DISCUSSION.

Mr. WILLIAM SINCLAIR said that he wished to propose a hearty vote of thanks to Mr. Shirra and to Mr. Boult for their very interesting papers. The last time he had anything to do with Nominal Horse Power of Steam Engines was when he was trying to show a shipowner what it meant; he had a wages board award in front of him, and the two of them had a pretty bad time. He thought afterwards that so far as Australia is concerned, seeing that the great question is wages, why should they not work on the Indicated Horse Power wherever possible? Supposing there are auxiliaries on the ship, then add a percentage for the freezer, electric light engine, or whatever else there may be. Then when matters are complicated by a combination of turbines and reciprocating engines, or turbines only, they would probably have to fall back on the boilers.

The speaker remembers some time ago coming across a book dated about 1840, and although at that time he did not think there were any registration conditions of the present kind, the author of the book had fully five or six pages devoted to N.H.P. Rules. They were, he thought, evolved from the author's own practice, and, as Mr. Shirra has shown us to-night, there have been a tremendous number of rules evolved since.

Mr. Shirra, in his opening remarks, said that, with the exception of marine engines, the term Nominal Horse Power was practically dead; unfortunately it is not. In land boilers, for instance, the term is constantly occurring, and both land and marine engineers are getting into trouble over it. He thought that for small engines up to, say, 20 H.P., a Brake Horse Power would be a satisfactory expression.

Then with regard to boilers, one of the commonest forms in Australia is the "Colonial" type. He thought that probably every maker of that type in Sydney and Melbourne differed with regard to what is the Nominal Horse Power of their production. They will all tell you something different. Some will give you as a basis the heating surface; and the speaker thinks that is a step in the right direction, for the evaporative capacity of a boiler is certainly the best measure of comparison. When the gas engine came on the market they were not rated on the Nominal Horse Power, but on the Brake Horse Power; this used to be a very simple matter, but it is not so now. One really gets confused with all the various ways in which the term, which forms the subject matter of the discussion to-night, is used.

He had much pleasure in moving a hearty vote of thanks to the writers of the papers put before us to-night.

Mr. A. J. ARNOT remarked that he had very much pleasure in supporting the vote of thanks. Mr. Shirra has dealt very completely with his subject, and he has brought before us a lot of old and obsolete formulae which many had to some extent forgotten, for the simple reason that they do not have to use them. He has also brought forward a formula which is a reasonable one, and which might be adopted with much more satisfaction than the earlier ones he referred to. The origin, as, of course, we all know, of the Nominal Horse Power was undertaken by our old friend Watt. He arrived at the conclusion that 33,000 foot pounds represented one horse power per minute, and he estimated on a mean pressure in the cylinder of something like 7 pounds. On that basis was obtained the Nominal Horse Power. Of course, the mean pressure in steam cylinders now is considerably more. The use of the Indicated Horse Power is very much more satisfactory, as has been mentioned to-night, and it is to be recognised that the paper was dealing with the question of Nominal Horse Power and the adoption of a more satisfactory measure. The best way

to get over the difficulty is to drop the old term altogether, because there will never be a satisfactory solution, or any satisfactory formula, that deals casually with certain factors only. The whole of the factors should be stated in any formula, and in every individual case, so that whether it be a turbine, or reciprocating engine, or an oil engine, each must be dealt with separately. Hence he thought that the Indicated Horse Power of a steam engine is undoubtedly the measure that ought to be generally adopted, and the term Nominal Horse Power dropped entirely.

The term is always causing trouble. In his own business, the speaker would like to say he was always "up against it." Very often he is asked what is the meaning of it, and it is a matter of considerable annoyance, inasmuch as he has practically to say that he cannot give an explanation. It ought to be dropped, and he would like to take this opportunity of emphasising the fact that we, as engineers, ought to protest against the common use of the term, as it is so frightfully misleading in every direction. If we can only confine ourselves to the actual Indicated Horse Power of an engine, or the evaporation in the boiler, we will be doing the right thing. We do not refer to the heating surface in order to indicate the horse power of a boiler; in every case, as a rule, it is the evaporation that is spoken of. This, it is known, indicates correctly the capacity, or power, of a boiler.

As to the R.A.C. Rating, he knew it was also weak, and there certainly ought to be some other satisfactory method of arriving at the power of a car engine.

The papers have been extremely interesting, and he felt very much indebted to both Mr. Shirra and Mr. Boult for them, and he had very much pleasure in supporting the vote of thanks.

Mr. R. R. FERRIER said that he had not intended saying anything to-night, principally because he really could not work up sufficient interest in the subjects. In his

experience he had always gone on the one rule, and that was to have nothing to do with the term Nominal Horse Power, because he thought it is a subject that leads to a great deal of controversy and very little satisfaction. After looking at the various formulae placed on the blackboard by Mr. Shirra, it is clearer than ever that the term is misleading, because of the wide variations. This means that it is practically useless, and we ought. as Mr. Arnott said. simply try and get the term Nominal Horse Power expunged from use. That is the main point that should be aimed at, and if it is necessary to have something more useful, but similar in its application, then he thought it might be well to have the experts of the Department to which Mr. Shirra belongs devise some good rule with which we would be able to satisfactorily determine the relative powers of engines. As a matter if fact, when one comes to think of it, if 50 examples were taken of steamers in Sydney, it would be found that the principal factor considered is the coal consumption. This is the main point, and is more important than anything else, because, after all, it can safely be said that steamship owners are going to measure their results thereby; and, if this is the case, then it seems that some rule based on the coal consumption would be a true measure for registration or other purposes. Of course, coal varies in quality, but when it comes to that, we might get right down to the actual amount of "coal consumed per day," and be much nearer the measure of work done in a ship than by rating its power according to the fallacious rule now used.

To sum it all up, we ought to raise our protest against the continued use of this old-fashioned term of "Nominal Horse Power," and should this Association have anything at all to do in connection with the matter, even if an Act of Parliament determines the course, we should protest upon the ground that the term is of no value, and is very misleading

Mr. WALTER REEKS said that he thought the Association was very much indebted to Mr. Shirra and to Mr. Boult for their papers to-night. He thought Mr. Shirra struck the nail right on the head when he used the word "Normal" in relation to the Horse Power, as distinguished from "Nominal Horse Power." He did not desire to make a long speech, but he thought Mr. Shirra got down to bed-rock when he used the term "Normal Horse Power," and if the word "Normal" could be made to supercede the obsolete word "Nominal," he felt sure that if the "Normal Horse Power" was derived by the formula suggested by Mr. Shirra, then confusion would disappear. He thought the word an excellent one, and that Mr. Shirra should be thanked for the introduction of it to-night. Shakespeare wrote:— I thank you, Jew, for teaching me that word." Well, I think Mr. Shirra has applied the right word in the right place, and that we should attempt to use it in the future.

Mr. BAYLISS said that he thought the formula

$$\frac{n d^2 s r}{12500}$$

was a very satisfactory one for oil engines. He also referred to the very much higher speed, or number of revolutions, that many motor car engines ran at, and which could not be reasonably estimated for horse power according to the ratings dealt with.

THE AUTHORS' REPLY.

Mr. SHIRRA, in reply, said he did not propose to do away with the term "Nominal" Horse Power, but to give it a definite meaning, which it certainly did not have now. In introducing the subject, he said it was necessary, given the principal dimensions of a steam or other prime-mover, to state the probable rate at which it will work under normal conditions, and the power thus calculated ought to be

known as the N.H.P. Indicated, brake, or evaporative powers are all very well, but the engines or boilers have first to be made, and then tried experimentally to get these; and if they are to determine the official rating, possibly a week's trial at full power and by a factory inspector will be needed. But surely some rational rule for estimating the power beforehand, and taking all the factors into consideration, can be devised; and such he had endeavoured to set out. It would give the "Normal" power, but he did not propose to alter the word " Nominal " into " Normal," the two words were too much alike. "Estimated" horse-power would be better if a change were to be made, but we already have an E.H.P., viz., the effective, or brake horse-power. We might state the power in kilowatts, for the watt is really a mechanical unit, though it has been popularised by electricians; it is derived from force and velocity data in the centimetre--gramme-second system, as the horse-power is on the foot-pound-minute system, and the electrical units of volt and ampere have been chosen to fit into it. There is approximately a very simple relation between horse-power and kilowatts; a horse-power is very nearly three-fourths of a kilowatt, and a k.w. 1 1/3 h.p. "Nominal" horse-power, as at present the term is used, is a meaningless absurdity, however, and of no quantitative value.

He had not found fault with the endeavour made in the new Navigation Bill to determine a standard for referring the engine-room manning to, but he did so as to the vagueness of the formulae given, and especially protested against the proposed standard being called a Nominal Horse Power.

Mr. Boult had shown that the rating of motors was getting into the same state of confusion as that of steam-engines; and this was mostly through calculating on the piston area only, as in the R.A.C. rule. The rule which

takes cylinder capacity as the basis, or $d^2 \times$ stroke, is also incomplete; and these rules, giving approximately correct results sometimes, can only be due to accidental coincidence. Revolutions per minute should be given, as well as the diameter and the stroke; and then, since the mean pressure in an oil motor cylinder is much more uniform in different cases than with steam engines, and may be taken as from 80 to 90 lbs. per square inch, the formula N.H.P. $= \frac{nd^2sr}{12000}$, gives reasonably approximate results. This supposes a mean pressure in a four-cycle cylinder of 84 lbs.; the same formula was mentioned already in the discussion, with a divisor of 12500, which assumes about 80 lbs. mean pressure. But with large diameter cylinders the mean pressure will be higher than with small ones like those of motor-cars; and the speaker was most interested in large cylinders like those being tentatively used in ocean-going motor-ships to-day.

If revolutions are not given, we must assume a normal piston speed which will depend on the stroke, but which might be higher than that he had taken as the normal piston speed for steam engines, say twice as much, or $333 \sqrt[3]{s}$, in inches. The revolutions would then be $\frac{2000\sqrt[3]{s}}{s}$, and if we substitute this quantity for r in formula above, $\frac{nd^2sr}{12000}$, we get N.H.P. $= \frac{nd^2\sqrt[3]{s}}{6}$, which seems the best formula to rate motors by when only the number of cylinders, diameter, and stroke are given. The engines of motor-cars may run at many more revolutions than this formula gives, but such high revolutions are often preposterous and un-practical; for marine motors it gives a fairly high but not excessive speed of revolution; thus a motor with 8 inches stroke would normally run at $333 \times 2 = 666$ feet per minute piston speed, and $\frac{2000 \times 2}{8} = 500$ revolutions per minute. But the large marine motors of sea-going boats, already referred to, do not run so much faster than steam-engines of the same stroke, although they may yet be speeded up.

In his reply, Mr. BOULT put before the meeting three Ratings that have been under consideration in England, the first being that proposed by the R.A.C. Technical Committee— $.45\ (d+s)\ (d-1.18)\ N-A$

The second was a modification thereof preferred by Mr. Dugald Clark, the well-known expert—

$$.27\ (d+s)\ (d-1.18)\ N-A$$

and the third was Marshall's formulae—

$$\frac{NSD}{12} \qquad \frac{NSD^2}{200000}$$

The first for calculating the horse power when the bore and stroke are given in inches, and the second when these dimensions are given in milimetres. Both of these formulae have been designed to meet the requirements of engines working at a normal speed of 1,000 revolutions per minute. The observations made by Mr. Bayliss dealt purely with what are popularly called "freak-cars," and which did not need to be seriously considered in the adoption of a Rating for general purposes.