus entering Canada, they proceeded to

Edmunston, and thence due north to Notre Dame du Lac, bagging a few partridges on the way. Here procuring Canadian guides, they made a detour to Lake Temiscouata, across which they were ferried. They skirted along the sandy shore walled by dense forest, until they found an opening into this by way of a crude corduroy road, which they traversed to Lake Touladi, seven miles of very rough driving.

The spot proved a perfect paradise for hunting and fishing, and they enjoyed it to their hearts' content. Then retracing their route to Riviere du Loup, they trekked down the Canadian bank of the lower St. Lawrence. Near Bic they penetrated the forest as far as the automobiles could be made to go and camped for several days, being rewarded by caribou. Breaking camp at last, they returned to Bic and thence by rail to New York.

All this was accomplished in two weeks from the time our friends left Portland. They sometimes had to ferret out gasoline among the lumber mills or local tinsmiths, but as they had carefully canvassed the gasoline situation in Maine before starting, they were able to get a supply every hundred miles or so, though as a rule it was of distinctly inferior quality.

This is only one of many instances of the way the car can be made to open up wide areas to

the determined sportsman in little more than a fortnight, even in the effete East. In contrast may be mentioned the experience of four men in one car who covered six thousand miles in six months over the mountains and roadless deserts of Nevada. The conditions necessitated special equipment, and they carried spare parts in such profusion that they could have replaced almost everything except a crank shaft. Although none of these was called into requisition, it was a necessary precaution, a wise selection of spares being the first thing with which the motorist must provide his car if he would cruise in it. The usual block and tackle for getting the car out of trouble was also supplemented by two strips of heavy canvas, fifteen inches wide and fifty feet long, an essential in getting the car across the soft spots in the sandy Western plains where otherwise the wheels would sink above the hubs.

You may not aspire to perform such pioneering feats with your car as those just described, but even if your ambition is limited to an occasional week-end or a brief vacation in the not too desolate open, you must know how to rig your car for it, or it will prove a sad disappointment. In the first place you need not attempt cruising much off the beaten road, unless you have a fairly high-powered car, thirty-horse or so.

It should have a high clearance if you expect to make your way over the open spaces of the woods or along unfrequented roads, which, as a rule, are worn down at either side leaving a continuous hummock in the middle. You will often have to employ the first speed, so as to put all the power possible upon your driving wheels to get you out of some rough and untried path—and woe betide if the power is not there!

As for preparation, the United States Topographical Survey maps and the official county maps of Maine and other States will supplement your regular route books and sportsman's library in determining where you can go and what you can do. If you are of an adventurous spirit and have been once inoculated with a feeling for all outdoors, it will not take you long to ferret out, with your car, localities in your neighborhood for a radius of two hundred miles or so, where a few days' camp-cruising will be richly rewarded.

As to special equipment, it is advisable to procure the lightest, most compact, and at the same time serviceable camping conveniences possible. The very essence of automobile cruising is to be able to pitch or strike camp quickly so that you may enjoy to the full the long range which the car gives you. Hence it is advisable to choose the special automobile tents with telescoping steel

poles and steel tent pins, which are great time-savers and were evolved out of the experience of an inveterate motor-camper.

They go up with one operation, waterproof floor cloth and all, the guy ropes being made taut to the steering column and wheels of the car. One large size tent is ample for a party of five men, two small ones being substituted if the womenfolk go along. If there is a chance of insects on the camping ground, it pays to take along bobbinet fronts for the tents. Each of the party should have a waterproof sleeping bag in cool weather, preferably of the variety lined with several thicknesses of blanket, under as many of which you can crawl as you desire.

For luxurious sleeping, air mattresses and pillows should be added. They can be inflated with a few strokes of the tire pump, and, held under the sleeping bags by special flaps, make the automobile camper sceptical of home comforts. Folding aluminum lanterns and folding buckets and basins may be added to complete comfort within the tents. In nipping weather four-quart hot water bottles may be found friends in need inside the sleeping bags.

Very complete and extremely stowable cooking outfits of aluminum or steel can be procured, and if the campers are not inclined to cook over a wood fire, compact kerosene or hydrocarbon burn-

ers are to be had. A folding oven puts the camper in a position to prepare superior menus of roast oysters, duck, or other forage from his hunting; it may be tucked under a seat cushion, to be used for a multiplicity of things, from baking hoe cake to washing dishes.

In hot weather a refrigerator basket may be stowed somewhere to carry butter, fresh meat, or other spoilable food, and if a luncheon de luxe in the open is desired, very compact folding chairs and tables may be obtained. As for food, it will not do to depend entirely upon the guns and rods for that, and various five or ten-pound assortments of staples can be purchased cheaply in compact form. Here is a typical list of supplies, enough to furnish a varied menu for eight people an entire week:

Flour	24 lbs.	Rice	6 lbs.
Corn meal	10 lbs.	Julienne	1 lb.
Beans	6 lbs.	Soup tablets	½ lb.
Erbswurst	½ lb.	Evaporated apples	2 lbs.
Bouillon capsules	1 lb.	Evaporated apricots	2 lbs.
Lentils	2 lbs.	Salt	1 lb.
Sugar	9 lbs.	Chocolate	1 lb.
Baking powder	1 lb.	Tea	1 lb.
Coffee	2 lbs.	Bacon	6 lbs.
Butter	6 lbs.	Dried potatoes	4 lbs.
Pork	10 lbs.	Shelled nuts	1 lb.
Shredded cod fish	1 lb.	Dried eggs	1¼ lbs.
Evaporated milk	5 lbs.	Dried onions	¼ lb.
Oatmeal	2 lbs.	Total,	106½ lbs.

Pepper, spice, mustard—shaker full.

The automobile medicine case must not be forgotten, nor waterproof clothing for the party, together with at least one good axe, a compass, and a waterproof cover for the car, if it has no top.

Following is a very complete list, with weights per article, of accessories that may be stowed neatly on the running boards of any car for a short or long cruise:

Article.	*Weight.*
2 automobile tents	18½ lbs.
2 doz. 12-in. steel tent pins (per doz)	4¼ lbs.
2 tubular steel telescopic tent poles	3½ lbs.
8 sleeping bags, style "A"	21 lbs.
8 No. 1 air beds	9 lbs.
2 three-quarter axes and sheaths	3¼ lbs.
1 aluminum cooking outfit for eight people, in leatheroid case, with all accessories	15 lbs.
1 large aluminum folding baker, with pan, bread board, canvas case and two broilers	8 lbs.
1 folding grate with canvas bag	3½ lbs.
4 chairs	4½ lbs.
4 steel folding stools	2½ lbs.
2 folding aluminum lanterns	7 oz.
4 folding wash basins	7 oz.
2 folding pails	8 oz.
2 folding tables	16 lbs.
2 shotguns and two rifles in each car	Discretionary
2 fishing rods with reels, lines, hooks, flies, etc.	Discretionary
1 toilet tent	6 lbs.
2 wall pockets	1½ lbs.
1 refrigerator basket	9 lbs.
1 folding safety saw	4 oz.
2 military night marching compasses, one for each car	7 oz.
1 medicine case	21 oz.

Equipped with such an outfit, or at least its essential items, the motorist is prepared either to emulate his French brethren—who are past-masters in taking little jaunts along their good roads, lunching luxuriously on the way—or to cross an entire continent, as the famous French sportsman, Baron de Crawhez, has lately done in Africa. No one can escape the enthusiasm of the motor cruise, and the car owner who tries it once will find himself planning more and more adventurous sorties

into the open, and will be persuading his motoring friends to accompany him in their cars. A cavalcade of two or three machines, well supplied with sportsmen and their accouterments, makes possible the cruise *par excellence.*

APPENDIX—TROUBLE CHART

APPENDIX.

TROUBLE CHART.

IF THE ENGINE STALLS WITH NO SPARK.

HIGH TENSION MAGNETO

- Armature shaft not turning
- Cable to switch for shutting off magneto short circuited
- Circuit breaker out of action, failure to lock adjusting screw
- Circuit breaker points burned away, no contact made
- Circuit breaker points separated by dirt
- Circuit breaker points roughened, pitted or blackened
- High tension short circuit between armature or coil secondary and distributor
- Distributor short circuited
- Safety spark gap too short
- Loss of magnetism in field magnets
- Condensor broken down
- Secondary winding insulation broken down

LOW TENSION MAGNETO

- Switch in off position
- Armature shaft not turning
- Wire to bus-bar broken or short-circuited
- Collector brush fouled or broken
- Magneto out of time with make and break mechanisms
- Loss of magnetism in field magnets

BATTERY SYSTEMS

(*See first if batteries are too weak.*)

- Switch in off position
- Switch plug loose

Connection in or at switch loosened or broken
Battery ground wire loosened or broken
Wire at battery binding posts loosened or disconnected
Wire from battery to coil or switch broken
Insulation on battery wire to coil or switch worn, causing short circuit
Timer rotor loose on shaft and not driven
Timer contacts burned away (no contact)
Timer roller or plunger spring weakened, broken or disconnected
Vibrator points fused, pitted, or blackened
Vibrator point adjustments loosened
Vibrator and adjusting screw post short circuited
High tension wire disconnected from coil or distributor
High tension wire between coil and distributor broken or leaky
High tension distributor dirty, causing short circuit
Distributor rotor loose on shaft and not turning
Condensor broken down
Insulation of secondary winding broken down
Circuit breaker lever stuck
Circuit breaker actuating spring broken or stretched
Circuit breaker contact insufficient in duration

WITH STRONG SPARK.

FUEL SUPPLY
(*See that fuel valve is open.*)
Float mechanism stuck
Dirt under float valve
Float valve leaky
Float perforated or water-logged
Throttle valve disconnected from control device
Carburetor air valve stuck, spring weakened or broken
Air vent passage between float chamber and atmosphere plugged
Intake pipe fractured
Water in fuel
Spray nozzle plugged
Carburetor adjustment wrong; see fuel level, nozzle and air valve adjustments
Tank punctured

Leak in or around tank filler cap
Pressure leak in hand pump line
Pipe to pressure check valve leaky
Gauze strainer in pipe to check valve dirty
Check valve stuck
Pressure pipe to tank broken or clogged
Pressure regulating valve adjustment lost
Fuel pipe to auxiliary tank broken or plugged
Fuel pipe from auxiliary tank to carburetor broken or plugged
Auxiliary tank level controlling mechanism stuck
Spark
Timing
Timer or circuit breaker shifting link disconnected
Timer or circuit breaker rotor shifted with reference to driving shaft
Timer or circuit breaker shaft driving gears shifted
Magneto armature driving gear shifted
High tension wires connected to wrong plugs

WITH NO COMPRESSION (OR IMPOSSIBILITY TO CRANK MOTOR)

BOTH EXTERNAL AND INTERNAL CAUSES

No oil in lubricator
Disconnected lubricator drive
Lubricator adjustment improperly made or lost
No pressure on oil (in gas pressure system)
No water in cooler
Pump drive sheared or disconnected
Radiator fan belt broken, disconnected or slipping
Water-piping passage closed
Timing pinion or gear on crank or cam shaft loose
Timing pinion or gear stripped
Hot engine, see above externally apparent causes of no compression
Crank or connecting rod bearing overheated or seized
Piston overheated or seized
Flywheel jammed (in enclosed flywheel engines)
Timing gear or gears broken or jammed
Connecting rod disconnected
Connecting rod bent or broken
Crankshaft bent or broken

IF THE ENGINE "MISSES" OR LOSES POWER (OR STARTS WITH DIFFICULTY)

With Source of Trouble in Ignition System

High Tension Magneto

Cable to switch momentarily short circuited
Spark plug fouled or broken
High tension wire to spark plug disconnected
Spark plug gap too great
Circuit breaker points dirty, burned, pitted, blackened, etc.
High tension distributor damp or dirty
Wire or insulation in primary circuit broken
Collector brush dirty or worn
Examine all external wiring insulation
Gradual loss of magnetism in field magnets

Low Tension Magneto

Make and break inoperative, spring broken, bearings stuck, etc.
Make and break mechanism fouled
Bus-bar connections loosened
Binding post connection at magneto loosened
Collector brush worn or dirty
Loss of magnetism in field magnets

Battery Systems

(*See first if batteries are too weak.*)
(Test voltage and amperage for weak battery)
Timer or circuit breaker arc of contact too long
Tension on vibrator too great
Vibrator or circuit breaker contact screw set down too far
Low tension wiring leaky, due to poor or broken insulation
Switch plug or lever loosened
Spark plug fouled or broken
Spark plug gap excessive
Wire to spark plug disconnected or short circuited
Wire or connection from battery or timer to coil broken or loosened
Vibrator stuck, points fused
Vibrator points burned, dirty or roughened
Tension on vibrator insufficient
Tension on vibrator too great

Coil condenser damaged
Insulation in coil secondary damaged
High tension distributor dirty, wet or worn
Circuit breaker worn, dirty or points burned
Circuit breaker spring weakened

WITH SOURCE OF TROUBLE IN FUEL SUPPLY

Fuel Tank and Pipe Line

Tank nearly empty
Tank vent partially stopped
Fuel pipe valve partially closed
Fuel pipe partially stopped
Pressure weakened (in pressure systems)
Water in fuel

Carburetor Troubles

Float valve leaky
Fuel adjustment loosened
Air valve action clogged
Fuel adjustment loosened
Air valve spring weakened or broken
Air vent to float chamber partially stopped
Float chamber contains dirt or water
Spray nozzle partially stopped up
Intake pipe leaky

WITH SOURCE OF TROUBLE IN ENGINE.

Mechanical Troubles

(*First examine muffler.*)
Valve spring or stem broken
Valve stem bent or gummed
Valve spring weakened
Valves leaky (carbon on seats)
Valve Stem and cam-follower always contacting
Cylinders and valves carbonized
Piston rings gummed or broken
Piston ring slots in line
Cam worn, shifted or broken
Piston head or cylinder wall cracked
Piston rings and cylinder walls scored

LOSS OF POWER IN ENGINE.

Motor Loses Power

(*Without cylinders missing*)

Ignition system adjustments shifted or wrongly set
Carburetor adjustments shifted or wrongly set
Lubricating or cooling systems not working properly
Valves leaky
Batteries weakened
Valve springs weakened
Cam-followers, valve stem ends, push rods, rocker arms, cams, etc., worn
Valve mechanism adjustment lost, resulting in lost timing
Intake piping leaky
Muffler or exhaust pipe obstructed
Engine bearings overheated
Compression weak
Spark plug, priming cock or plug over valve leaking

*The data in this table is based on *Motor's* **Trouble Chart.**

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¶ Each book deals with a separate subject and deals with it thoroughly. If you want to know anything about Airedales an OUTING HANDBOOK gives you all you want. If it's Apple Growing, another OUTING HANDBOOK meets your need. The Fisherman, the Camper, the Poultry-raiser, the Automobilist, the Horseman, all varieties of outdoor enthusiasts, will find separate volumes for their separate interests. There is no waste space.

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¶ Two hundred titles are projected. The series covers all phases of outdoor life, from bee-keeping to big-game shooting. Among the books now ready or in preparation are those described on the following pages.

OUTING PUBLISHING COMPANY
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141-145 WEST 36TH ST. NEW YORK 122 S. MICHIGAN AVE. CHICAGO

THE AIREDALE, by Williams Haynes. The book opens with a short chapter on the origin and development of the Airedale, as a distinctive breed. The author then takes up the problems of type as bearing on the selection of the dog, breeding, training and use. The book is designed for the non-professional dog fancier, who wishes common sense advice which does not involve elaborate preparation or expenditure. Chapters are included on the care of the dog in the kennel and simple remedies for ordinary diseases.

"It ought to be read and studied by every Airedale owner and admirer."—Howard Keeler, Airedale Farm Kennels.

APPLE GROWING, by M. C. Burritt. The various problems confronting the apple grower, from the preparation of the soil and the planting of the trees to the marketing of the fruit, are discussed in detail by the author. Chapter headings are:— The Outlook for the Growing of Apples—Planning for the Orchard—Planting and Growing the Orchard—Pruning the Trees—Cultivation and Cover Cropping—Manuring and Fertilizing—Insects and Diseases Affecting the Apple—The Principles and Practice of Spraying—Harvesting and Storing—Markets and Marketing—Some Hints on Renovating Old Orchards—The Cost of Growing Apples.

THE AUTOMOBILE—Its Selection, Care and Use, by Robert Sloss. This is a plain, practical discussion of the things that every man needs to know if he is to buy the right car and get the most out of it. The various details of operation and care are given in simple, intelligent terms. From it the car owner can easily learn the mechanism of his motor and the art of locating motor trouble, as well as how to use his car for the greatest pleasure. A chapter is included on building garages.

BACKWOODS SURGERY AND MEDICINE, by Charles S. Moody, M. D. A handy book for the prudent lover of the woods who doesn't expect to be ill but believes in being on the safe side. Common-sense methods for the treatment of the ordinary wounds and accidents are described—setting a broken limb, reducing a dislocation, caring for burns, cuts, etc. Practical remedies for camp diseases are recommended, as well as the ordinary indications of the most probable ailments. Includes a list of the necessary medical and surgical supplies.

The manager of a mine in Nome, Alaska, writes as follows: "I have been on the trail for years (twelve in the Klondike and Alaska) and have always wanted just such a book as Dr. Moody's Backwoods Surgery and Medicine."

THE BULL TERRIER, by Williams Haynes. This is a companion book to "The Airedale" and "Scottish and Irish Terriers" by the same author. Its greatest usefulness is as a guide to the dog owner who wishes to be his own kennel manager. A full account of the development of the breed is given as also description of best types and standards. Recommendations for the care of the dog in health or sickness are included. The chapter heads cover such matters as:—The Bull Terrier's History—Training the Bull Terrier—The Terrier in Health—Kennelling—Diseases.

CAMP COOKERY, by Horace Kephart. "The less a man carries in his pack the more he must carry in his head", says Mr. Kephart. This book tells what a man should carry in both pack and head. Every step is traced—the selection of provisions and utensils, with the kind and quantity of each, the preparation of game, the building of fires, the cooking of every conceivable kind of food that the camp outfit or woods, fields or streams may provide—even to the making of desserts. Every recipe is the result of hard practice and long experience. Every recipe has been carefully tested. It is the book for the man who wants to dine well and wholesomely, but

in true wilderness fashion without reliance on grocery stores or elaborate camp outfits. It is adapted equally well to the trips of every length and to all conditions of climate, season or country; the best possible companion for one who wants to travel light and live well. The chapter headings tell their own story. Provisions—Utensils—Fires—Dressing and Keeping Game and Fish—Meat—Game—Fish and Shell Fish—Cured Meats, etc.—Eggs—Breadstuffs and Cereals—Vegetables—Soups—Beverages and Desserts.

> *"Camp Cookery is destined to be in the kit of every tent dweller in the country."—Edwin Markham in the San Francisco Examiner.*

CANOE AND BOAT BUILDING, by Victor Slocum. All of us like to think we could build a boat if we had to. Mr. Slocum tells us how to do it. Designs are given for the various types of canoes as well as full descriptions for preparing the material and putting it together. Small dories and lapstreak boats are also included.

CATTLE DISEASES, by B. T. Woodward. Mr. Woodward takes up in detail the various common diseases to which cattle are liable. His book is designed for the aid of the practical farmer in cases where the skilled veterinarian is not necessary. A careful description of the various diseases is given and the accepted forms of treatment stated.

EXERCISE AND HEALTH, by Dr. Woods Hutchinson. Dr. Hutchinson takes the common-sense view that the greatest problem in exercise for most of us is to get enough of the right kind. The greatest error in exercise is not to take enough, and the greatest danger in athletics is in giving them up. The Chapter heads are illuminating. Errors in Exercise—Exercise and the Heart—Muscle Maketh Man—The Danger of Stopping Athletics—Exercise that Rests. It is written in a direct matter-of-fact manner with an avoidance of medical terms, and a strong emphasis on the rational, all-round manner of living that is best calculated to bring a man to a ripe old age with little illness or consciousness of bodily weakness.

"One of the most readable books ever written on physical exercise."—Luther H. Gulick, M.D., Department of Child Hygiene, Russell Sage Foundation.

FARM DRAINAGE & IRRIGATION, by W.J.McGee. Sometimes it is necessary to spend money to get water on the land; sometimes to get it off. Mr. McGee has studied the question from both angles in his work for the Department of Agriculture and this book will contain his latest and fullest conclusions. Particular attention will be paid to the matter of sub-surface irrigation to which little heed has been given until lately.

FENCING, by Edward Breck. Dr. Breck was for many years one of the best-known amateur fencers in America and is acquainted with the best swordsmen of the present day, here and abroad. His book is a practical guide for those who wish to know the most approved practice in the use of the foil, duelling sword, or saber. Suggestions are given on training and condition, as well as on the finer points of the game.

THE FINE ART OF FISHING, by Samuel G. Camp.

Combines the pleasure of catching fish with the gratification of following the sport in the most approved manner. The suggestions offered are helpful to beginner and expert anglers. The range of fish and fishing conditions covered is wide and includes such subjects as "Casting Fine and Far Off", "Strip-Casting for Bass", "Fishing for Mountain Trout" and "Autumn Fishing for Lake Trout". The book is pervaded with a spirit of love for the streamside and the out-doors generally which the genuine angler will appreciate. A companion book to "Fishing Kits and Equipment". The advice on outfitting so capably given in that book is supplemented in this later work by equally valuable information on how to use the equipment.

"Will encourage the beginner and give pleasure to the expert fisherman."—N. Y. Sun.

FISHING KITS AND EQUIPMENT by Samuel G. Camp.

A complete guide to the angler buying a new outfit. Every detail of the fishing kit of the freshwater angler is described, from rod-tip to creel, and clothing. Special emphasis is laid on outfitting for

fly fishing, but full instruction is also given to the man who wants to catch pickerel, pike, muskellunge, lake-trout, bass and other freshwater game fishes. Prices are quoted for all articles recommended and the approved method of selecting and testing the various rods, lines, leaders, etc., is described.

"A complete guide to the angler buying a new outfit."—
—Peoria Herald.

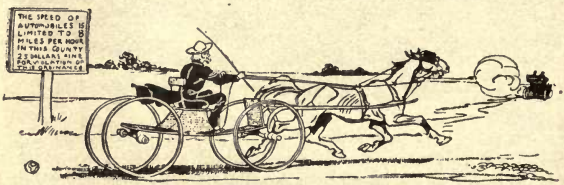
FISHING WITH FLOATING FLIES by Samuel G. Camp.

This is an art that is comparatively new in this country although English anglers have used the dry fly for generations. Mr. Camp has given the matter special study and is one of the few American anglers who really understands the matter from the selection of the outfit to the landing of the fish. His book takes up the process in that order, namely—How to Outfit for Dry Fly Fishing—How, Where, and When to Cast—The Selection and Use of Floating Flies—Dry Fly Fishing for Brook, Brown and Rainbow Trout—Hooking, Playing and Landing—Practical Hints on Dry Fly Fishing.

THE FOX TERRIER, by Williams Haynes. As in his other books on the terrier, Mr. Haynes takes up the origin and history of the breed, its types and standards, and the more exclusive representatives down to the present time. Training the Fox Terrier —His Care and Kenneling in Sickness and Health—and the Various Uses to Which He Can be Put—are among the phases handled.

THE GASOLINE MOTOR, by Harold Whiting Slauson. Deals with the practical problems of motor operation. The standpoint is that of the man who wishes to know how and why gasoline generates power and something about the various types. Describes in detail the different parts of motors and the faults to which they are liable. Also gives full directions as to repair and upkeep. Various chapters deal with Types of Motors—Valves—Bearings—Ignition — Carburetors — Lubrication — Fuel — Two Cycle Motors.

GUNSMITHING FOR THE AMATEUR, by Edward C. Crossman. Mr. Crossman, who is one of the best-known rifle experts in the country, takes up in detail the care and repair of the gun. He discusses such questions as The Present Development of the Gun—Tools for the Amateur—Rifle Barrels—Smooth Bore Barrels—Rifle Actions—Pistol and Gun Actions—Refinishing and Processing—The Stock, Sights and Aids to Accuracy.



THE HORSE—Its Breeding, Care and Use, by David Buffum. Mr. Buffum takes up the common, every-day problems of the ordinary horse-user, such as feeding, shoeing, simple home remedies, breaking and the cure for various equine vices. An important chapter is that tracing the influx of Arabian blood into the English and American horses and its value and limitations. Chapters are included on draft-horses, carriage horses, and the development of the two-minute trotter. It is distinctly a sensible book for the sensible man who wishes to know how he can improve his horses and his horsemanship at the same time.

INTENSIVE FARMING, by L. C. Corbett. A discussion of the meaning, method and value of intensive methods in agriculture. This book is designed for the convenience of practical farmers who find themselves under the necessity of making a living out of high-priced land.

LAYING OUT THE FARM FOR PROFIT, by L. G. Dodge. One of the farmers' great problems is to put every acre of his land to the best possible use. This book discusses the methods of obtaining this result. The author is an investigator for the Department of Agriculture and has given particular attention to this subject.

THE MOTOR BOAT—Its Selection, Care and Use, by H. W. Slauson. The intending purchaser is advised as to the type of motor boat best suited to his particular needs and how to keep it in running condition after purchased. The Chapter headings are: Kinds and Uses of Motor Boats—When the Motor Balks—Speeding of the Motor Boat—Getting More Power from a New Motor—How to Install a Marine Power Plant—Accessories—Covers, Canopies and Tops—Camping and Cruising—The Boathouse.

NAVIGATION FOR THE AMATEUR, by Capt. E. T. Morton. A short treatise on the simpler methods of finding position at sea by the observation of the sun's altitude and the use of the sextant and chronometer. It is arranged especially for yachtsmen and amateurs who wish to know the simpler formulae for the necessary navigation involved in taking a boat anywhere off shore. Illustrated with drawings. Chapter headings: Fundamental Terms—Time—The Sumner Line—The Day's Work, Equal Altitude, and Ex-Meridian Sights—Hints on Taking Observations.

OUTDOOR PHOTOGRAPHY, by Julian A. Dimock. A solution of all the problems in camera work out-of-doors. The various subjects dealt with are The Camera—Lens and Plates—Light and Exposure — Development — Prints and Printing — Composition — Landscapes — Figure Work — Speed Photography — The Leaping Tarpon—Sea Pictures—In the Good Old Winter Time—Wild Life. The purpose of the book is to serve as a guide not only for the man or woman who has just taken up the use of the camera, but also for those who have progressed far enough to know some of the problems that confront them.

OUTDOOR SIGNALLING, by Elbert Wells.

Mr. Wells has perfected a method of signalling by means of wig-wag, light, smoke, or whistle which is as simple as it is effective. The fundamental principle can be learnt in ten minutes and its application is far easier than that of any other code now in use. It permits also the use of cipher and can be adapted to almost any imaginable conditions of weather, light, or topography.

"I find it to be the simplest and most practical book on signalling published."—Frank H. Schrenk, Director of Camp Belgrade.

"One of the finest things of the kind I have ever seen. I believe my seven year old boy can learn to use this system, and I know that we will find it very useful here in our Boy Scout work."—Lyman G. Haskell, Physical Director, Y. M. C. A., Jacksonville, Fla.

PACKING AND PORTAGING, by Dillon Wallace.

Mr. Wallace has brought together in one volume all the valuable information on the different ways of making and carrying the different kinds of packs. The ground covered ranges from man-packing to horse-packing, from the use of the tump line to throwing the diamond hitch. The various chapters deal with Packing and the Outfit—The Canoe and Its Equipment—Camp Equipment for the Canoe Trip—Personal Equipment—Food—The Portage—Travel with Saddle and Pack Animals—Saddle and Pack Equipment—Adjusting the Pack—Some Practical Hitches—Traveling Without a Pack Horse—Afoot in Summer—With Snowshoes and Toboggan—With Dogs and Komatik.

PRACTICAL POULTRY KEEPING, by R. B. Sando.

In effect a comprehensive manual for the instruction of the man who desires to begin poultry raising on a large or small scale and to avoid the ordinary mistakes to which the beginner is prone. All the statements are based on the author's own experience, and special care has been taken to avoid sensationalism and exaggeration. The general contents are Poultry Keeping and Keepers—Housing and Yarding—Fixtures and Equipment—Choosing and Buying Stock—Foods and Feeding—Hatching and Raising Chicks—Poultry Diseases. Illustrated.

PROFITABLE BREEDS OF POULTRY, by Arthur S. Wheeler. Mr. Wheeler discusses from personal experience the best-known general purpose breeds. Advice is given from the standpoint of the man who desires results in eggs and stock rather than in specimens for exhibition. In addition to a careful analysis of stock—good and bad—and some conclusions regarding housing and management, the author writes in detail regarding Plymouth Rocks, Wyandottes, Orpingtons, Rhode Island Reds, Mediterraneans and the Cornish.

"This is an invaluable book for those who would make a success in the poultry business."—Grand Rapids, (Mich.) Herald.

RIFLES AND RIFLE SHOOTING, by Charles Askins. A practical manual describing various makes and mechanisms, in addition to discussing in detail the range and limitations in the use of the rifle. Among other things, the chapters deal with The Development of the American Breech-Loading Rifle—Single Shot Rifle—Lever-Action Repeater—Pump-Action Repeater and

Military Bolt-Action—Double Rifle—Rifle and Shotgun—Self-Loading Rifle—Rifle Cartridges, Miniature and Gallery—Small Game—Match-Rifle Cartridges and Their Manipulation—High Power, Small Bore Hunting Cartridges—Big Bore, High Power Cartridges—Trajectory, Accuracy, and Power of Hunting Cartridges—Weight of Rifle and Recoil—Stocks and Triggers—Rifle Sights—Positions for Rifle Shooting—Outdoor Target Shooting,—Quick Firing and Running Shots—Fancy Snap and Wingshooting—Two-Hundred Yard Sharpshooting.

SCOTTISH AND IRISH TERRIERS, by Williams Haynes. This is a companion book to "The Airedale", and deals with the history and development of both breeds. For the owner of the dog, valuable information is given as to the use of the terriers, their treatment in health, their treatment when sick, the principles of dog breeding, and dog shows and rules.

"The happy owner of a terrier for the first time could not go wrong if he follows Mr. Haynes' advice."—Brooklyn Standard Union.

SPORTING FIREARMS, by Horace Kephart. This book is the result of painstaking tests and experiments. Practically nothing is taken for granted. Part I deals with the rifle, and Part II with the shotgun. The man seeking guidance in the selection and use of small firearms, as well as the advanced student of the subject, will receive an unusual amount of assistance from this work. The chapter headings are: Rifles and Ammunition—The Flight of Bullets—Killing Power—Rifle Mechanism and Materials—Rifle Sights—Triggers and Stocks—Care of Rifle—Shot Patterns and Penetration—Gauges and Weights—Mechanism and Build of Shotguns.

TRACKS AND TRACKING, by Josef Brunner. After twenty years of patient study and practical experience, Mr. Brunner can, from his intimate knowledge, speak with authority on this subject. "Tracks and Tracking" shows how to follow intelligently even the most intricate animal or bird tracks. It teaches how to interpret tracks of wild game and decipher the many telltale signs of the chase that would otherwise pass unnoticed. It proves how it is possible to tell from the footprints the name, sex, speed, direction, whether and how wounded, and many other things about wild animals and birds. All material has been gathered first hand; the drawings and half-tones from photographs form an important part of the work, as the author has made faithful pictures of the tracks and signs of the game followed. The list is: The White-Tailed or Virginia Deer—The Fan-Tailed Deer—The Mule-Deer—The Wapiti or Elk—The Moose—The Mountain Sheep—The Antelope—The Bear—The Cougar—The Lynx—The Domestic Cat—The Wolf—The Coyote—The Fox—The Jack Rabbit—The Varying Hare—The Cottontail Rabbit—The Squirrel—The Marten and the Black-Footed Ferret—The Otter—The Mink—The Ermine—The Beaver—The Badger—The Procupine—The Skunk—Feathered Game—Upland Birds—Waterfowl—Predatory Birds. This book is invaluable to the novice as well as the experienced hunter.

"This book studied carefully, will enable the reader to become as well versed in tracking lore as he could by years of actual experience."—Lewiston Journal.

WING AND TRAP-SHOOTING, by Charles Askins. The only practical manual in existance dealing with the modern gun. It contains a full discussion of the various methods, such as snap-shooting, swing and half-swing, discusses the flight of birds with reference to the gunner's problem of lead and range and makes special application of the various points to the different birds commonly shot in this country. A chapter is included on trap shooting and the book closes with a forceful and common-sense presentation of the etiquette of the field.

"It is difficult to understand how anyone who takes a delight in hunting can afford to be without this valuable book."—Chamber of Commerce Bulletin, Portland, Ore.

"This book will prove an invaluable manual to the true sportsman, whether he be a tyro or expert."—Book News Monthly.

"Its closing chapter on field etiquette deserves careful reading."—N. Y. Times.

THE YACHTSMAN'S HANDBOOK, by Herbert L. Stone. The author and compiler of this work is the editor of "Yachting". He treats in simple language of the many problems confronting the amateur sailor and motorboatman. Handling ground tackle, handling lines, taking soundings, the use of the lead line, care and use of sails, yachting etiquette, are all given careful attention. Some light is thrown upon the operation of the gasoline motor, and suggestions are made for the avoidance of engine troubles.