ENGINEERING FACTS
about
PACKARD TWIN SIX
and
OTHER CARS

By

J. G. VINCENT

FOR THE EXCLUSIVE USE
AND INFORMATION OF
PACKARD SALESMEN

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Gentlemen:

Informed that I had been appointed godfather to the St. Louis and Kansas City organizations for the Lincoln Highway Sweepstakes contest, I naturally began to cast about in an endeavor to hit upon some scheme that would help in landing my bunch right up in front.

After thinking the matter over carefully, I decided that if I could only succeed in giving the men on the firing line a more comprehensive picture of the actual comparative value of cars now offered for sale to the public, I would at least be doing some good and I immediately wired Mr. Parish putting the proposition up to him. He promptly wired back accepting and this conference is the result.

Today, you have all had a chance to ride in and drive a number of the more prominent cars being offered for sale at the present time. You have had a chance to quietly examine these cars and compare them with our Twin Six under exactly similar conditions. I wanted you to make these comparisons yourselves without any suggestions from factory men in order that your minds might not be biased by any findings we have made. I, of course, realize that a day is entirely too short a time in which to go into so many different cars thoroughly, but I believe each of you probably have obtained a more definite idea of the good and bad features of the various cars examined and tried out. It is my purpose in this talk to cover somewhat in detail what might be called the "Technical Information" side of the sales problem. I will endeavor to put the matter up to you in such a way as to enable you to take the facts given and use them as you think best in making a

further comparison of cars and in improving your sales arguments.

There are, of course, two kinds of successful salesmen, i. e., the man who is simply a wonderful salesman and has the faculty of selling anything that he makes up his mind to sell, regardless of whether he knows much about it or not and, on the other hand, the man who may or may not have great selling ability, but who sells his goods through intimate knowledge of not only the goods he has to sell, but also those of other manufacturers. While there are shining examples of the former type, it is my belief that the latter type predominates and that this type of salesman is much more apt to win consistently.

I know that I have no selling ability, yet I would not hesitate to try to sell a Packard car, because I not only know the Packard car thoroughly, but I am fairly well acquainted with all other makes of cars and I could, therefore, go after a prospect with a full knowledge that I could answer intelligently any question which he might bring up. It may be that I over-estimate the value of not only knowing our own goods thoroughly, but also those of other manufacturers, but it would certainly take some strong arguments to make me change my mind.

I have often thought that it is to be regretted that our Packard selling organization is not in full possession of the information that we gather in the Engineering Department through experimenting with our own cars, and also the principal other cars on the market. I have, from time to time, endeavored to pass some of this information out to our sales force, but on account of being very busy day after day, I have never gotten very far with this work.

On April 14th, 1916, I wrote to all our dealers on this subject, and I would like to quote from that letter, as

I believe that it sets forth clearly a point that I want to make tonight:

April 14th, 1916

"To Packard Dealers:

No motor car built in America goes to such lengths in obtaining perfection of performance and refinement of every individual detail as the Packard Twin Six. Many of these refinements and excess luxuries of detail are not appreciated by Packard owners until they have become acquainted with the car through continuous driving. Hundreds of dollars easily could be cut out of the expense of building Packard Twin Six cars without changing their general dimensions or appearance, and without any clue, so far as the eye is concerned, that any change had been made in their construction.

I sometimes wonder whether members of our Packard organization, and our Packard customers, who drive Packard cars almost exclusively, really appreciate the many refinements that are built into Packard cars to make them more luxurious, more pleasing to ride in, more convenient to drive, and more reliable than any other cars that ever have been produced.

Packard advertising always has been and will continue to be conservative, and I believe that this is the proper way to advertise goods, but we should not overlook the fact that some companies do not advertise their product on a conservative basis, because if we were to interpret the advertisements of some companies that are claiming so much for their cars on a Packard basis, we would obtain an entirely wrong impression of these cars as compared with Packard Twin Sixes.

I know that I sometimes read a cleverly written advertisement of some car and in spite of past experience in interpreting advertisements, I obtain an entirely wrong impression of the automobile advertised. I carry this impression around with me until such time

as I get opportunity to thoroughly try out the car in question and I then usually have my opinion suddenly changed. It is the many experiences of this kind that I have had that tend to make me think that our salesmen and customers as a rule gain an entirely wrong impression of various cars that are widely advertised, and I am therefore writing you in an endeavor to give you a picture of the condition as I see it.

In designing Packard cars, we try to study every particular feature of the car from a good many different view-points. In the first place, we want it to be good-looking, but we do not want to obtain good looks at the expense of comfort or service. From time to time we buy samples of the various better-known cars that are on the market and have these cars driven by the various members of our engineering organization that we may be well posted as to what is being sold to the public. In a great many of these cars we find that everything has been sacrificed to gain some particular end, such as stream line, light weight, low effect, etc.

I have just finished carefully testing out a number of various makes of cars that sell from One Thousand Dollars up to over Four Thousand Dollars, and in no one of these cars do I find anything like the total number of desirable features contained in the Packard Twin Six. It would take time and space to enumerate all the various points that I have been over, but as a matter of general information I will outline a few of them.

1. MOTOR:

Not one of these cars is equipped with a motor that even approximates the wide range of smooth ability of the Packard Twin Six motor.

2. ELECTRICAL EQUIPMENT:

Not one of the cars carries an electrical equipment

having anything like the efficiency and all around reliability of that of the Packard Twin Six.

3. WINDSHIELD:

Not one of these cars is equipped with a windshield that even approaches the tightness and all around reliability of the Packard Windshield.

4. SIDE CURTAINS:

Not one of these cars is equipped with side curtains that even approach the all around convenience and tightness of the Packard Equipment.

5. FRONT SEAT ARRANGEMENT:

Most of the cars are more or less cramped in the front compartment and many of them seem to have been designed to make it just as uncomfortable for the driver as possible. The ease with which you can get into the Packard front compartment, and the convenient arrangement of all controls, is an important Packard feature not thoroughly appreciated until one handles various other cars.

6. RIDING QUALITIES:

Long flexible springs, coupled with proper balance of the car, plus snubbers, combine to give the Packard Twin Six wonderful riding qualities, and I have been unable to locate any other car that I consider rides as well under all conditions.

7. ACCESSIBLE FILLERS:

It seems strange that the majority of automobile engineers have paid so little attention to the matter of locating fillers for gasoline, oil, water and the battery so that they are accessible. Most of the cars above mentioned have one or more of these fillers located in a very inaccessible place. A great deal of thought has been put in on these features for Packard cars, in order to not only make them accessible but also to make them non-losable.

8. WHEEL EQUIPMENT:

We go to a great deal of extra expense in building the Packard car, in order to furnish the safest possible wheel equipment. Our wheel hubs are made of the finest quality of drop forgings, accurately machined not only for the fit of the bearings, but also for the fit of the spokes; we use the finest quality of second growth hickory, which is not only very expensive but very hard to obtain at the present time and we put in a sufficient number of high grade bolts, including rear wheel spoke bolts, to make the completed wheel absolutely safe. I know of no other car that is equipped with such fine wheels. In some cars the wheels are cheapened by using stamped hubs; in others by using malleable iron or cast steel hubs, and in others by omitting spoke bolts; and some cars resort to all of these various savings.

9. STEERING GEAR AND CONNECTIONS:

We go to a great deal of extra expense in the Packard car in order to make the steering train of mechanism absolutely safe. The steering gear not only is made of the finest possible material with the finest possible workmanship, but the steering connections are very expensively designed and carefully made, to provide automatic take-up for wear, which not only prevents rattle but also provides insurance against the possibility of some connection wearing and coming apart with disastrous results. I know of no other car in which the steering details are so carefully worked out.

I could go on enumerating a very large number of refinements found in Packard cars which are not found in other cars, but I believe the above examples will serve to convey to you the idea that I am trying to make clear.

As mentioned above, in carrying on our Packard

engineering work we try to look at every part of the mechanism from various angles, but always have uppermost in our minds the comfort and safety of the passengers. While a very great majority of Packard refinements are probably ordinarily overlooked, I am sure that if we left out any of these refinements our product would cease to be Packard.

No one realizes how much can be cut out of the expense of producing an automobile by omitting a feature here and there, changing the material specifications, using inferior equipment, etc., until he has been very carefully through the matter and it will, therefore, surprise you when I tell you that we could cut the cost of producing our Packard Twin Six cars several hundred dollars without changing anything that would be apparent to the salesmen or owners. From a strictly money-making point of view for the immediate future, this probably would be a good thing to do, but we are building Packard cars to maintain Packard prestige and intend to continue to do so."

The point I tried to make clear in the above letter is this: Packard salesmen and Packard customers as a rule take the Packard car as a matter of course and do not half appreciate many of its features. For instance, a Cadillac body or a Hudson body on a Cadillac or Hudson chassis matches up in the material and workmanship with its respective chassis and is, therefore, acceptable to the buyer, but the Packard organization knows that this same type of body on a Packard chassis is not salable.

I do not wonder that prospective buyers are baffled when they are endeavoring to make a selection of a car, particularly if they read the advertising of some motor car manufacturer, in which the only limit is the ability of the advertising man to think of big words. If the

public only knew the real merits of the various cars that are being offered today there would be a stampede to buy Packard Twin Sixes, and this year's allotment would be sold out within a few days. Unfortunately, we cannot educate even a small percentage of the public within a few months, but if we go after the job consistently and keep hammering away at it, we are bound to make a dent. In order to make a dent, however, our sales force must be armed with complete information about our cars, as well as those of other manufacturers. When I say that we must know other cars, I do not mean that I think we must knock them in order to sell our own, but I do believe that we have got to know all principal cars in order to know how good Packard cars are. In other words, I am forced again to make the old statement, that automobiles, like most anything else, are only good or bad by comparison.

It is, of course, a very hard matter to compare our car with several other makes of cars in a single talk, but I am going to make an effort to give you some *accurate information* in the form of comparisons between the Packard Twin Six and other cars in as clear and concise a manner as possible. These comparisons are based on unbiased engineering information. In other words, these comparisons are based on engineering information which we have gathered for our own guidance in connection with the designing of Packard cars, and when gathering such information we always give the other fellow's car the benefit of the doubt, as it will do us no particular harm if we slightly overestimate his car, but if we underestimate it the public would be bound to reverse our findings in a way that would be disastrous to us.

To put it another way, I would be perfectly willing to make these same statements before any body of automobile engineers.

In considering these comparisons, the following explanation should be kept in mind. All gasoline economy runs were made under similar conditions in cold weather over good roads with a 5-passenger load. The cars were driven on a continuous run of approximately 50 miles, at a speed to average 25 miles an hour.

All acceleration tests were made under similar conditions and in cold weather. Before making these tests the speedometers were all checked up and their accuracy verified.

The word "Excellent" is used—it is intended to mean the best possible construction or result, the next step down is Good, below that Fair, and then Poor.

	Packard Twin Six	Cadillac Eight	Hudson Super Six	Marmon 34	Pierce 48	White 16 valve 4
Weight	4500	4200	3500	3450	4800	4000
M.P.G. Gas	10	10½	11	12	8	12
Average Tire Mileage	10,000	7,000	5,000	7,000	7,000	5,000
Acceleration 5 to 50 in seconds	29	35	32	30	37	38
Min. Speed	3 m.p.h	3 m.p.h.	3 m.p.h.	3 m.p.h.	3 m.p.h.	5 m.p.h.
Max. Speed	65	63	64	60	62	58
Piston disp. in cu. in.	424	314	288	339	524	326
Hill Climbing ability	Excellent	Good	Good	Good	Fair	Poor
Motor Sensation	Excellent at all speeds	Good to 25 m.p.h. unpleasant above	Fair roughness increasing with speed	Fair roughness increasing with speed	Fair roughness increasing with speed	Regular 4-Cyl. roughness Particularly at average to high speed

	Packard Twin Six	Cadillac Eight	Hudson Super Six	Marmon 34	Pierce 48	White 16 valve 4
Motor Starting	Instantly under all conditions	Fair, but often hard to start in extremely cold weather	Fair, but often hard to start in extremely cold weather	Fair	Fair	Starter often fails to turn motor over without releasing comp.
Warming up in cold Weather	Very quick	Slow	Slow	Slow	Slow	Very slow
Clutch Release	Fairly soft, free	Soft, free	Soft, drags when hot	Fairly soft, drags	Fairly soft, grabs	Very hard Drags
Foot Brakes	Fairly soft with good braking and no grab or squeak	Soft, but with some tendency to grab and squeak	Fairly soft and efficient but bad squeak	Fairly soft and efficient	Hard action and inefficient	Fairly soft and efficient
Change Gears and hand brake action	Both on left side; out of way and handle easily	Both in center; somewhat in the way but handle easily	Both in center; somewhat in the way and handle easily and with rather long reach	Both in center; and badly in way but handle easily	Both on the right and badly in way of getting out on right hand side; change gear lever does not handle easily	Both in the center, somewhat in way, and neither handles well
Steering	Soft and easy, yet steady at high speeds	Very soft and easy, but erratic at high speeds	Fair	Fair	Fairly soft and easy but erratic at high speeds	Fairly easy but erratic with front wheel wobble
Riding Qualities	Excellent	Good	Fair	Rough at low speed good at high speed	Good	Good
Wheels	Best Possible	Good	Fair	Wire, good on good roads	Good	Fair
Standard Tire equip.	Goodyear Cord	Fabric tires	Fabric tires	Goodrich Cord	Goodrich Cord	Goodrich Cord
Time required for lubricating Chassis in Minutes	10 min.	30 min.	30 min.	20 min.	20 min.	25 min.

	Packard Twin Six	Cadillac Eight	Hudson Super Six	Marmon 34	Pierce 48	White 16 valve 4
Gasoline Filler	Accessible and non-losable and does not require wrench	Close up against the body, small and requires a wrench	Fairly accessible but requires a wrench	Inaccessible under bonnet over hot motor	Fairly accessible but requires a wrench	Fairly accessible but requires a wrench
Appearance	Distinctive and high grade	Conventional design but not distinctive	Conventional design but not distinctive	Rather freakish but distinctive	Good lines and distinctive	Good and distinctive
General Finish	First class in every respect	Fair	Just fair	Fair	Excellent	Good
Equipment	Complete	Complete	Poor—no clock	Fair	Complete	Fair—no clock
Door Action	Solid, quiet and with inside and outside handles	Somewhat tinpanny. No outside handles	Somewhat tinpanny. No outside handles	Solid and quiet, but with no outside handles	Solid and quiet, but with no outside handles	Solid and quiet, but with no outside handles
Side Curtains	Particularly good tight job and with door curtains swinging with doors	Not very tight and inconvenient on account of no outside door handles	Very poor and do not open with doors	Poor and do not open with doors	Very poor and do not open with doors	Fairly good but inconvenient on account of no outside handles
Vision under top and windshield	Excellent	Good	Poor	Poor	Good	Good
Top	Well made, of best material and lined	Well made, but bad color and unlined	Fair material and workmanship but unlined	Fair material and workmanship but unlined	Well made, of best material and lined	Good material and workmanship and lined
Upholstery	First class in every respect	Good, but front seat too soft	Good	Hard	First class in every respect	Good
Windshield	First class in every respect	Not tight	Not tight	Not tight	First class	First class
Detail Finish	Excellent	Good	Fair	Good	Excellent	Good

Of course, I realize that it is very hard to make a chart of characteristics as just outlined, and have it convey exactly the right meaning, simply because the human element enters into both the arranging of the information and also interpreting it.

In order to understand the difference between the Packard Twin Six car and various other cars, it is necessary to ride in the various cars in question, and it is also desirable to drive them, because in driving the car it is possible to get very much better acquainted with its various characteristics. The comparisons just made, therefore, are not intended to convey actual information so much as to point out important characteristics, with the hope that it will enable our salesmen to actually check these points up themselves and thereby become educated in a way that will enable them to answer all questions promptly and intelligently.

This chart should be studied very carefully, as it indicates the value of the Twin Six motor. For instance, this very powerful motor drives our big luxurious car ten miles or more to the gallon of gasoline, under average touring conditions, *although it is the most powerful motor of any listed in the chart, which results in our car having more ability than any other.*

In spite of the fact that our car excels all others in ability, it should be noted that *it still has the highest tire economy.* This is partly due to the fact that we equip with the Goodyear Cord tires, which is the best that can be obtained, partly due to the fact we use ample size of tires, but in my opinion this result is *very largely due to the smooth even torque of the Twin Six motor.*

A good clutch and good brakes of course help to contribute toward this result.

This chart contains so much information that it would be impossible for me to discuss each point in detail without making my talk entirely too long, and I

will therefore not attempt to do so, but as soon as I am through I shall be very glad indeed to answer any questions that may be brought up regarding any of this information. Let me urge that each one of you study this chart very carefully and when opportunity presents check up the various information regarding other cars.

I might mention in this connection that I never have been able to properly size up a car by driving it for a short time. To properly appreciate the difference between cars, it is necessary to drive the car that is to be compared with the Packard Twin Six for several days without getting into any other car. In this way only can one become thoroughly familiar with its action; or, in other words, get into the same condition that an actual user of that car would be in. After getting into this condition, and then stepping back into a Packard Twin Six, any one will be able to fully appreciate how a user of that car would feel when first getting into the Packard Twin Six for a drive or ride.

Having now covered a lot of generalities, I want to come down to a more detailed discussion of the most important feature in the Packard Twin Six car, that is, the Packard Twin Six engine itself. To those who are really motorwise, it is, of course, unnecessary to discuss the merits of this type of engine, as amongst that class of people it is now conceded that the Packard Twin Six is the highest possible type of motor car motor, but there is so much blue sky advertising being done about other types of motors that I think it advisable to review the matter.

In this connection, I would like to quote from my letter to Mr. Mack, our dealer at Albany, under date of August 15, 1915, as a year and a half's additional experience with the Twin Six has not proved a single statement in that letter wrong, but has simply served to strengthen the views set forth:

"I am just in receipt of your letter of the 13th enclosing copy of letter containing comparison of advantages and disadvantages of six, eight and twelve cylinder motors by Mr. David Fergusson, Chief Engineer of the Pierce Arrow Motor Car Company of Buffalo, New York, and will comment on the arguments contained in that letter as follows:

"Taking the comparison that Mr. Fergusson makes of a 38 horsepower size of engine, I have proved by actual experiments that a six, eight and twelve-cylinder engine of this size will *not* develop the same horsepower from 300 to 1500 r. p. m., as suggested. *The six-cylinder will develop the poorest power, the eight the next best and the twelve the best,* simply because as we make the pistons smaller, we can carry the compression higher, thus resulting in more power developed per cubic inch of gas. The reason we can make the compression higher is because the smaller piston is easier to cool and we, therefore, do not get pre-ignition from higher compression and, on the other hand, on account of exploding a smaller quantity of gas in each cylinder, we can explode it at higher efficiency without having the blow great enough to produce unpleasant power impulses.

"To put it another way, comparing the 6 and 12 directly with the 6-cylinder engine we get but three impulses per revolution and even though you could take care of pre-ignition, there is a definite point beyond which you can't carry the force of each explosion without having the engine appear to be rough at low speed on account of the violence of each power impulse. Now if you double the number of cylinders, you, of course, double the number of impulses and with an engine of the same power, halve the violence of the explosions. You will readily understand that this brings the violence of each explosion down to a point where it is possible to build up some more efficiency by slightly increasing

the violence of each explosion without having such explosion of sufficient magnitude to become objectionable.

"I believe that you appreciate the fact that our 3-38 engines were good performers and so far as I know, they have never been equalled by any other 6-cylinder engine of the same piston displacement. The Twin Six is of practically the same piston displacement, that is, 424 cubic inches, as compared with 415 cubic inches of the 3-38, yet the Twin Six motor develops 10% more power between 300 and 1500 r. p. m., thus directly disproving the first statement made by Mr. Fergusson.

"As the 1-35 equipped with the Twin Six motor is approximately 300 pounds lighter than the 3-38 and has 10% more power up to 1500, as outlined above, you will realize that we could have used our 3-38 gear ratio, and secured an excellent performance. I have driven the Twin Six cars with this 25-mile gear ratio and found its performance to be wonderful. As this motor has the ability, however, to turn up to extremely high speed without any undue strain on the bearings, we decided to make the gear ratio slightly lower in order to give our customers a measure of ability that would be absolutely satisfactory under all conditions. We, therefore, adopted a 23.5 mile gear ratio, or, in other words, at 900 r. p. m. in the Twin Six the car runs but 1½ miles slower than last year's 38. So you will see that the five to one argument does not apply. Mr. Fergusson probably refers to some small 8-cylinder cars—probably 100 cubic inches smaller than their 38, and, in that case, it is, of course, necessary to use a low gear ratio in order to haul around a fairly big car.

"While I have shown by the above that we are not running our engines at extremely high speeds, I still want to make the statement that we could run it at extremely high speeds and have it safer than a 6-cylinder

motor at considerably lower speeds. I will give you the following facts and figures to prove this statement:

"In all modern automobile engines, it is the force due to inertia that is hard on the bearings rather than the power stroke. By this I mean that the force required to stop and reverse the reciprocating parts at the end of the stroke is the one that tends to wear out the bearings at high speed. Comparing our last year's 3-38 single six-cylinder engine with this year's Twin Six of practically the same piston displacement, figuring the forces due to inertia, we get the following very illuminating information:

"Considering both engines running at 2000 r. p. m., it required 2130 pounds to stop the 3-38 piston assembly at the end of the stroke, whereas it only requires 492 pounds to stop the Twin Six piston assembly at the same speed. Under the same conditions, it requires 1030 pounds to stop the upper end of the connecting rod of the 3-38 and 430 pounds in the Twin Six. Taking the gross inertia effect of all pistons and connecting rod upper ends, we obtain a figure of 12,780 pounds for the 3-38 and only 5900 pounds for the Twin Six. This is, of course, counting 12 pistons and connecting rods for the Twin Six and 6 pistons and connecting rods for the 3-38. Even if you figured the maximum speed of the 3-38 to be 2000 and the maximum speed of the Twin Six to be 3000, the inertia forces, and, therefore, the bearing pressures, would be less in the Twin Six than in the 3-38. Actual running of these motors on the dynamometer has proved that the Twin Six will stand up better when running constantly at 3000 than the 3-38 will at 2000. We are not guessing about this—we know.

"This principle has been thoroughly proved out in modern racing car design. A few years ago, racing cars were equipped with large, slow speed motors and whenever an attempt was made to slightly speed these motors

up in order to get a little additional speed, a lot of trouble would develop in connecting rod bearings, pistons, etc. The size of racing motors has been gradually reduced and the speeds increased until the modern racing car engine is about half the size, in total piston displacement, that it was 3 years ago, yet speeds have increased at an enormous rate. A number of races have been won in this country this summer where the average engine speed was around 3000 and much above that figure for a good part of the race, yet practically no engine trouble has developed. In fact, there has been a great deal less engine trouble than used to be experienced with larger engines running around 2000.

"Now in regard to the length of the 12-cylinder engine, you, of course, know that it is not longer than the Pierce, although it is designed with L-head cylinders for higher efficiency. Pierce, of course, uses T-head construction to get the shortest possible motor, but this type of engine can never be built to have any great amount of efficiency.

"We build our Twin Six with 3-bearing crankshaft because there are good reasons for making it that way. It would take too long to go into this by letter, but I will make the broad statement that the main bearing pressures of our Twin Six construction are considerably lower than they were in our Single Six of last year with 7-bearing crankshaft, and lower than any other 6-cylinder with 7-bearing crankshaft that I know of.

"So far as ignition is concerned, we, of course, have thoroughly proved out our Twin Six ignition before adopting it, and I can assure you that it has proved to be at least equal to magneto ignition up to 2000 r. p. m. and better than magneto ignition above that point.

"So far as the chain front end is concerned, there is

no reason why we could not have used gears, and gears would have been cheaper, but we have succeeded in designing a chain front end with an adjustment that is so much better than any gear front end that we know anything about, that there is no comparison. I have driven my personal car over 9500 miles without even taking up the chain and it is running absolutely quiet today, although a considerable part of this mileage has been made on the Speedways during test work at speeds above 70 m. p. h. I do not know of any gear front end that will stand this kind of work so well.

"So far as gasoline consumption is concerned, I know that our Twin Six engine will develop more horsepower per gallon of gasoline than any 6-cylinder engine that has ever been built, and this statement is proved by the records of our demonstrators.

"In conclusion, I would like to state that there is nothing particularly new or experimental about our Twin Six engine. It is simply a well-designed, small, L-head 6-cylinder motor of 3-inch bore by 5-inch stroke with an additional set of cylinders, pistons and connecting rods set at an included angle of 60 degrees.

"I think the best proof of my statements above is the fact that automobile engineers throughout the country have had so few criticisms to offer against this new car.

"It is, of course, to be expected that an engineer in the employ of a company that had nothing but 6-cylinders to sell should be loyal to his company and dig up all the arguments he can offer in favor of their product. The Twin Six is so clearly right in principle, however, that it is very hard to dig up arguments against it and I, for one, would not like to have the job of digging up those arguments.

"I am very glad, indeed, to have a chance to write you about this matter and if you hear of any more so-

called arguments against the Twin Six, please send them along and give me a shot at them.

"If you have not already done so, I strongly recommend that you carefully read the little booklet entitled "How Many Cylinders?"

"This little booklet is particularly interesting because it contains the results of exhaustive experimental work with various types of motors, and we are probably the only concern that have had a chance to compare 6 and 12-cylinder motors of the same cubic inch piston displacement brought up to the same standard of engineering. The fact that we did make this careful comparison and then abandoned our high-grade 6-cylinder motor and all the expensive tools that we had for making it, is conclusive proof that there were sound engineering reasons for making the change."

When the above letter was written we had not, as yet, delivered a single Twin Six car manufactured from tools. We had only had our experimental experience plus the experience of the fifteen demonstrating models which were built by hand and put out with our representatives to be used solely for demonstrating purposes. Since that time we have manufactured and delivered approximately 14,000 cars without making any changes outside of minor refinements, which were incorporated in the second series.

The fact that these cars have been purchased promptly by the public and that we have been able to manufacture and deliver an output of Twin Sixes three times as great as our largest output of six-cylinder cars in an equal time, is conclusive proof that we made the right move in abandoning the six-cylinder principle, even at the enormous expense involved.

I think it will not be out of place at this time to briefly review the history of Packard engineering. In

the beginning, the Packard Company was founded on an ideal. The men who founded the Packard Company had one big idea in view and that was to build the best possible motor car. During the first few years' existence of the Company practically all the work was engineering work, because at that time very little was known about motor car construction and it was necessary for the engineers of the Packard Company to delve into absolutely an unknown field.

Gradually the Packard organization began to grasp a number of the essentials, with the result that the first 4-cylinder Packard car to be marketed would actually run smoothly and possessed a fair degree of reliability. This was, however, but a stepping stone, as the spirit of the Packard organization made it necessary to push on for further refinements.

The 4-cylinder car was improved year after year until finally a point was reached where it seemed impossible to make any further improvements. How well this work was done can best be judged by the fact that there is not a 4-cylinder car in existence today that runs as smoothly and quietly as the later models of the Packard "30." Realizing that they had about reached the limit in the development of the 4-cylinder motor, Packard engineers began to cast about in an endeavor to find the next logical step.

There were at that time some 6-cylinder cars on the market, but they were more or less unsatisfactory on account of oiling troubles, carburetion troubles, crankshaft whipping troubles, lack of efficiency and numerous other difficulties too numerous to mention. Packard engineers, however, tackled this problem with their usual thoroughness, and finally produced the 12-48 which immediately became the most active car on the road. The following two years were devoted to the improving of the "48" 6-cylinder car, and the bringing

out of a smaller 6-cylinder car known as the "38."

Attracted by the personnel of the Packard organization and their ideals, as well as the quality of their output, I had, for several years, been desirous of becoming associated with them and when Mr. Macauley offered me the position of Chief Engineer in the Fall of 1912, I promptly severed my connection with the Hudson Company and cast my lot with Packard.

When I came with the Company, plans were just being drawn for the 2-38 and the 4-48, and I had the pleasure of assisting in the development of these models, It was after we had finished the development work on the 3-38 and 5-48 models that we began to realize that we had again about reached the limit of the possible development in the type of motor which we were manufacturing. This was in the summer of 1914, and we had for more than a year been carrying on exhaustive experimental work in the drafting room, laboratories, and on the track in an endeavor to find the absolute limitations of six cylinders. At that time our 6-cylinder motors carried about 60 pounds compression and when well worked in would deliver 70 H. P. at about 2100 r. p. m. These cars would run about nine miles per gallon. We found that by lightening up the reciprocating parts to the limit and increasing the compression to 75 pounds we could increase the gasoline economy, as well as the power, but motors built in this way were quite rough at low speed on account of the intensity of each explosion, with the result that they were unfitted for any kind of ordinary driving.

After a careful analysis of the problem, we decided that it would be necessary to increase the number of explosions and decrease their intensity in order to obtain the proper degree of smoothness with the increased power that we desired.

The next step was to determine how many cylinders

we should adopt. At that time eight cylinder cars had been manufactured in Europe for several years, but they had never become very popular. We took up the study of the 8-cylinder motor very carefully, however, in order to determine its good and bad points. After going into the matter exhaustively, we decided that the eight was better than the six, at low speeds, but that it was not as good as the six at the higher speeds on account of its inherent vibration, due to the 4-cylinder principle involved.

We next took up and considered carefully the 12-cylinder, or Twin Six type of motor. At that time there were no 12-cylinder cars being manufactured, either in this country or abroad, and so far as we know only two or three 12-cylinder motors of any kind had been made, and these were made by the Sunbeam Company of England for racing purposes.

After careful analysis, the Twin Six principle looked so good that we determined to build an experimental car. The experimental car proved out right up to our expectations, with the result that we decided to abandon all our old tools and re-arranged the factory to bring out an entirely new model.

The officials of the Packard Company were so much pleased with the qualities of this new car that they immediately gave orders to prepare to manufacture them in much larger quantities than we had ever produced Sixes. You are, of course, all familiar with the fact that it was the decision to manufacture in larger quantities that enabled us to reduce the price, as the Twin Six car is more expensive to manufacture than the 3-38 was, if manufactured in similar quantities.

It is very gratifying to the Packard engineering organization to note that their judgment regarding the 12-cylinder construction has been so thoroughly concurred in by the engineers of the warring nations in

connection with aircraft motors. Aircraft motor development has been going forward feverishly during the last two and a half years in Europe, and the concensus of opinion at the present time is that the 12-cylinder V-type is the best possible construction, where high power, coupled with absolute smoothness and reliability, is important.

You have all had a chance today to go through the Packard aircraft motor department, and to examine the high class type of design, material and workmanship that is being put into these motors. The Packard Company took up the development of aircraft motors for various reasons. In the first place, we are patriots and realize that this country is liable to need high-class aircraft motors, and we knew that there was nothing being manufactured in the United States that would compare favorably with the latest motors being used abroad. In the second place, we knew that the development of this type of motor would be an additional education to our engineering and factory organizations, and we are always anxious to take up anything that will accomplish this result and tend to raise our product to a still higher plane.

I know of no company in this country that is spending anything like the effort and money the Packard Company is spending for development work, and it naturally follows that we are getting farther and farther ahead of everyone with our engineering and manufacturing development. I venture the statement that there is not another Company in the United States that could manufacture the Packard aircraft motor, even if they were given all drawings and specifications, without first going through at least a year's educational work. I think that this is worth thinking over.

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