for the multitude of duties that even a small vessel finds imperative. One connection that may be mentioned is that which allows of transferring water from the fore peak to the aft peak tanks.

These vessels are essentially timber carriers, and all deck machinery is installed with this in view. The winches are all fitted with slewing barrels, which permits of one man doing the two operations of lifting and slewing. The later vessels have electric light, and small refrigerating machines have also been installed for handling perishable produce.

Discussion.

The President called on Mr. Shirra to propose a vote of thanks to the authors of the paper.

Mr. Shirra said it had been a great pleasure to him to have heard the papers read that evening, and he considered it a very good thing to have put on record the experience of shipbuilders. He had a few remarks to make, but was speaking from general knowledge only.

With regard to sections shown in Fig 1, he considered they looked rather weak. Referring to the heavy wooden knees introduced in this type, he understood they required a great deal of labour to fashion, and were very difficult to procure at the present time, they must certainly be very carefully selected "crooks," and as such were hard to handle when of any size, and he thought it a very difficult thing to obtain a proper frame, as the fastenings were not always good. Sometimes iron knees with galvanised iron bolts were used as stiffeners. He preferred the design in Fig. 1 to that in Fig 2. The lattice girders certainly appeared efficient, but as they appeared to be shown for use in a cargo carrier they took up too much space. It would be far better if they could be built into the ship's side. The placing of longitudinal

timbers as shown in Fig. 4 is the correct way. Transverse frames were once universal. It is now difficult to get longitudinals of any fair length, and the jointing by scarfing is always weak owing to the give of the bolts.

If the lattice girders shown in Fig. 4 were in the ship's side, they would take up some of the wracking strains now taken by the knees. In Fig. 5, if interlacing beams in the form of a raft were provided, vibration would be overcome somewhat.

Some modern ships have no bilge, but a chine; a bilge in a ship was a good feature, for it prevents rolling in a seaway very much.

Mr. Sinclair's paper deals with the engines of modern steamers. A few years ago it was quite a common thing to hear of broken tail shafts. This was due no doubt to the makers supplying shafts of too light a section, perhaps with the object of avoiding the introduction of heavier bearers and increased metal in the scantlings. Another frequent cause of breakage was a sudden change in section. He was glad to say that a decided improvement has been noticed since the stern liners have been carried well into the propellor boss.

In large, deep draught steamers, it is not a bad plan to run a pipe out from one of the water tanks so that the run off may wash the sand and grit from the spacer in the tube.

With regard to Mr. Gyler's invention, he would say it was a good one, and he was very glad to see it brought forward at this meeting, so that it may be introduced in such a paper as this in our "Proceedings." The principle of wood, iron and steel ships was the same, with perhaps the exception met with in the fastenings of the members together. It was more difficult to obtain a good fastening in a wooden ship than in one with a metal

hull. Builders were apt to stint the yellow metal fasteners, so indispensable to a good joint, when engaged upon wooden construction. He again thanked the authors for their contribution.

Mr. Payne said he was sure that the ingenuity of the designers and builders of the coastal ships of to-day, in providing ships to suit the peculiar local conditions, was deserving of the highest praise. He felt he could not say very much on the subject, but he had great pleasure in seconding the vote of thanks to the joint authors of the paper.

Mr. Gyler (visitor) said it used to be the usual thing to change the shafts on some of the small coastal steamers about three times a year, but since the introduction of the sandproof joint referred to by Mr. Sinclair, he could assure the members that the shafts now had a life of as many years as they previously had in months. The essential feature of the invention, as could be seen by reference to Fig. 2, consisted of the introduction of the compressible rubber ring which prevents foreign substances from entering the space between shaft and sleeve. He would say that another reason for frequent breakage of shafts was that small vessels often had to bump their way over the bars, and if sand, etc., had worked into the bearing a "fulcrum" existed, which, with the weight of the propellors and the working of the ship, caused a breakage at the part referred to.

The oil in the space between shaft and sleeve was either let in by gravity or forced in by a slight pressure by a small pump. The oil used was a saponifying oil, and the pressure generally 5-6 lbs. per sq. in.

Mr. Burnside said he had a few points he would like some information upon, and perhaps Mr. Reeks would inform him as to these. First, how were the main keelson and bearers fastened; and secondly, in what manner

were deck strengtheners provided for in the boats under consideration? He asked for this information because he was mainly interested in harbour steamers, and thought that the design of these corresponded a great deal with that of the small coastal steamers.

Mr. Doran said that, not being an engineer, he could not contribute anything to the discussion, but as a representative of one of the large harbour ferries he had been greatly interested in what he had seen and heard this evening, and thanked the authors for the privilege of being present.

Mr. Fildes said he would like some further information as to the meaning of the apparently low figures given for steel and wood in Fig. 8, viz.:

.24 in wood vessels.
.17 in wood vessels.
1.92 in steel vessels.
1.131 in steel vessels.

With regard to Mr. Shirra's remarks re girders, he had had some experience with this type of stiffening in a gold dredging plant with which he had to do some time ago; in one instance, a girder was carried along the main timbers, and in another a series of diagonal planking was carried from stem to stern.

Mr. Tournay-Hinde drew some diagrams to illustrate his remarks respecting the method of bracing hulls by means of longitudinal girders and diagonal braces.

Mr. Hasemer said he was surprised to hear Mr. Sinclair's statement about Scotch and Colonial boilers, then with regard to Mr. Reeks' remarks re the advent of steam in the coastal trade, he took it that the reference dealt with the introduction of the present type of cargo carrier on the coast. The question of "hogging" was certainly a very hard one to meet, and one that the

builders had devised some very ingenious methods to overcome. He rather thought that too much deference had been given to the "bush builder," when in reality the city builder had just as big drawbacks to fight against, such as freight on raw materials and labour conditions. The building of any vessel, whether for foreign or coastal trade, is going to be a question of standardisation, in order that we may compete with other parts of the world (take, for example, all the American yards, which, as we know, since the war have practically adopted a standard ship throughout). How can we expect to compete unless we classify and standardise on similar lines to those adopted by our competitors? He thought we must do this if the shipbuilding industry is to be firmly established in the Commonwealth. He did not quite agree with the authors on the question of composite ship construction, for he did not consider it good practice to bury iron in wood owing to the harmful action that took place between these materials when damp affected them both; one would rust, and the other rapidly decay.

The question of stiffening plates along the deck of wooden vessels had also had his attention, and he recalled an incident where a plate had been laid "in the flat" along the deck of a certain wooden ship to stiffen it, when an old and experienced workman said that such a proceedings was wrong and against all good practice. He (the speaker) quite agreed with this, and would say that such means of attempting to stiffen a boat was only throwing good material away and wasting money.

He had pleasure in supporting the vote of thanks to the authors.

Mr. Marriott said he would like to ask Mr. Sinclair the reason for the installation of two suctions for the circulating pumps—why would not one suffice?

Say, for example, the top opening of the two. Perhaps Mr. Sinclair could give the reason for the apparent anomaly.

Mr. Russell Sinclair said he was much struck by a series of papers delivered by Major Denny, in which he suggests a square section of the new concrete ship now exercising the minds of builders and designers in the United Kingdom and elsewhere. From the data given in the paper referred to, it appears that the "straight line" method of building a ship did not put her to a great disadvantage as regards the drawing of the hull through the water. He was inclined to think that Mr. Reeks favoured steel ships for our coastal service, but he considered that even in 10 years' time we would not see the wooden ship replaced by the steel vessel on the coast.

He had had considerable experience with steel vessels on the coast, and would say that the erosion of the steel plates due to bumping on the sand bars at the entrances to the rivers was a thing not to be too lightly regarded. Then a further trouble was that, owing to the bumping and straining of those small vessels when thrashing up against a strong N.E. wind, the rivets were often started in the bottom plates. One instance he particularly remembered was where, after such an occurrence, the ship's bilge was filled with concrete, but even this did not have the desired effect, and it was not until the first concrete was removed and substituted by well reinforced ferro concrete that the vessel could be said to be absolutely seaworthy.

Mr. McEwin: I would like to join with the others in thanking Messrs. Reeks and Sinclair for the extremely interesting matter which they have prepared for this meeting.

Mr. Reeks suggests that ships may be built soon of something better than steel. I would suggest reinforced concrete as a better material than all steel, for present conditions at least. For this material the cupboard skeleton mentioned by Mr. Reeks has no terrors. Concrete vessels have a low first cost, low cost of maintenance, and low repair cost. Moreover, standardised concrete vessels could be constructed at a faster rate than wood or steel vessels, and could be more quickly repaired than either of the latter. It is quite true that the special conditions on our coast which give trouble in the design of wooden or steel vessels would cause the same trouble in the design of concrete vessels, and possibly greater trouble. In other countries, however, concrete craft are being constructed of all sizes up to 7500 tons carrying capacity, and for a great variety of purposes. We may safely assume, then, that problems just as difficult as our own are being met and disposed of satisfactorily elsewhere.

Since I brought this subject before the members of this Association in July last, remarkable progress has been made in other countries in the method of ship construction. It is to be hoped that Australian energies may soon be put into the construction of concrete ships, not only for coastal work, but also for deep sea work. This class of shipbuilding is now established in England, France, the United States, Canada, Spain, Holland, Italy, Norway, Denmark, Sweden, and is said to have been taken up in Germany also.

France has launched her first concrete steamer, and is building and launching river tugs and other small vessels. The Scandinavian countries already have concrete ships in service, and are building light ships and floating docks of the same material. In the United States the successful trial trips of the "Faith" have led to the

laying down of a big programme of concrete shipbuilding. Contracts are in hand in England and Scotland for the construction of concrete ships. What has been done elsewhere can be done just as well here, and the public must look to Australian engineers to push this matter on.

With respect to the engines of coastal and other vessels, I would like to draw attention to the rapid progress made, particularly on the American Pacific coast, in the use of semi-diesel, surface ignition, and other oil engines for auxiliary craft. Quite a large fleet of these vessels has already visited Sydney, and I have had the pleasure of inspecting most of them. We must recognise the fact that the oil engine has come to stay as a serious rival to the marine steam engine, and there is no doubt that the use of the oil engined vessels in the coastal service cannot be long delayed, not only in the form of auxiliaries with surface ignition engines, but also in the form of straightout motor ships with full powered diesel engines. There is really nothing to prevent auxiliary engines at least being constructed in Australia in more than one design, and it should be possible before long to manufacture diesel engines also.

Mr. Reeks, in reply, said the diagrams he had presented that evening were from sketches and particulars forwarded by the various "bush" builders referred to in the text of his paper, hence the reason for their not being set out in a more elaborate form. The question asked by Mr. Burnside was an almost impossible one to answer; the jointing depended so much upon the timber at the disposal of the builder. With regard to the strengtheners along the hatches, they were not considered necessary, and unless specially stipulated for were never provided.

In reply to Mr. Fildes, he would say that the apparently low stresses in Fig. 8 were not unusually low, and were worked to in small vessels such as were now under consideration. They were also applicable, however, to vessels of much larger size.

With regard to the proposals put forward by Mr. Tournay-Hinde, they were quite all right, for such a system of stiffening by girders and diagonals is to be met with in vessels designed for special purposes in several countries of the world.

Mr. Hasemer's remarks re the value of the plates laid on the flat certainly demonstrated that they were of not much value when laid in that way. In the reference to the steamer he had shown, which was designed for the State brickworks, this showed that what he had proposed was exactly what had been carried out in the design of that vessel.

With regard to the question as to why the rise in the floors had been provided for, he would say that vessels with flat bottoms often burst the bilges when they get ashore on the bars, and it had been proved that this did not occur with those which had been given a good rise in the floor plates.

He thanked those present for the vote of thanks.

Mr. Russell Sinclair, replying on behalf of Mr. Wm. Sinclair, said that with regard to Mr. Shirra's remarks as to the size of shafts, he would say that they always concurred to the Board of Trade rules, plus 10 per cent. added strength. In reply to Mr. Marriott re the reason for installing two sea valves, he would say that they always provided the lower one to ensure the inflow of water when the vessel was rolling in a seaway.

The President drew attention to the system of crossing the main steam pipes to the engines, and the confusion that might occur by the inadvertent opening of the wrong valve. Well, he would say that even if this were to happen, not very much harm could be done, and, in fact, he had not heard of any complaint in this direction so far.

In answer to a question from the President if any flexible coupling were needed when coupling the main engine shaft to the tail shaft, he would say that this was not provided for in any of the vessels he had been connected with.

On behalf of Mr. William Sinclair, he thanked the members for the vote of thanks.

The President Mr. D. F. J. Harricks, said that at the present time any paper dealing with the question of ships, large or small, was of interest to the community as a whole, and to engineers especially. The authors had dealt with the subject of the small coastal steamers particularly, but there was no reason why those discussing it should not bring into their remarks to some extent the broad aspect of shipbuilding. They could not have anything but admiration for those who had developed the small coastal steamers of N.S.W., and there was perhaps no place in the world where such craft had so exceedingly difficult conditions to contend with. He was particularly interested to notice Figure 4 in the authors' paper.

Some time ago, the C.S.R. Co. had occasion to build a 200-ton lighter, and as the cost of constructing these on the ordinary ship curve lines had so increased owing to the difficulty of obtaining bent timbers for the frames, it was decided to design a lighter with practically flat bottom and flat sides, eliminating all bent timbers and using steel angle knees where necessary. The appearance of this boat out of the water was very much criticised, but in the water she did not appear nearly so unorthodox, and, after some years of use she was so well thought of by those who had to run her that when a second lighter was asked for, the request was made that she should be a duplicate of the first. It had come to light during the last two years that, even in the construction of the large standardised American wooden steamers, many of these have been built on absolutely identical lines, the usual ship curve lines being eliminated and straight lines substituted. If the model of the lighter referred to and the model of the 300ft. long standardised American wooden steamer were placed side by side, it would be really difficult to detect any real serious difference in general form. Again, in the construction of the 7000-ton concrete steamer, "Faith," recently launched in America, it is

striking to notice that almost exactly the same model had been adopted, practically a flat bottom and flat sides for perhaps two-thirds of the length of the hull, with, of course, sweeps forward and aft somewhat upon orthodox lines. What had struck him forcibly about this was that certain naval architects seemed to have come to the conclusion that very little sacrifice was made in speed on account of this unorthodox design for even large steamers. Mr. Sinclair had referred to the standard design recommended by a leading shipbuilder of Great Britain, and this again was similar. To some extent, of course, the design had been affected by the necessity for quick and easy construction, but even so it seemed to him likely that no serious reduction of speed was expected.

Mr. Reeks had taken the precaution of allowing in the future for the possibility of some new form of ship construction, which, in the light of modern progress, was quite conceivable. It was an interesting fact perhaps to those who believed in cycles that eighty years ago the "Wooden Walls of Old England" were replaced by "Ironsides," and that forty years later "Ironsides" were replaced by "Steel." Now concrete is being largely adopted for certain classes of boats, and it is claimed will be used more and more for large craft. It would be indeed unwise to suggest what another forty years would perhaps bring forth, but that some form of seamless construction will be then used he had little doubt whatever.

With regard to machinery, it seemed to him that whilst we had all the facilities for making steam engines of any size whatever, and experience also, this form of propelling machinery should, for the present, be adhered to. He would like to ask Mr. Sinclair whether, in view of his remarks about the exceedingly great vibration of the engines in the small coastal steamers, and in view of the short length of shafting between engine and propellor, it had been found necessary to adopt any form of flexible coupling? He would have thought that, with engines

so much on the move, a rigid coupling would have led to difficulties.

Again, one feature in the illustration of a typical set of machinery, as shown in Figure 1, he did not like in crossing the steam connections to the boiler, that is to say, putting the boiler stop valve for the starboard engines on the port side of the boiler, and vice versa; although it might be said that an engineer would always operate these valves, it was quite conceivable that in an emergency a mistake might easily be made. Then, with regard to the author's remark about expansion joints, these were undoubtedly one of the banes of engineers' lives, and wherever it was possible nowadays the best practice was to instal a bend or U pipe rather than attempt to take up the movement in a horizontal direction through a sliding joint. Certainly he knew of many instances where packed joints had, in the course of time, become so much trouble that the packing was jammed up hard, and no expansion allowed to take place.

He was much struck with a recent description of an expansion joint in which no packing whatever was used, but in which both male and female ends of the joint were made of bronze, the male end being made a good sliding fit, and gradually reduced in diameter until at its inner edge it was perhaps a sixteenth of an inch thick, the temperature and the pressure of the steam being sufficient to enable this thin edge to be expanded out to the sides of the female end, and thus make a thoroughly tight joint. Many of these were in use in the Navy and Mercantile Marine.

Referring again to the question of shipbuilding, although it was perhaps irrelevant, one could not help feeling more happy about the position of shipbuilding in Australia at the present moment, for since this Association last discussed the matter less than a year ago, we had seen orders placed for some thirty vessels of various sizes, and he could only express the hope that the manu-

facture of such would be carried through by everyone concerned in a proper spirit, for it indeed was, as much as ever, a national emergency that we were faced with in providing tonnage.

Practically the whole of the Engineering Associations of Australia had recently offered their services to the Commonwealth Government for the formation of Advisory Committees in national matters arising out of the war, and he could not help feeling that in the question of shipbuilding it was surely feasible that the assistance of professional engineers could be made use of in many directions, without in any way trespassing upon the rights of any person or concern.

He had very much pleasure in conveying to the authors the vote of thanks moved, and would ask those present to carry this in the usual way, by acclamation.

Before closing the meeting, the President asked those present to join with him in expressing their pleasure upon seeing Mr. William Grant, an ex-Councillor of the Association, once more among them. As most of them knew, Mr. Grant had recently gone to Great Britain to offer his services to the British Government in whatever capacity it might think fit. He knew that Mr. Grant had rendered excellent service, and that he was only interrupted because of the necessity to return in connection with some important matters of a private nature.

Mr. Grant briefly responded, and thanked the members for their kindly welcome.

Upon the President then expressing, on behalf of the Association, the pleasure it gave them to see so many visitors present, and that it was always the desire of the Association to bring together engineers interested in matters being discussed by the Association, the meeting terminated.