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Standardization of Marine Engines for Cargo Steamers.

BY MR. W. V. LANG (Member).

READ ON

Tuesday, April 10, 1917, *at* 7 *p.m.*

CHAIRMAN: Mr. JAS. SHANKS (Member of Council).

DISCUSSION ADJOURNED

TO

Tuesday, April 24th, at 7 *p.m.*

The CHAIRMAN: We have met to-night to hear a paper on one of the most interesting subjects ever brought before the Institute. I am pleased to notice that Mr. Lang is treating the subject in the light of the marine engineer. I will now call upon him to read his paper. There is plenty of scope for discussion.

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Preface.—I have taken this subject as being one of immediate import to Marine Engineers. There have appeared many articles, letters and correspondence of late *re* "Standardized

Ships." Although just what this term means it is difficult at present to apprise, as it has become a sort of catchword with non-technical newspapers, and with journals that cater for the general public. But it is inconceivable that any standardized marine engine should be designed and built for merchant commerce by the shore staffs of engine builders—however expert and technical—without that large body of men represented in and by the title of this Institute having some say and criticism in any such projected design; *i.e.*, marine and classification surveyors, consulting engineers and superintendents, who have the drawing up of specifications on behalf of the ship owner, and the inspection, maintenance and repair of such machinery during its life; and those directly in charge of such engines at sea and in port, who, from their intimate and personal knowledge of result in action under actual conditions at sea, can best inform and advise of much that can only be learnt by hard experience—such experience as is represented by the official Board of Trade certificate of competency—and to whom, to-night, I especially address these notes, to invite and open a discussion which, I trust, may not be without profit to us all.

The Transactions of the N.E. Coast Institution of Shipbuilders and Engineers at the meeting held in Newcastle in January marks a great advent in marine engine construction, in that the dogmas and old fashioned ideas of numerous designers and builders are sought to be skilfully focussed upon one type and approved pattern.

At the meeting, men at the head of world-renowned firms, whose machinery propels a large proportion of our mercantile tonnage in all waters of the globe, sat together and discussed economies, ratios, diameters and standardization. A hopeful sign indeed, when managers meet with a view to scrap all differences in minor things and aim to unite on main principles.

It was a kindly and proper reference, too, that was made to the presence of that large body of men who superintend such machinery from the inception of its need by the owner until it disappears by sale, storm or wreck.

No machinery for marine purposes can be successful in wear and tear were it designed and built by calculation alone. Motive power owes much to the technical man and the designer, but it is the practical man who, in the past, the present and the future, tests the results, and by attention to details brings the design to success in operation.

In relation to marine engineering, we have, broadly, two interests (1) the seller; (2) the buyer. The former represents works, management and design; the latter, commerce, maintenance and result. As a constructive asset, "Goodwill" only goes with the former; *i.e.*, "Works" stands or falls by the result of his product, and "result" runs into years of experience, and may be summed up tersely as wear and tear.

Those of us who have had long association with wear and tear can best appreciate the differences between the respective "jobs" we have had to deal with, and where, in a specification, it is necessary to add, here and there as experience dictates, to the parts requiring special attention.

It would be a misfortune for a standard marine engine to be put upon the market without due consideration being given to the after years of its life; and to that consideration, as a member of the army of maintenance, I would like to make some remarks. It will be easier to classify them under heads, for engines of (say) 1,000 to 2,500 I.H.P. of typical East Coast pattern, as follows:—

Design.—A composite design, embracing the best and eliminating the faults in individual engines, should be the object and the outcome of all deliberations. It is to be hoped, and fully expected, that simplicity with ample strength and rigidity will characterize an adopted design; and from the data available in the various existing designs there should be no lack—or need of revision—in thickness of cast iron sections or flanges, or of bearing and wearing surfaces, nor of efficient guides; the minimum of vibration to working parts; or of accessibility to all and every part, and ease in overhauling and adjustment.

Bedplates are usually found in two designs: (1) of box section bolted direct on tank top; (2) of girder section bolted on a built seating. The former necessitates the holding down bolts going through the water-tight plating, the latter allows of independent bolting and re-bolting. It is important in any design that the holding down bolts are easily accessible; also that pump facing and jointing bolts are easily get-at-able. Where an unnecessary depth exists between the tank top and the level of the engine platform, it is a pity that such lost space is not better utilized by making the engine room tank deeper, thereby increasing water ballast or boiler feed capacity.

The Life of a Marine Engine.—For the purpose of allowances for wear and tear, I have assumed a period of (say) 30 years. We all know "jobs" of near that age which are, broadly speaking, as good as ever, and I personally lost from my superintendence in 1915 (by that cowardly and insane torpedo attack on commerce) a Palmer job of 30 years of age, still good for years of sea going, and the double ended boilers of which had the original furnaces without any patches upon them.

Sizes of Engines might be arranged for by leading engine builders on the basis of I.H.P., rising by increases of (say) 500 H.P. per size, from 1,000 to 2,500 I.H.P., to suit the standard hulls that may be evolved (from the prevailing idea on this subject), and which might give (say vaguely for the purpose of the argument) vessels of 3,500, 5,000, 7,500 and 10,000 tons D.W. Such standardized engines might, would, or could have cylinders of equal diameter and centres, similar stroke rising (say by 3 in. per size) and similar disposal of valve chests. etc. It would then become possible—making due allowance for individualism in the respective builder's design and finish, and attention to details, etc.—to have the component parts of such standardized engine sets absolutely identical to length, diameter and gauge. So much so, that manufacturing firms could specialize in piston rods, valve spindles, connecting rods, crank shaft pieces, thrust, propeller, and tunnel shafts (except the make-up length to finish to a size), air and circulating pump, buckets and rods, feed and bilge rams, eccentric and drag rods, etc.; and one builder could even take the surplus or spare parts from another to help forward his own erections; whilst a standardization of prices for spares and renewals would keep down un-remunerative production and competition. I suggest there is nothing new in this hypothesis ; it is merely carrying into mercantile design on the grand scale what the Navy does in types of warships; and that without materially altering general practice but only consolidating upon output and reducing cost and maintenance.

Metric System.—By all means let the decimal system be introduced into modern dimensions and money; but, as it is bound to have a transition period, the standard sizes should be in the system that we are all familiar with; but the equivalent metric unit should be shewn in parallel column, that it may become known by easy comparisons. Those of us of mature age will never—in our time—learn to *think* in other than the 12 in. rule and its fractional sub-divisions. All modern rules, straight-edges and tapes should be marked in *both* systems.

Scantlings.—These remarks are not intended to touch upon the ground of expert calculations of ratios, diameters or surfaces. There must be too much modern practice, data and experimental result at hand to leave much error permissible in any standardized type of marine engine that a committee of professors, designers and builders could produce; therefore, only the wear and tear problem is before us in this paper. The marine engineer, as such, is only concerned with doing the best possible with the job put into his charge, and the superintendent over all. For it must not be overlooked that the cargo vessel of the type herein considered is a product for sale and purchase; and, in nine cases out of ten, a superintendent engineer has nothing whatever to say as to the builder or size of engine.

Reliability is everything in a cargo boat engine. Such steamers trade the world over; to such out-of-the-way places as Mauritius, Ocean Island and Iquique, and places where practically no facilities exist for repair or renewal. A run of a month or two months is nothing nowadays to a tramp steamer, and a run of nearly 80 days, without an easement oı alteration of the stop valve, can be vouched for by the writer, for a typical East Coast job of 2,000 I.H.P. Neither the Navy nor the passenger services can beat the work of the ocean tramp steamer where reliability comes in. It is important that this feature should not be weakened in any new design. Equally should a steamer's time between ports bear a close approximation to calculation, but it is the shipbuilder and his designer who are chiefly responsible in this matter, and unless the engine builder is a partner in the modelling, the "best all-round ship" will never be produced.

Speed and Consumption are the twin factors that the ship owner is most interested in, next to dead weight. If a ship can transport 8,000 tons D.W. a distance of 240 nautical miles (equal to 276 land miles) in 24 hours at an expenditure of 33 tons of coal, he will not complain. I have such a vessel in mind. She is 400 ft. × 52 ft. × 26 ft., loaded draught with a co-efficient of ·78. It may be taken as good practice that the beam of a cargo steamer should not exceed $7\frac{1}{2}$ beams to length, and at such a proportion of hull, good ends are obtainable. The vessel that cannot average 240 miles per day to the R. Plate and back is too slow for modern needs and the hustling times ahead. A co-efficient of ·76 would be better.

Maintenance.—As an owner's man, I cannot too strenuously urge that this important factor should be kept in view. A cheap first cost will be a dear investment if its maintenance is costly. There are no rest houses on the long sea routes, and stoppage for adjustment is "bad form" at sea.

We don't want the repairer oftener than possible on the marine engine, and provision is required for the contingencies of wear and tear.

Power versus Weight.—It seems to me that in the majority of cases there is too little power and too much weight. No cargo boat engines are run at sea *full opened out.* If they were, the boilers are not capable of maintaining steam. The average tramp steamer lumbers along at a 54 revolution gait with the wheel $2\frac{1}{4}$ turns back and the "links" well in. Why not a size smaller engine in the same vessel running at 60 revolutions, with the leads and cut off's at a calculated maximum of efficiency and a full head of steam in the H.P. chest? The present useless reserve of engine power is only exerted *once*, and that is at the trial trip, with a good fireman on each boiler, good steaming coal on the plates, clean tubes and fires, and—plenty of refreshments. We want boilers that will steam easily through the Tropics with the wind aft, bunkers of the usual "Through-and-Through" quality, and the very ordinary fireman based on a calculation of 3 tons per man on the consumption. This, with tubes unswept for a week, is the proper test for size of boilers in relation to speed.

Cylinders.—It is for the expert to decide the ratios and clearances, but the calculations should be for *sea conditions* and not for indicator card marking on trial trips. The least that should be calculated on in deciding the thickness of cylinder walls and liner, is for possibly reboring the H.P. thrice, the M.P. twice, and the L.P. once, in a probable life of 30 years. It might reasonably be considered that the *minimum* allowance for reboring a cylinder *once* would be (say) $\frac{3}{16}$ in. for a 24 in. H.P. cylinder, $\frac{1}{4}$ in. for a 40 in. M.P. cylinder, and $\frac{7}{16}$ in. for a 68 in. L.P. cylinder.

Pistons.—Doubtless these will be, and probably always will be, best of cast iron. The all-important thing is that the core plugs should be in the *side*, and not on the top or bottom.

N.B.—I have to record a smash-up at sea through a core plug—in the latter arrangement—falling out.

Undoubtedly, the simplest and cheapest rings are those of the Ramsbottom type, and they are hard to beat when in good order; but most engineers prefer a more durable ring, and one possessing greater efficiency. All I propose to remark on this head is that depth between flange and space between cylinder wall and piston body should be designed to suit the leading makes of rings.

Piston Rods.—Whilst leaving the minimum of scantling to experts, the owner's superintendent is entitled to claim allowance for wear and tear. There is no "expectation of life" for such parts subject to friction. A rod may be in good order after 12 years; it may require turning up in 12 months. I consider a reasonable allowance for turning down (or "truing up") in lathe would be $\frac{1}{16}$ per inch of minimum diameter. That is to say, for a 6 in. estimated diameter $\frac{3}{8}$ in. of excess should be allowed for (say) twice truing up the rod. It would then become condemnable when badly worn for the third time. Such extra diameter should be over and above the size at top of cone, and it would tend to a better running rod if the lower portion of the rod—below the gland—was turned down to the rule size. This would permit of ridging (or "swell," due to wear) being easily filed away, and the rod kept true on its working part.

Valve Spindles.—These are even more subject to turning down in the lathe than piston rods, and not less, but rather the more, allowance should be made for wear and tear. Such rods, too, frequently come for renewal, owing to lack of allowance for turning down; original sizes quite frequently only permitting of one such treatment. H.P. spindles often require trueing up in 2—3 years regularly. This is due to several reasons—principally (1) soft material; (2) hard or faulty packing; (3) careless gland adjustment; (4) wet steam. It is not usually desirable to weld a new end on a main valve spindle. The part working in the guide bush or brasses should be "swelled" and reduced to the rule diameter at each side of the travel to prevent ridging. As regards the method of securing the valve, the clamped (lugged) nut is a very satisfactory arrangement, adjustable to a nicety and safely secured by the screw bolts. Ordinary double nuts are unreliable, and difficult to accurately adjust. Some makers fit a similar clamp over collars, but adjustment has then to be made by washers to take up the slack.

Shafting.—The present revised rules of Lloyds (as the premier classification society) appears ample for all shaft diameters, and, presumably, covers for a reasonable wear in the journal, but it is in every way desirable to allow a little over the rule for a possible accident, necessitating a re-setting and truing up in the lathe; or a new journal end or crank pin, necessitating truing up the entire crank piece. An extra $\frac{1}{8}$ in. on the crank pin and journals would cover for this. The thrust is not liable to above; it is the surfaces of the collars that may require refacing up at some time or the other. The shaft should be reversible. Tunnel shafting should be swelled (say a $\frac{1}{4}$ in.) in way of bearings. Propeller (or tail) shaft should be as short as possible. It is perfectly easy to effect this by carrying the Peak bulkhead well back in the way of the after recess.

The Propeller.—This is the least-considered feature of a marine engine. A steamer is contracted for; machinery to the value of £10,000 is installed; the best of the midship section is appropriated to machinery and bunker space; thousands of tons of bunkers are consumed annually, and hundreds of pounds paid in crew wages—to turn a chunk of cast iron costing £100. If £20 extra was asked for grinding up and facing smooth the surface of the blades, nine out of ten owners would refuse to pay it. Assuming diameter, pitch and surface to be identical, it does not require much imagination to assume that a bronze propeller, being lighter and thinner, *must* show better results, and without the assistance of any expert evidence we might reasonably assume an increase of (say) 2 revolutions per minute, and anything up to $\frac{1}{2}$ knot increase on a 10 knot basis. Yet the first cost of £500—£600 stands in the way of the maximum of efficiency. In a standardized type of ship it will be possible to experiment, and really ascertain the best form, diameter, pitch and surface of a suitable propeller!

Eccentrics.—I see by the N.E. Inst. discussion that sheaves and straps of same width should be standardized: all fitted on the shaft journals and none on the couplings! I only know that you cannot have the go-ahead sheaves too wide, but to get go-ahead surface you must reduce go-astern, as the fore and aft space is limited. Provided the go-ahead is of ample width, it is preferable if the go-astern is interchangeable. That top and bottom halves are "interchangeable and reversible" is important, and what I have specified for some years past. Eccentric troughs should never be omitted; they save wear and tear enormously.

Condensers.—In a new design for main engines these could be of the round-bodied separate type, either placed on brackets at the back of engine or entirely apart. The body could be of cast iron, or W.I., or steel plate. Such detail of design or position would not matter; the chief point for standardization is that the brass *tubes* should be all the same diameter, length and gauge for one or more sizes of engines. The difference in *surface* would be merely a matter of number of tubes, viz., larger diameter of condenser body. The great advantage would be the ease of obtaining condenser tubes, as obviously a standard size would permit of stocking by either the engine builder or the manufacturer, or both, to their mutual advantage in cost and time and to the owner in renewal.

Air Pump.—It is not our province here to compare the ordinary type of bucket—with head and foot valves—with the valveless type having head valves only. The discussion at the Newcastle Institution suggested a ratio of diameter, and it is for experts—together with the results of practice—to make due allowances for wear and tear and consequent loss of efficiency. Such *mean* loss of efficiency in any pump should be the calculation of its power, and not that of a new pump with everything working to technical calculation. The valves should be the same size throughout, but the *lifts* would naturally vary a little. To prevent the fouling of the engine-room atmosphere, the air pump overflow pipe should have an atmospheric air exhaust. Air and circulating pump rods should be interchangeable. They are so in some jobs.

Circulating Pump.—Calls for no special remark, but the valves should be arranged horizontally, and can then be of the metallic type and interchangeable with the air pump. The rod interchangeable with the air pump rod. A circulating pump would be more efficient if the bucket was fitted with brass rings of the Ramsbottom type or vulcanite rings, but it is a question if such is worth the extra expense.

Auxiliary Pumps, &c.—There could be no conceivable sense in specifying any one or particular make of pump or auxiliary for a standard engine specification; that would merely bestow a monopoly and congest one firm's workshops, and ruin or be greatly detrimental to the many other manufacturers of similar and quite possibly equal (or even better) productions. The all-important point to maintenance is that spare parts, or renewal (in the event of accident) should be reasonably prompt, and to that end (especially in view of the things we have learnt since 1914) no foreign-made fitting should be found in a steamer built in this country for a British firm. But for convenience of maintenance, ordering of spares, etc., it is much to the owner's interests that the various auxiliaries and the deck machinery should be from as few sub-contracting firms as possible, and the interchangeability of component parts—especially piston rings, suction and delivery valves and seatings, etc.—as practicable as possible.

Valves.—In air, circulating, feed bilge and ballast pumps it is quite a question of arrangement as to whether all valves for the above, if of the metallic or disc type, should not be the same size for all. At the outside two sizes might be arranged for so as to reduce the present large number of sizes required when renewing. Flat disc valves in the boiler feed checks could at any rate be interchangeable with the main feed and bilge pump valves, and the air, circular and ballast pump valves be alike and interchangeable.

Main Injection.—The usual position, *i.e.*, just above the turn of bilge, is necessitated by submergence when light ship, but a most desirable fitting is a second, or duplicate, injection valve (say) 10-12 ft. higher up the side. When crossing bars and steaming up rivers or manœuvring into or out of river berths, the lower injection valve would be shut off, and liability to choking of the circulating pump—and scoring of same—entirely removed. I have known several cases where such an arrangement would have prevented stoppage of the main engines at a time when the steamer was aground on a sandbank, and saving of tugs and salvage claims that ensued as a natural consequence. I consider marine insurance should encourage such items in a vessel—together with large ballast pumps and large suction pipes—as tending to reduce risks and the high costs of salvage claims.

Main Stop Valves.—A standard valve by valve specialists would be a great improvement on present diverse designs, all more or less steam tight, and more often leaky than tight. Some are laborious arrangements with V threads, requiring a number of revolutions from full open to shut; others require a lever on the wheel to close them tightly. A proper main stop valve is an important fitting, and represents both safety and speed in handling high-pressure engines. The valve should be more or less an equilibrium valve, and preferably with a pilot valve. This is not a fitment for amateur design nor for the experimental draughtsman.

Standardized Fittings.—It is equally important in standardizing main engine parts that the valves, cocks, mountings, pipe flanges and scantlings should be equally considered and standardized for copper, wrought iron, steel, cast iron or lead pipes and connections. There is, or was, a Standards Committee on such matters, including threads, etc., but I am certain their deliberations have never penetrated into marine engine practice, for the variety of fittings and diversity of flange diameters in the engine room is truly bewildering. In this respect there would be a great gain in standardizing on proportions of flange diameter to bore, and pitch and number of bolts, etc. But do let us, as an awakened people, discard the foreign-made "patent" or component part, not only for our marine engines, but, let us hope, for all our needs where our own brawn and brains and our well-equipped works are capable of producing them. And on this head may we briefly refer to the splendid national service of our womenfolk, who have so ably filled the need of standardized fittings for the Army and Navy munitionment, and suggest that there is ample future employment for all these trained women and the new factories to produce in this country for the future that late enormous importation of German electrical fittings, hardware, motor accessories, clocks and instruments that have taken millions to pay for annually, and which production in this country—chiefly by our women—would not affect or compete in the slightest degree with the recognised trades and unionist employments of this country. All this talk and jealousy regarding women competing with home workers wants scrapping. It is the British women who have stepped into the breach to assist our arms to victory, and may they remain, and be honourably allowed to remain, to assist in keeping the Hun and all his works out of this our Motherland.

References.—The subject of this paper is standardization of parts, but to prevent unnecessary re-statements or suggestions I cannot do better than refer you—if you are interested—to a paper I read at the old premises on March 18th, 1912, entitled "Notes upon a Marine Engine;" also to "Some Details of a Cargo Steamer," read on February 15th, 1909, which touches upon some aspects of our consideration; as also an article in the "Shipbuilding and Shipping Record" of February 22nd of this year on "Standard Parts for Standard Ships," all more or less bearing upon the subject before us, and to which I refer you for notes on standarization, cylinders, liners, cylinder lagging, piston rings, shafting, thrust, stern tubes, white metal, pumps, boilers, condensers, rods, slide valves, plans, data, and tools, etc. A few of the remarks therein are now obsolete by alterations of rules, and there were a few printer's errors occasioned by my hieroglyphics.

Uniformity.—It is of more importance than a first thought would be deemed necessary, that the manipulations of Marine Engines should be more uniform. Engineers come and go—particularly Juniors—and mistakes are liable to be made with the variations of present design and practice. Without referring to those differences it is suggested that in a standardized type of engine: (*a*) All starting platforms should be on the starboard side; (*b*) All propellers right-handed; (*c*) All link motions at the front for ahead position; (*d*) All reversing wheels to work right-handed for ahead—left for astern; (*e*) All main stop valves in particular, and check valves in general, including tank and bilge valves, right-handed, viz., right-handed to *open*—left-handed to *shut;* (*f*) All engine telegraph dials to face athwartships, viz., the handle, or reply, to be aheadways for ahead, and asternways for astern.

N.B.—Some may suggest that the above are obvious and the remark unnecessary, but I am acquainted with port starting platforms (although the engine runs right-handed) with left-handed propellers (although these are scarce); and reversing gears are sometimes at the back for ahead, although generally at the front. But main stop valves are found both right and left-handed. I need hardly say that this varying practice tends to accident or disaster at a critical moment.

It is not uncommon to find engine telegraph transmitters placed facing forward or aft, and the index hand and reply handle working port or starboard—an arrangement obviously liable to incur confusion.

Renewals.—The great and permanent advantage of standardization on the lines indicated would be simplification and economy in production, permitting of special machinery and the use of jigs, gauges and templates for speed and accuracy. The convenience and saleability of stocks—whether castings, forging or finished parts. Immediate supply for breakdown, renewal, or for space gear at the principal ports and repairing bases at home and abroad, of propellers, tail shafts, piston rods and valve spindles, condenser and boiler tubes, these being in the main the parts chiefly concerned with breakdown or repairs. The saving in time and cost to shipowners and underwriters would be enormous in the course of years, as against the present cumberous and expensive day and night work to prepare and supply a new part—especially propellers (10/14 days) and tail shafts (4/6 days), not to mention railway transit and special trucks.

Non-Standardization.—I want to be quite clear on one point, viz., I do not advocate standardization of makers or of non-essential parts. You do not expect to ever renew main engine cylinders or bedplates, or the boiler shells; nor would there be any object gained in one particular make of auxiliary. On the contrary, standardization should aim at a specification for sizes of the essential parts, mainly the component parts subject to assemblage and renewal—whether to replace wear and tear or as spare gear. Anything tending to "corner" requirements by the nomination of any one firm or firms will defeat the object of standardization, which should be to produce in plenty and economically—consistent with reasonable and fair profit—this mighty factor of international commerce.

Lubrication.—With a new standardized type of marine engine it seems to me that economy in this particular is deserving of attention. At present the sizes of engines we are commenting upon consume an average of $2\frac{1}{2}$ to $3\frac{1}{2}$ gallons of engine oil per day, which, at 2s. 6d. per gallon, is a large expense per annum. If solid lubricant, in screw-down spring cups, could be fitted to main shafting, rocking and weigh shafts, eccentric rod and drag link ends and pump links, eccentric straps, etc., it would greatly reduce oil used and wasted, and solve the greasing question.

Piping Arrangements.—There seems to be no symmetry or design in the average piping arrangement, nor any provision for an additional supply; or indeed for the required capacity of steam and exhaust areas of auxiliaries if all are working together. A simpler arrangement can be made when junction pieces are introduced for the distribution of the steam services and connections from exhausts brought to a C.I. junction box, thereby simplifying the control to atmosphere, condenser, or to the L.P. chest. It also permits of suitable drainage.

N.B.—A prize of £50 for the best piping arrangement in a typical cargo boat would, I doubt not, set some brains busy with the lighter tools of our profession.

Nothing is more wasteful and uneconomical than the practice with some engine builders of running a single steam pipe fore and aft the machinery space, with branch pipes to the winches, steering gear, and all auxiliary pumps, etc. This occasions steam being on everything all the time, with the consequent leakages and loss by radiation of heat. Surely in a standardized design something better can be devised and better proportions of pipe areas arranged,

Exhausts at Sea, from steam-steering gear and dynamo engine, is well worth carrying into the L.P. steam chest. There is an appreciable increased I.H.P. shown on the L.P. Indicator Card.

Injector.—This is an auxiliary I have fitted during the past 12 years. It is a valuable duplication to boiler feed in port, and puts the water in at a high temperature. By specifying "with salt water cones" a suitable marine injector is procurable. By standardizing the pattern a spare injector can be kept at the makers, always ready to exchange for one that requires renewal of the cones.

Gratings.—In way of the ordinary top gratings there should be arranged—at back and front—a loose section, easily lifted out and in the proper position and of sufficient size, to lift out or put down any auxiliary pump, evaporator, or the pump levers at the back, and a crank shaft piece at the front. As at present—in most jobs—there is no such provision, but such requirement usually entails unbolting the whole structure, on one or the other side.

Skylights.—Skylights should, without exception, be provided with bolted sections of sufficient size to enable any engine part to be lifted out without recourse to unriveting. Skylight design might be much improved to give a maximum of light and air service.

Main Boilers.—It seems a pity that there are not similar ideas as to the strength of boiler scantlings between the Classification Societies and the Board of Trade. One wonders why, at this stage of marine engine and boiler practice, the Board of Trade should consider that some parts—particularly boiler shells—require, under the rules, such additional thicknesses. The only explanation to the ordinary mind is that their rules require revision in the light of modern improvement of material and workmanship, for if $1\frac{3}{16}$ in. is good enough for a given W.P. for a first-class cargo steamer carrying, say, 75 of a crew, why should a small passenger ship, carrying (say) a total on her certificate of 50 persons, and having a similar size boiler and W.P. require, say, a $1\frac{3}{8}$ in. steel plate? I am not giving exact figures, but the difference is something about that named.

Where this anomaly comes in to the detriment of the cargo steamer—particularly of the shelter decker or 'tween deck steamer—is when a temporary certificate is required for the carrying of labour emigrants, coolies, troops or similar human freight. For such conditions the W.P. (calculated on the scantling) suffers a quite serious reduction, as also for the B.T. calculations for crank shafts, etc. If, on the other hand, the machinery is specified to pass Board of Trade rules, the extra expense and the additional weight to be carried is quite a considerable item. For the main boilers of standardized vessels the chief point that appears to me essential is that furnaces and tubes should be standardized into certain groups of sizes. For instance— say, based on a W.P. of 180lbs.

Furnaces might be standardized on certain diameters, as 38, 40, 42, 44 in., etc., with length to correspond to an agreed practice, and the back ends—preferably of the withdrawal type for easy renewal, as now general practice. It would not be necessary to arbitrarily specify for Gourley-Stephen or Ashlin type flues, although the latter offers a simpler—and possibly cheaper—fitting. The important thing is that a maker could stock ready—or ready to complete to templates—a minimum of standard sizes. Then the difficulty of getting flues for new or renewal requirements would save enormously in time. Neither would the *make* of a furnace matter—particularly of the ribbed or corrugated type—matter if the *ends* were to a standard fitting. As things are at present, the furnaces (or *flues*, as makers class them) are to every conceivable length and fraction of diameter. On this head one might draw attention to the objection (in practice) to large diameter in furnaces. When these get up to 48 in. diameter the tendency to distortion and sagging is very marked, and particularly on long voyages. With furnaces not exceeding 44 in. diameter this tendency is greatly reduced. There is rarely any trouble with flues of, say, 42 in. diameter. It is a moot question whether four furnaces of small diameter is not much better than three of large diameter, notwithstanding the usually accepted objection on the score of firing, or of single or conjoined combustion chambers. The fact remains that there *is* a very large amount of furnace renewal, and that not on account of age, nor often due to actual neglect.

Tubes naturally fall into the same line of reasoning, and if these were required within certain standards of length and diameter, makers could afford to stock such sizes in advance of requirements without doubt as to their saleability. The present practice of cramming in mere theoretical heating surface might be better considered in the light of larger diameter of boiler, with freer circulation and ease of access for examination and periodical cleaning. For stay tubes it is most desirable—particularly from the owner's point of view—that the diameter and pitch of the screw threads should be standard to the maker's taps, which latter are then available for use when renewing.

Stays in combustion chamber walls should be considered and so arranged that cleaning is facilitated. It is not unusual to find—through bad draughtsmanship—that odd stays are so put in as to prevent proper slicing of the combustion chamber backs and sides. The *swell* of tubes at the front ends should be never less than $\frac{1}{8}$ in. It facilitates withdrawal of odd tubes and the fitting of new ones.

Furnace Fronts should be standardized with balanced doors—now almost general practice—as hinged doors require constant repair after a certain time, and give more trouble to the firemen—particularly when ship is rolling badly.

Manhole Doors should be 16 in. by 12 in., both top and bottom. A stout man cannot get through a 14 in. by 10 in. orifice—except perhaps stripped—and boiler examination suffers accordingly if the chief is portly. It would be much better if all manholes were fitted with saddles. The doors could be then well fitted, and when wastage occurs such saddles are renewable.

Donkey Boiler.—This is an auxiliary of the very first importance. I have nothing more to remark than that this boiler is—in five cases out of six—inadequate to its requirements. Unless this boiler is of *ample* size for all the demands that may and will be made upon it, its cost may as well be saved, for with insufficient steam the modern requirements of discharging cargo will demand a main boiler to be on. With a two-boiler job a donkey boiler is almost imperative, but with three or more main boilers I have practically come to the conclusion (rather reluctantly, I must confess) that a donkey boiler can be dispensed with, for the demands of eight winches and the other auxiliaries—pumps, dynamo, etc.—requires a boiler as large as the main.

Funnels.—The *maximum* of height is usually controlled by the headroom of the Manchester Ship Canal, viz., 72 ft. above the *ballast* load line. The efficiency, and constancy of draught of funnel, is continually impaired by firing. In a nine-furnace job *one* furnace door is more or less always open for attention to the fires, and for quite an appreciable time when cleaning a fire. It is worth consideration whether a funnel to *each* boiler would not be good in practice. Only the draught of *one* boiler would then be influenced by the opening of fire doors in the rotation of attendance to the fires. The smoke-box arrangement would be simplified, and the weight on foundation plates reduced. Instead of one 8 ft. diameter funnel, three of $4\frac{1}{2}$ ft. diameter (with three boilers abreast) would give proportionate area, the wing funnels forming derrick posts for the bridge and bunker hatches.

N.B.—I am only here referring to ordinary two or three boiler jobs.

Smoke Box Doors badly require re-designing and strengthening to prevent buckling. The principle of angle iron framing should be on both the door and the opening.

Fire Bars.—These might easily be to a series of lengths, with ends all to standard. At present fire bars vary in length by fractions of inches, and end fit to every conceivable angle and form. Properly standardized, stocks could be kept by foundries in the principal ports, and plain bars obtained ex stock. The grooved fire bar is to be recommended.

Stokehold Plates of cast iron could well be standardized to one size for the front of the boilers; say plates 2 ft. 6 in. square, and the marginal or fitted plates templated in the usual way and of wrought iron. As to whether the bearers should be of angle iron or wood is immaterial to standardization. It is always desirable that a wood flooring be laid under cast iron plates.

Water Gauges.—In this, a comparatively small although all-important item, we have a typical illustration of the vagaries at present existing in Marine practice. There is no approximation whatever in depth of water over heated spaces, in length or diameter, in glasses, or size in mountings.

Too much water over combustion chamber tops—when water is shewing in the bottom of the gauge—is not desirable, nor is too long a glass for the same reason, for the tendency is to keep the water level at *half-glass*.

The amount of saving in thought, trouble and stocks would be enormous if there was a standardized practice of (say) $4\frac{1}{2}$ in. of water over the tops, with 12 in. of glass shewing. All glasses $\frac{3}{4}$ in. (and the same length) for main auxiliary and donkey boilers, and for evaporators.

Ventilation.—There is not an engineer in the Mercantile Marine who will not subscribe to the verdict that in 90 jobs out of 100 the ventilation of the engine room is totally inadequate. In most cases the centre of the stokehold space will show a lower temperature than the engine room platform. There is no reason whatever (except £ s. d.) that it should be so, or that men should have to do duty—especially in hot weather or climates—where so much unnecessary fatigue and discomfort could so easily (in the original design) be obviated. A similar stricture may be added *re* the ventilation of bunker spaces.

Watertight Doors.—It is within the scope of the machinery department to mention the watertight doors usually found in the stokehold bulkhead for access to reserve bunkers, and the door controlling the tunnel entrance. These former are too frequently of such small dimensions as to make passage difficult for a man, and impossible for a barrow. There is no reason why such doors should not pass the usual iron wheel barrow, *i.e.*, a width of (say) 24 in., and the proportionate height would make access to bunkers easy. The tunnel door is governed by (a) access to tunnel; (b) for withdrawal of condenser tubes. When the latter is the main factor in regard to size it is an ample opening, but otherwise it is too frequently inconveniently small.

Fire Extinguishing.—It is within the scope of this paper, as relating to the machinery department, that this important point should receive consideration. I do not think I put it too strongly when I say that the present arrangement is totally inadequate. Every steamship is fitted along one side—usually close up under the main rail—with a 2 in.—$2\frac{1}{2}$ in. water service pipe, nominally for washing deck. Now, fires on shipboard are usually—when serious—caused by fire in the cargo (either by heat or spontaneous combustion, or by design), and the essential requirement in water is not *force*, but quantity. The present arrangement is sufficient for an outbreak of fire in a forecastle, but for an efficient fire service I suggest, as a minimum, a separate pipe line from end to end of the bridge space of (say) 4 in. diameter in a 3,500 tonner to a 6 in. pipe in a 10,000 ton D.W. steamer. At *each* end of the bridge space, or island, two, three or four connections for 3 in. hoses, according to the size of ship. The 3 in. canvas delivery hoses to be each in length equal to the length of the fore deck or the after deck—whichever is longest; the supply to be from the main ballast pump—taken off the discharge pipe, same having a spring loaded discharge valve on ship's side to act as relief valve. The bridge space in the type of vessel we are considering is usually a bunker space. Such an arrangement would be the minimum of expense with the maximum of supply, and proportionate to the size of hold compartments and of ballast pump. The present arrangement, supplied by the general service, or feed pump, would remain as a small supply, but of greater force.

Deck Machinery quite properly belongs to the subject of this paper, but it is of sufficient scope to require a paper to itself, and some criticism on windlasses, winches, steam-steering gears, and the necessary steam and exhaust piping and distribution of same, together with feed tanks, auxiliary condenser, etc., would be of great interest to those of us who go down to the sea in ships and repair and maintain the same.

Spares and Renewals.—I am an advocate, and prefer in practice, to order all spares and renewals from the original makers. This is only possible, and practicable, when such makers' standardize and keep a proper record of sizes and designs. For that reason (spares and renewals) it is important to specify auxiliary machinery and fittings from firms of repute, and not from casual manufacturers—and particularly not from foreign firms who do not manufacture in this country. For the success of a standardized engine, firms should agree upon a fair and equitable charge for component parts required from time to time for spares or renewals. At present, as I have found from experience, charges vary enormously for similar items, and when prices were asked in pre-war days I have known them vary from $33\frac{1}{2}$ per cent. to 50 per cent., and even more, for the same item. From the builder or maker of any ship or engine, the owner—whether original or otherwise—should expect, and receive, the best consideration.

Markings.—All important and heavy parts of a marine engine should have the weight of each item cast or stamped on, so that lifts and overhauls may be attended with the minimum of risk. The boiler should be stamped with their shipping weight and total gallons of water to the level of half-glass. All rods and journals should be stamped with their original outside diameter of the wearing part. Each chamber and cylinder should be stamped at their respective ends with the original bore. Piston and slide valve should be stamped on their top edges with the travel, lap, and leads respectively. All glands should be stamped with the size of packing required for each gland, and, better still, if the depth is also given. A propeller shaft should be lettered on its inside end as to whether the brass liner is continuous or in two portions. All auxiliary machinery should bear the maker's name, number and size. All valves should be properly brass labelled for the object they control.

Finally, if some such standardization and allowances for maintenance could be arrived at by a joint committee of both technical and practical men it would simplify the whole question of specification detail, and secure to the superintendent —on his owner's behalf—those extras and allowances against wear and tear that the practical man feels justified by experience in providing for—on the present basis of specification—more particularly with some firms than with others. The whole gist of my paper is not design, but such conditions of machinery that stability, reliability, and economy may be the outcome of a standard marine engine. For its many shortcomings and omissions, for any or all mistakes and disjointedness, I beg your kind forbearance. I have put these notes together at odd times within the last month, and it bears but the outline of what I desired it should be.

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The CHAIRMAN: I am sure you have all enjoyed this excellent and practical paper. It deals with a subject with which we all are thoroughly conversant. I see before me gentlemen who are thoroughly competent and sufficiently conversant with the subject to take up the discussion, for which the meeting is now open.

Mr. B. P. FIELDEN: Mr. Lang, in the last paragraph, states that "if some such standardisation and allowance for maintenance could be arrived at by a joint committee of engine builders and classification surveyors it would simplify the whole question of specification detail." I differ from that. I rather take the view that in the past the mercantile marine has been built up largely by shipowners, and they have been very successful in making the British mercantile marine what it is. They are the persons to decide as to what class of ship or machinery they should have built to do certain work, and classification surveyors, engine and shipbuilders are not the authorities to settle as to what ships should be. This whole standardisation business has been puffed up, and one might imagine that at the present time we are suffering from having been asleep. But what are the facts? The facts are that, previous to the war, standard ships had been built for many years, but the standards were fixed to suit the trades upon which the vessels were employed. A ship for the Indian Ocean trade is unsuitable for the North Atlantic or the Argentine trade, while both of the latter are unsuited for ordinary cargo tramping, or for iron ore. The railway companies do not carry meat, grain or steel rails in the same kind of railway truck. They have special trucks made to carry the gear they are asked to carry; and so it is with shipowners. Shipowners have been trading to different parts of the world, where they know they will receive heavy or light goods, or ore, meat, grain, etc., and they provide ships accordingly. When the war started a percentage of the mercantile marine was requisitioned by the Admiralty as Transports, and remarkably good serivce those ships have performed. It was done by numbers of ships in existence when the war broke out—ships of all types, and suited to the different requirements of the Admiralty, as well as the trades upon which they were formerly employed on.

In his paper, the author refers to the question of donkey boilers. I thought that donkey boilers were more or less being given up, and that ships were built with auxiliary boilers of the same pressure as the main boilers, so that they could be used as main boilers at sea or worked in port, as occasion required.

Then, as to shafting, Mr. Lang recommends that propeller shafts should be as short as possible. My experience is that these are a constant source of trouble. The long shaft seems to have a "give" in it which the short shaft has not. I have had experience with two short shafts, and I will not have experience with any more if I can help it. In regard to condensers, Mr. Lang recommends the round-bodied separate type. I think the general practice is to make them pear-shaped, with large spreading plates on top. Some experiments were carried out by well-known firms, and they proved that the pear-shaped was the better type. Mr. Lang claims that all condenser tubes should be the same length. I have found it very handy not to have them all the same length. Corrosion often takes place alongside the ferrule, and we have cut off pieces and put the tubes into another ship where the tubes are shorter, and so run them for five or six years more with good results. Then, as to deck machinery and things being done in a cheap manner by coupling up winches and steering, it really seems to me that shipowners only get what they pay for. If they go to the shipbuilder and ask him to quote for a ship to carry so many thousands of tons at a certain speed, he will provide that at the lowest possible cost to himself, irrespective of what is going to happen afterwards in the matter of efficiency. As to the passing of the exhaust from the steering gear and dynamo engine into the low pressure steam chest. That is good; but a much better practice is to fit an exhaust feed heater into which all exhausts are run to heat up the feed water before it goes into the boiler. The result of doing this is that the feed water is raised up to 210 degrees, and the benefit on the boiler also is very marked. Mr. Lang suggests that each boiler should have a separate funnel. Cases have been known where divisions have been put into funnels, so that each boiler had its own independent draught. I believe our Chairman knows something about that.

Mr. F. O. Beckett: Mr. Lang reminds me of old Sir Joseph Whitworth going round the country, asking people to use his threads. Quite right, too; standardize everything. But there is one fitting on board ship and in connection with ships that should be noted, and that is the $\frac{3}{4}$ in. bolt or stud. I think you will find in general practice that men making joints, where studs are fitted less than $\frac{3}{4}$ in. diameter, often put in soft—I refer to breaking, not permanent—joints, and you either have the studs broken or the joint not set up—hence trouble. There should be no bolts less than $\frac{3}{4}$ in. Then comes the size of boiler doors. It is wicked to expect a man to get into a boiler through a door 14 in. by 10 in. I speak feelingly, as I am in and out of boilers every day, and 10 in. by $14\frac{1}{4}$ in. is the least I can get through. I consider 16 in. by 12 in. a very useful door, both for boilers and tanks. Tank tops are awkward jobs for men to twist themselves into when trying to get to the intercostals. If you are going to standardize link gear, why not take one eccentric and be done with it? I have crossed from London to New York (just one million revolutions), and, strange to say, without going one revolution astern until we got to New York Harbour. I think that Marshall's valve gear would satisfy the requirements and simplify the gear, besides being less severe on the crank-shaft. I agree with Mr. Lang as to his experience with 3,000 to 10,000 ton cargo ships. I look upon the double eccentric as a failure for constant use—there is a lot of friction, and they are always taking oil and throwing it about. With one eccentric rod all is clear in front of you. As to condenser tubes: I heartily endorse that all tubes should be of one standard diameter. If they were to be $\frac{3}{4}$ in. outside and $\frac{5}{8}$ in. inside, we will have an all-round standard type, but you cannot have lengths standardised in the same way. I would further suggest that tubes for boilers be standardised. Not until a certain firm of water-tube boiler-makers got tube makers to make a standard tube, for immediate contact with fire as well as the tubes in the third series, did they get a satisfactory boiler. Since then it has been found that not one tube in a hundred will vary $\frac{1}{32}$ in. in diameter; they are 3 in. tubes throughout. Some with 2 in. tubes do not steam so well, and they do not give such efficiency. You cannot clean the 2 in. as well as the 3 in. tubes. You also get homogeneity, and the tube is thus more reliable to make; the centre of a 16 ft. tube will stand the same tensile test as the ends.

As to tunnel and thrust shaft blocks and the horseshoe block for the latter, I think it is doubtful about getting it conceded to have these midway between the couplings. Shipbuilders, in designing, will not put the thrust block where you want it—they will put it near the turning wheel, and, indeed, it is the unfortunate detail in regard to universal conformity. I had a peculiar experience in China with the thrust shaft, and nearly lost my finger. We were going out, and had called at Kobe. It ran hot one morning with no apparent reason; the Chief came down and said there was a spring on the ship, due to difference in the cargo, as we had been trading and had taken so much cargo out, hence the ship had more spring; we had the thrust shaft warm all the time. If shafting is made $\frac{1}{8}$ in. or $\frac{1}{4}$ in. more in diameter to permit of turning down, it would not be a bad plan to have the thrust collars a bit thicker; and, also, make builders put in a respectable thrust block. I knew a new boat that went on to a bank in the Danube and broke her thrust block. As to injection, Mr. Lang has not referred to special pipes for the Suez Canal or the height above the keel for the inlet. It would, indeed, be a simplification of pipes if you could have an engine-room pipe line embracing the tanks, the boilers, and the feed water system, with the valves all of standard design and interchangeable. Unfortunately, our classification societies and the Board of Trade have allowed some cheap engine builders to hamper engineers and shipbuilders in that they have been allowed to make shafting to the minimum requirements, and the superintendent engineer has not always the right to protest. A 6 in. piston rod is fitted to the high p. piston, and it should be $6\frac{1}{2}$ in.; a little nickel is put into the steel, making it rather greater in cost per ton, but the slightest score while at work means a new piston rod. I had the experience once with a hot piston rod when a small piece of steel came out with the packing, and it was necessary to turn down the rod to fair it; the Surveyor, however, condemned it, as there was no margin, and a new rod had to be fitted. If they had a margin factor of safety beyond the liner right through such troubles would be avoided. These bare margins of safety are the greatest mistake, and some builders live on them. On one steamer I served in a Spaniard came on board with a man to buy. The first plate he saw was laminated over the bunker tops. He spent two days with us, going everywhere, and looking for defects. Our Captain asked the Spaniard what he thought of the ship, and he replied: "Your ship is built to the very minimum of the requirements of Lloyd's." The Captain replied, "Yes, yes, she is a splendid ship, built to the minimum of Lloyd's requirements." "Ah, well," said the Spaniard, "we do not buy. Good day."

Mr. Thom: I have been so long away from work that I have somewhat lost touch with it, but agree with Mr. Lang on many points. I think he means to advocate not the standardisation of ships so much as the standardisation of the engines and the engine-room requirements.

The Chairman: Mr. Lang has confined his paper to the ordinary type of cargo tramp steamer, and personally I believe it is quite possible to adopt some uniformity in the design of machinery suitable for this class of ship. I can fully understand the difficulties in ships required for a special purpose or trade, but Mr. Lang does not attempt to touch that. Mr. Lang, I think, refers to the reliability of the tramp steamer, and this recalls to my mind an experience I had thirty years ago, when I had the privilege, as Chief Engineer, of taking a large cargo steamer to Australia. The vessel was built on "spec" and bought when nearing completion, the only addition to the builder's specification was fitting forced draught to the boilers. The result was most satisfactory, and a better running job no engineer could ever wish to go to sea with. The engines were built by a firm of high repute. To get maximum efficiency engines should be designed to run at a fixed speed and have ample boiler power to maintain full steam pressure even with bad coal and indifferent firemen.

A great deal has been said about the various types of valve gears, and there is something to be said in favour of each, but the ordinary link motion has held its own in marine practice against everything else, due in a great measure to engineers' intimate knowledge of it. As regards Ramsbottom piston rings, this is one of the simplest and cheapest types, and most of us have had very varied experience with their use. Success with them, especially in high pressure cylinders, can only be expected when special care is taken in the design of the piston and the quality of the material with which the cylinder liner and the rings are made. A ship under my superintendence for 15 years had a certain patent piston in her H.P. cylinder, and during the whole of that time the cylinder was never bored out or the rings renewed. Encouraged by this remarkable result, I specified the same type of piston for a new vessel, but the cylinder had to be bored out after the first voyage, the result of a soft liner and very hard rings. I would refer you to the last paper read before the Institute on "Cast Iron," which is one of great value. I fear that engine builders have too long neglected this important subject, but many are now engaging scientific experts in the foundry, and, let us hope with beneficial results.

Mr. Lang refers to the difference between the Board of Trade Rules and the Classification Societies. There should be no reason at the present day why they should vary, and standardisation, when it does come, must embrace all the present varying rules. It is a question for a National Committee to deal with, and I hope the time is not far distant when we shall have a universal set of rules.

Mr. Fielden has referred to a practice I adopted in sub-dividing funnels, so that each boiler has practically a separate funnel. Of course, such a funnel becomes rather heavy for the ordinary uptake to carry; but this objection is overcome by suspending the funnel proper from the ship and telescoping the lower portion into it. The advantages are many, and when in port with one boiler at work, while the others are being cleaned or repaired will be appreciated by all Marine Engineers.

The scope of this paper is endless, and I would suggest that an adjourned discussion might be arranged to-night.

Mr. Fielden: Would Mr. Lang be agreeable to attend another meeting, so that in the meanwhile some of us can think of other matters in connection with the subject?

Mr. Timpson: There are several gentlemen whose opinion would be of value. I know they would like to be here.

Mr. Lang: I am at the service of the meeting, and whatever is in the paper I have only tried to express what I think would be the marine engineer's point of view. Any information that an adjourned discussion would bring forth will be for our benefit.

Mr. A. H. Mather: I propose that this meeting be adjourned for further discussion of Mr. Lang's paper. Mr.

Lang has not told us everything. It will give him time to think matters over. I propose we have the adjourned discussion this day fortnight.

Mr. W. E. Farenden: I second that proposition.

The proposition was carried, and votes of thanks were accorded to the author of the paper and the Chairman.

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ADJOURNED DISCUSSION.

Tuesday, May 24th.

Chairman: Mr. JAS. SHANKS.

The Chairman: We are met to-night to continue the discussion on "standardisation" of marine engines for cargo steamers. We had a good start last week, and I am pleased to see several members present who then took part, and who will be able to continue the discussion for the benefit of all concerned. Our Hon. Secretary has a communication from Mr. Lang to read, also some comments sent in by other members who could not attend.

The Hon. Secretary: I am sorry Mr. Veysey Lang has been called away owing to the death of a relative, otherwise he would have been with us, and I promised to read his remarks; also contributions from Mr. W. E. Farenden and Mr. J. Paterson.

Mr. W. V. Lang: I take this opportunity of thanking the members and friends who attended the meeting on the 10th inst., and to Mr. Shanks, who occupied the chair, for their kind reception of the above paper. Referring briefly to remarks: I made it quite clear in that paper that standardisation as therein set forth was only considered in relation to a stated class of vessel. I think I may safely say that 50% of the steamships of the Mercantile Marine is comprised within that limit, and I do not think I should be far out in stating the percentage as two-thirds for the ships that trade for cargo to foreign countries. At least I can say that in twelve years of ship-repairing, and a further sixteen years of superintendence, I have had to deal almost exclusively with that type of vessel. Of passenger, liner and fast ocean steamers of special class and of coasting and river steamers this paper does not deal with. I am perfectly aware that various types of ships are required for various trades; but this does not necessarily eliminate standardisation of hull bodies or engine parts. It would be possible and practicable to build off the same body lines a single, a 'tween, or a shelter decker; but there would be a difference of draught and of freeboard, and a consequent difference of speed with the same indicated horse-power. The same deadweight with the same horse-power would propel at speeds that varied as the co-efficient of the submerged hull. For instance—and only by way of illustration—a ship of (say) 8,000 tons D.W., of 375 ft. length, at a co-efficiency of (say) ·79, might steam $8\frac{1}{2}$ knots; a similar D.W. at 400 ft. and ·78 co-efficiency at $9\frac{1}{2}$ knots; and a 425 ft. at ·77, give $10\frac{1}{2}$ knots, all with the same power! The slow average steaming speed at sea of the modern tramp steamer is due to estimating constructive value on a D.W. ton basis. Thus you get (or say, rather, in the past obtained) a collier barge with a co-efficiency of ·80, at (say) £5 per D.W. ton, with a fine weather speed of (say) 8 knots; and the cost has (roughly) seemed to go up £1 per ton to each rise of co-efficient on the same or a similar specification of requirements. Not sufficient account seems to have been given, in the consideration of "full" ships, to the enormous loss in sea time, bunkers and wages; but the recent tendency is all the other way, and improved form of hull and better sea speed is undoubtedly the present requirement. With higher wages and working costs a better speed is economically necessary to lessen the time of transport of cargo between ports. I do not think any profit can be gained by discussion of Patent Valve Gears; they have had their day and a fair trial, and the result of experience has passed its inexorable verdict upon them. Neither do accessories, that properly belong to "extras," come before us. These are properly determined by individual selection—and of payment. Nor is the size of bolts or the multitudinous detail of machinery before us; but if there is any profit at all to be got out of the subject of this paper, I suggest it is on the lines of simplification, reduction of parts and economy in production and maintenance of the type of engine that, for the present at any rate, is the one we have, in the main, to deal with. In regard to Mr. McLaren's criticism *re* condenser tubes, I do not wish to be understood to mean that a condenser for 1,000 I.H.P. should be the same length as for 2,500 I.H.P. but the tube lengths alike for similar groups of engine sizes. Personally, I have never found condemned tubes sufficiently good between ends to cut and use in another job. I was interested by Mr. Fielden's remark *re* short *versus* long tail-end shafts. I presume he really refers to length of stern tube—*i.e.*, length of actual bearing surface of the stern bush. With bearing surface and length between bearings equal, it would be difficult to account for any appreciable difference in short *versus* long propeller shafts; but the difference in handing in the confined tunnel recess would not bear comparison. Forced Draught, Independent Air and Circulating Pumps, &c., is not before us. Their inclusion or otherwise is a matter entirely of preference, requirement and cost.

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As I end these notes, I see the following announcement in the daily paper of the 18th inst.:—

SHIPPING CONSTRUCTION.

Further Work for Engineering Firms.

The Ministry of Shipping makes the following announcement:—The Shipping Controller would be glad to hear from any engineering firms in the United Kingdom, not usually engaged in building marine engines, who would undertake this class of work. They should state their possibilities.

Further, the Controller would be glad to know of any schemes for establishing new shipbuilding yards in any parts of the country. Letters should be addressed Shipping Controller, St. James Park, London.

I need hardly point out that whilst no non-marine shops are laid out for the special requirements and machinery of marine engine work, yet hundreds of works could tackle component parts such as this paper advocates, who could not do the bedplates, condensers or cast columns, nor entertain erection; and despatch by railways which could easily transport large parts to the waterside.

Mr. W. E. Farenden: Supplementing my remarks on Mr. Lang's paper, the whole matter appears to me to be a question of £ s. d., or what the shipowner is prepared to pay for the machinery. If he specifies for the very best of material and refinements, then he must pay for it. It is like a man requiring a suit of clothes—he can have a cheap suit, which will not last any time or give satisfaction—or he can have a high class suit if he is prepared to pay a good figure. The matter in the paper before us for discussion is so full that the difficulty is to know where to start and where to end. On page 5, paragraph 5, I would like to know what the author would suggest in place of running a steam pipe fore and aft to the winches, windlass, &c. Controlling valves are usually fitted at the engine room, so that steam to the forward winches can be shut off if not required, and also to the aft winches; other valves are also fitted in the pipe line and on the winches themselves, so that each can be independently controlled. The steering gear should always have a separate pipe. The donkey boiler is now a thing of the past, and I fail to see why the author is rather reluctant to see it dispensed with. A single ended boiler of ample size of the same pressure as the main boilers is much better, for it can be used at sea for supplying steam to the main boilers, and in harbour for driving all the winches and other auxiliary machinery. Under Ventilation no mention is made of insulation as a means of assisting in the reduction of the temperature of the engine room. A good insulating material should always be used to prevent as much as possible radiation from the cylinders, covers, valve casings, steam pipes, and flanges, in addition to a carefully arranged system of downcast and upcast ventilators. This is again a question of £ s. d. I would suggest that the whole matter of Standardisation of Marine Engines be referred to the Council of the Institute to form a Committee, assisted by its Members, to deal with standardisation for structural purposes, and also to see if the different Classification Societies and the Board of Trade can be induced to harmonise their rules, so that standard designs may prevail throughout the range of cylindrical boilers, and thus make it possible for the various engine and boiler makers throughout the country to prepare a number of standard designs, with specifications for plates, furnaces, tubes, stays, &c., which would prevent delays in the manufacture and expedite the completion of the work.

Mr. Jas. Paterson: We have to thank the author for a very interesting paper, and I must say I agree with most of the items. The idea of a standardised marine engine is a good one, but it will be impossible to get shipowners to combine and get the same type of engine. Then, again, you won't get engine builders to depart from their particular pattern of engine. The only length you are likely to get to a standardised engine is that a shipowner with, say, 5 to 30 ships, gets them all built by the same builder and of the same pattern. I once knew a company who had 30 ships, 8,000 tons, 400 feet long, speed 10 knots, coal 33 tons per day; as they had three different engine builders, hence the spare gear, as it should have been for obvious reasons, was not interchangeable throughout the fleet. Donkey boilers are out of date; if not, they should be. I am quite sure that shipowners have lost considerable amounts of money in the past through having inadequate donkey boilers. I have never, in all my sea experience, been on a cargo steamer where the main boiler could keep steam for the gear and throttle valve of the engine to be run full open. I never could understand the reason for this. I may give my experience as engineer of a certain ship many years ago. The main boiler was a large double-ended one, three fires at each end, three combustion chambers, stayed in the usual way, but with extra stays from the top of the combustion chamber to shell of boiler; this makes a rigid job. While inside the boiler I discovered that 12 stays were sheared, six on the port side and six on starboard. Those stays were situated the first two rows from the top between the combustion chamber side and shell of boiler. To examine these stays you required to lie on top of the tubes and get your head close to the boiler shell. Should there be any scale or mud at the ends you might not notice that anything was wrong. I found out that the stays were sheared by passing a tin feeler between the stay and combustion chamber plate. As I could not get the stays renewed there and then, I decided to finish the voyage, involving eight days under steam. I then had new stays fitted. I felt quite safe in getting up steam again with the broken stays, being convinced that those stays were sheared a considerable time before we noticed the fact. As the combustion chamber plate was in good order and condition, as true as any plate could be, I have come to the conclusion that those 12 stays were not necessary for the safety of that particular boiler. This experience may give rise to further discussion on the subject of boiler staying.

The CHAIRMAN: The meeting is now open for further discussion.

Mr. B. P. FIELDEN: At the last meeting I criticised one or two statements in Mr. Lang's interesting paper, and I understood that gentleman to say, in reference to short tail shafts, that he was only referring to the Tramp Class when advocating these. I see no reason why there should be any distinction made in such a matter, as, irrespective of the kind of vessel to be propelled, the machinery should be of the best design. The tail shafts to which I made reference have a space of approximately one foot from the stern bush to the neck bush. When new this is quite satisfactory, but when the stern bush wears down to the extent of the clearance in the neck bush the latter part becomes a fulcrum. The aft coupling bolts were constantly being renewed, and on one occasion the shaft broke on the aft side of the tail shaft coupling. The trouble with and cost of stern gland packing is greater with short shafts, and the expense in the matter of renewals also heavier, the latter being inevitably more frequent, as it is inadvisable to allow the stern bush to become worn very much; in fact, when the extent of the wear equals the clearance of the neck bush the stern bush wood should be renewed.

Cylinders.—Mr. Lang does not state in his paper whether these should be of triple or quadruple expansion, or should or should not be bolted together or be in separate castings. Neither does he state how many of the cylinders should be fitted with loose , but he does state that $\frac{7}{16}$ inch should be allowed for boring out a 68-inch L. P. cylinder. There are L. P. cylinders larger than the size stated which have never required boring in ships 25 years of age.

Pistons.—There are several types, and some have advantages over others. Engines very much resemble people in that what agrees with the one has a directly opposite effect in the case of the other, and different treatments have to be applied in accordance with the different ailments. It is, therefore, useless to discuss standards on this particular part of an engine.

Piston Rods.—The same argument applies to these parts; packing suiting one engine will not do so in the case of another, and it is for the engineer to discover by test the most suitable.

Main Boilers.—At the Institution of Naval Architects' Spring Meeting a Paper was read by Mr. Morison pointing out the different results obtained by Board of Trade or other Classification Society's Rules, and I think the Institute of Marine Engineers should support Mr. Morison in his endeavour to bring about a standardisation on this matter. Nothing has been said by Mr. Lang about the most important matter of all in connection with boilers, viz., the capacity of same. All Marine Engineers know what it is to have the minimum capacity in a ship.

Auxiliaries.—In regard to most auxiliary engines, such as pumps, winches, steering gears and windlasses, these are mostly made by firms who have specialised on the making of these parts for many years, and it is a very rare occurrence for any of the good firms to be unable to supply a spare part at very short notice, and I am confident that most of these firms have and are still keeping abreast of the times.

Plenty of spare gear should be carried in all ships, as a very short delay to the working of a vessel, either at sea or in port, soon balances the cost of some spare parts.

If Mr. Lang's paper had been entitled "Second Edition of Notes upon a Marine Engine" I think it would have been preferable and useful for those who design and run engines, but, with all respect to him, I sincerely hope that no designers will limit themselves to turning out standard ships or machinery. There is, in my opinion, no finality, and unless we retain our individuality and are progressive we (whether shipowners, shipbuilders or engineers) will be left behind by other nations.

I do not know of any profession where there is more scope for individualism, and it is owing to the natural instincts of the Britisher that the Mercantile Marine of this country is what it is to-day. If we are going to make every ship alike, and continue to do so for some time, there might be some description of standard engineer produced who will have to be given some standard regulations as to what he is to do at stated intervals, but when this takes place our Flag, in my opinion, will not be very prominent in foreign parts. I have no fear on this matter; the Marine Engineer before the War was a national asset which even the discoverers of the standard ship never discovered, and there is no section of the community which has performed more useful and reliable service during the War, and in the years to come he will, as before, work to make the machinery of his ship a credit to himself and all concerned if given the right material to work with.

If there are shipowners who wish to retain cast-iron propellers rather than obtain better efficiency by paying more money for a bronze one, this being a free country, they are at liberty to do so; but so long as the shipping of the country is owned by private firms the majority of those who are successful will work for efficiency, and will not be content to keep on doing things simply because their grandfather did them, but will expand and make ships faster or larger or less costly in the matter of cargo handling. There is no finality, and, therefore, no fixed standard. I agree that the Metric System should be adopted in this country, and think the Institute should, if it is generally agreed that it would be an advantage, place on record their views.

Mr. Timpson: In the suggestion as to Classification Societies and engine builders laying down new designs. It may be an idea of the author's that there is room for a new type of engine. As the Classification Societies are the ruling authority, an improved standard for engines might tend to a better class engine being produced than what we are getting at present. Possibly Mr. Lang had this in his mind, viz., that we should have a better standard set down, without interfering with the ideas of the individual builder. At the present time parts for some types of engines are made at several places, and they are being brought to centres for assembling. If standard parts could be adopted it would tend to lessen cost of production. There is often great difficulty in getting renewals, whereas if there was some standard adopted it would save a great deal of time. Standardisation is very much before us at present, but there are a number of shipbuilders throughout the country who have specialised in a certain standard of ships, and there are engineers who only build two or three sizes of engines, and by that means they are able to favourably compete with other makers when it comes to an installation for a particular size of ship.

Mr. A. E. Sharp: This is the third paper on the same subject with which many of us have been favoured by different Institutions within the last six months, and they all have this in common, in that no decided case has been made out to show what has been lost in the past by not being standardised, or what is to be gained in the future by it. It would appear as if there were a consciousness and awakening that we have not done so well as we might, and that it is due to the want of standardisation. We would be nearer the mark in putting it down to our general business methods, which require modernising. In these three papers, issued by the N.E. Coast, Naval Architects, and Marine Engineers' Institutions, standardisation is treated from very divergent points of view, and only in the case of the first named have they focussed their attention on the subject, owing to it being the collective views of a body, as against individual opinions in the other two papers, which, it is needless to remark, have meandered away from the subject. If we are agreed that standardisation means marine machinery of the future being made in sizes, increasing by certain increments, then you will find engine builders are already equipped to cater for your wants, and even provided with elasticity in places to meet customers' views. But should common and interchangeable designs be what is intended to achieve through some form of standardisation, then individuality will be lost, and why? merely so that the smaller parts can be turned out in wholesale quantities and in all grades of material, with many objectionable expedients resorted to, to enable the parts to be worked in and made a fit. The reference in paragraph 6 of how the super-practical man of the past, present and future has kept, and is going to keep, the technical man and designer right, is somewhat amusing at the present time, when there is such a demand for the university trained engineer. It makes one uncomfortable to think what the results would be were this same practical man to attempt to design a boiler to carry the pressures now in use. In the matter of scantlings, we are advised not to touch upon the preserves of the expert calculator. What a splendid opening here presents itself to the practical man to show the calculator that what applies to the other parts of the ship if applied indiscriminately, would result in the boilers dropping through the tank, owing to the abnormal amount of wastage that takes place underneath. When we come to the present measurements in feet and inches and attempt a combination with the metric system we are immediately faced with many difficulties, and you cannot have fractions and recurring decimals in intricate calculations without causing more confusion. Imagine the consternation of the turner who has a metric lathe and has to cut a screw 9 threads to the inch, or the surprise of the fitter when handling the ·0254 metre tap and finds it is his old friend originally known as one-inch diameter. One can foresee, too, a few drills, taps, rosebits, jigs, standard gauges and other shop requisites having to be scrapped in our works, as well as pressure gauges, marine engine indicators, and the like, when the metric system has to become universal. Seeing that we are the premier shipbuilding nation, it cannot be claimed that the lack of adoption of the metric system has caused any orders to go abroad, and it is a very serious consideration to change our measurements. Miles would have to be discarded for kilometres, our charts would need to conform to it, and we would still be left with the 24 hours day. Under the heading of Shafting the author advocates the propeller shaft being as short as possible. Does he mean this to be taken seriously and literally, and some explanation on how the "beak bulkhead" affects this would be instructive. How are we to arrive at standardisation if the author begins by adding more material than that given by the rules? This is the very thing complained about by Mr. Morison in his paper, that the rules of three societies each give a different size. The propeller is a subject on which we can all air our views. By all means let us have bronze propeller blades, but take care your bronze blades do not degenerate into the thick sectioned, rough castings, and faces having all sorts of pitches, that have been prevalent during the last five years, the leading edges have been so thick one might just as well have had cast iron. Much can be said and written on boilers, and the thickness of the various plates, though it is doubtful whether it is realised that there is less superfluous material put into it than in any other part of the ship, and any differences between the rules of the various authorities will hardly affect the total weight by 5%, though alternatively one does not take it kindly when a change from one authority to another results in a reduction of pressure. The standardisation of furnaces presents many difficulties. Even with new furnaces there has been much friction between makers and builders in connection with the back flanging, so as to get the plating and water spaces to come in correctly. There ought not to be a large amount of furnace renewals without the boilers are neglected and badly treated. With the exception of three, due to carelessness, the company with which I am associated have had no furnace renewals during 20 years. It was only when the last paragraph of the paper was reached that it was realised the drawbacks the author was under in compiling it, and under these circumstances we must grant him every indulgence, and, therefore, hope he will not take the adverse criticisms too seriously. What we are particularly interested to know is, as an Institute and a body, are we to take any part in this new enterprise; if so, what shape should it take, and what should be our attitude to the other institutions that are considering the same subject?

Mr. Harvey: The last speaker remarked about the metric system. I know a firm that are using nothing but the metric system. They are building Diesel and marine engines. They do not use any other system than the metric. They find it the best and most satisfactory. Another thing is that the marine engineer often says, "An inch full." What is "an inch full?" It does not tell you anything. If you have the metric system it tells you what it is to the 1-2,000th, 1-3,000th or 1-4,000th of an inch. Again, the metric system, if used in this country, would help trade tremendously, because nearly every other country in the world uses it. Engineers on board ships fitted with Diesel engines have had experience of it for two years now, and they tell me it is the very best. They much prefer it to the old-fashioned inch. They say it is far more accurate, and they like it far better. I think it should be adopted in this country, and it would help things along quite a lot.

Mr. A. E. Sharp: I do not take any exception to the metric. system. But see the change you have to make to adopt it. I see difficulty about the two running side by side as advocated in this paper.

Mr. W. McLaren: I am pleased to say that one cannot but agree with the Author that the practical man who has the privilege of testing the care of the designer in the results by the running of Marine Engines is in a position to give his opinion on a good standard type, and that the particular firm he has been representing as guarantee chief engineer or superintendent representative appeals to him strongly, if his experience justifies. The engines of such firms as Messrs. Blair, Stockton; Richardson, Hartlepool; George Clark and The North-Eastern Marine Works, Sunderland; or the Wallsend Slipway, Tyneside, were each in their type and pattern standard, say, 30 to 40 years ago, of such a character that they worked well under continuous running in sea-going conditions. The standardisation of details was observed in a way that proof was given in one case in particular which came under my notice. An urgent message by wire from Cardiff arrived at Stockton for a tail-end-shaft, and it was delivered alongside the ship in Cardiff docks within 26 hours. In another case, the Hartlepool firm completed the erecting, fitting and fixing of engines and boilers, including a trial run of the machinery, in a new ship alongside the shearlegs within seven days. Both of these cases were vessels of no mean size for that period; the engines were of the compound type, the boilers were well made, roomy, with good circulation. I see no reason why the Triple Engine with the necessarily higher pressed boiler cannot follow suit. Since the early stage of the introduction of the Triple, when the h.p. cylinder and gear were added on top, tandem fashion, to convert the compounds of that day into triples or quadruples, the engine room space above the shaft-line remains about the same with all the altered designs of ships that have taken place, and I have never been on a ship as a member of the crew in which I could not suggest improvements. For a wholesale standardisation of engine parts by specialised firms, the Marine Engine is too large and heavy, but the firms that standardise their own set of engines will put out a more efficient machine and will keep a stronger competitive spirit to excel. in regard to steam consumption, weight of machinery and durability, combined with economy in the manufacture, by having the control of their own foundries and metal mixtures, which may not always pertain in the case of Ships' Auxiliary Machinery Firms unless these do work on a great scale. There is no doubt that bolts, nuts, screws and flanges are greatly improved, still there is much to be devised yet in seeking perfection. The author's remarks on piston rods, valve-spindles, eccentrics and reversing gear are, in my opinion, well worth considering, in order to keep these as simple as possible with the least number of pins and joints; with ample wearing surfaces and trough oiling where possible; double eccentrics, simple link motions, having, by designed provision, the advantage of interchangeability in case of breakdown. I would like to conclude with the remark that the paper is one of the best I have read in giving one the help to draw up a specification.

Mr. Timpson: I think we have got rather away from the subject that Mr. Lang had in view. I do not think he would mean to standardise all ships, which, indeed, was stated in his reply; but believe it has been common practice for various companies to standardise certain classes of ships, and some companies may have two or three classes. A superintendent to whom I was speaking on the subject told me that his company had built three classes of ships suitable to their trade. These were practically standardised. The standardising idea has been largely brought about by the coming of the motor car and motor engine, and it is no uncommon thing in the auxiliaries in common use in marine engineering. Mr. Sharp remarked upon the difficulty of getting replace parts. I think it misleading to make a statement of that kind, because you can go to makers and get replace parts that will fit exactly, either made to metric or British measurement. There should be no difficulty in the standardising of certain items for use in ships, but to standardise all ships other than in classes is apparently not proposed by the writer of this paper. In the Navy we have had certain squadrons which are homogeneous units of ships built to standard designs for certain ships in which the parts were practically interchangeable. No doubt a good deal of time and trouble could be saved if more standardisation were carried out in regard to auxiliary parts of marine engines. I agree with Mr. Fielden that we could never adopt an all-round system of standardisation without spoiling progress. I think there is a great deal to be said as to standardisation in detail; but you will never get positive standardisation in the vessels. I would like to corroborate Mr. Harvey's remarks as to the metric system being used in the construction of engines for some recent vessels. I have frequent occasion to meet with metric and British sizes to suit requirements of clients, and this on the increase.

Mr. R. Balfour: The difficulties attending the introduction of standardisation are numerous. Take the metric system referred to in the paper. This has been discussed from time to time in various Technical Institutions, and even in Parliament, and attempts made to introduce the metric system as a universal standard. In this connection I am reminded of the great controversy amongst Refrigerating Engineers, not only in this country, but in a progressive country like America, and their failure to agree to a standard unit of refrigeration. That being so, and having regard to the multiplicity of detail associated with marine engineering practice, it is only reasonable to think that it will take a long time to arrive at a standard engine. In regard to engine foundations, too great care cannot be paid to the design of these parts, the practice of terminating the girders abruptly, particularly at the after-end, should be avoided, as it tends to put undue stress upon the shafting in way of the aftermost journal of the crank shaft. The girders should extend well aft, and be gradually tapered off; the same applies to all structure in ships. Regarding "Lubricating Oils." This is a matter which rests with superintendents, who should be guided by the chemist. The quantity of oil allowed for use is sometimes limited, and if cut too fine is bound to affect wear and tear and increase the white-metal bill. Referring to propellers, opinions as to design are varied. The bronze blade is mostly favoured. Here, again, the guidance of the scientist is needed regarding the composition and casting of the metal. The pitch of the blade is also of the greatest importance. In passing, I might be allowed to mention a ready, though crude, method of comparing the pitch of propeller blades, viz., after a vessel has made a long voyage it is usual to find a deposit of marine growth on the after sides of the blades, and sometimes varying in quantity; the difference in the deposited area of the marine growth will show approximately the inequalities in the pitch of the blades. This I have proved, often by the aid of a pitchometer. In connection with propeller shafts, although not directly bearing upon the subject, I take this opportunity to refer to what might be called a remarkable phenomenon, which I have witnessed upon several occasions. As most of you know, when a propeller shaft is to be drawn in-board for examination, it is usual to disconnect one of the intermediate lengths of shafting and place it to one side, leaving its fellow-couplings a few inches apart. In many instances I have found the shafting magnetised, some cases more intensely than others. The most pronounced I experienced quite recently on a vessel which had lost one of her propeller blades, and had steamed a considerable distance under these conditions. On proceeding to examine the shafting, I found it strongly magnetised, and sufficient to hold in suspension a hammer weighing about 7lbs. between and in contact with the parted couplings, and, as I fully expected, found the body of the propeller shaft between the brass liners very acutely and deeply crowded in a zig-zag direction all over the surface. With regard to this phenomenon, I attribute it particularly to the hammering action of the propeller blades causing vibration, aggravated by the torsion, and bending action of the shafts, thus disturbing or setting in motion the molecules of the material. The very acute nature of the corroded parts, I think, is due to the tendency of the molecules to separate, thus admitting the corrosive action of a certain kind of air, which is evolved from the water in the stern tubes. In some of the worst cases the shafts were broken under the ball to ascertain the effect of the corrosion. When it was found to be from $\frac{1}{2}$ in. to $\frac{3}{4}$ in. in depth, and the granular structure of the material of a very coarse nature. As a result of this experience I am of opinion that the coarser the structure, the greater the magnetism, as in some cases it is scarcely noticeable. This phenomenon is well worthy of investigation, which might lead to enlighten those who are yet unable to account for the corrosion of manganese bronze blades in some cases and not in others. The present discrepancies between the various Classification Societies and Board of Trade Rules is not, in my opinion, the fault of the Committee of Lloyd's Register. Mr. Milton only the other day dealt with this matter in a discussion on Mr. Morison's paper, given before the Institution of Naval Architects. With regard to steam surface condensers, I believe that much less trouble would be met with if the water spaces were always kept full of water; this could easily be done by fitting a bye-pass. Most marine engines are designed to meet high temperature of sea-water conditions; the cooling surfaces and volume of circulating water necessary are computed accordingly, but when encountering comparatively low temperatures of sea-water the volume of circulating water required is correspondingly less, and consequently setting up aeration in its course, which is probably one of the chief causes of errosion or corrosion met with, particularly at the condenser tube ends. I would have liked to have dealt with the importance of the retention of heat and prevention of condensation of steam by the use of good non-conducting materials, but the subject of insulation is too important to treat in passing. Before closing my remarks, I hope the author will excuse me drifting somewhat from the main subject. I only read the paper this afternoon, so am to a great extent handicapped against the others who have come prepared. We owe a debt of gratitude to Mr. Veysey Lang for again coming forward and giving us the benefit of his large experience.

Mr. A. H. Mather: I should like to say, in my view, the principal value of this paper is that it takes one more away from generalisation. The subject of standardisation has been referred to very considerably lately, and in all cases, as Mr. Lang points out, it has been made use of as a journalistic catchword, and no one has come down to details. This paper goes beyond that, and it takes us down not only to separate headings, but it indicates under these headings the points of these particular items, which can possibly be standardised to within small limits. Taking it down into detail brings us much nearer a decision as to how far standardisation can be applied to the engines of cargo steamers. In that way the principal value of this paper can be obtained. If looked at in this light, then one can say whether standardisation would be of value. Although there has been standardisations in certain directions by certain builders, it can be carried further, and it is there that the practical value of this paper will come in. Taking separate details, such as the distance between the centre of cylinders, dimensions of piston rods and valve rods, these can be worked down to close figures, and this will not prevent any builder modifying other points where improvement or progress can be made.

Mr. A. E. Sharp: With regard to propellers: by all means let us have bronze propellers. But see that you get bronze. Also, take care your bronze blades do not degenerate into the thick section I have seen—rough castings, having all sorts of pitches. When I have gone into some of the bronze foundries I have said I should like the blades to have a knife edge, especially when going to high powers, because I know these blades have a lot to do with the vibration of a ship, in spite of the best balanced engine you can put in. There is a tendency in bronze blades towards degeneration. At the beginning there was such a keenness to make out a case for bronze blades that makers did their best, and were very keen competitors. But now in many cases the makers of the blades have settled what the scantlings of the blades are going to be, and do not care what your ship is going to do. Make sure when getting your bronze blades that you are going to get something more than you are getting with cast iron. I have seen some very good cast iron blades, but in many instances the bronze blades have not come up to the mark as they should have done. There is something to be said in favour of the pitch of the blades. In some cases the builders order the blades from the bronze founders as rough castings, and the founder, for his own reputation, cleans them up. In other cases the maker trims them up and rough-turns the flange, and that bronze blade is just as bad as any cast iron blade. Some 25 years ago I had to do with the designing of boilers, and I used to have strong arguments with the Board of Trade Surveyor. But I will say this, that I always found him very amenable to reason if there were any points as to which we had a difference of opinion. At the time I am speaking of there was a great tendency to put stays over the furnaces. It was the time patent furnaces were coming in. Previous to that the boiler got a fair amount of support in the ends from the straight furnaces, but after we got to the corrugated type of furnace a great deal of that was lost. The Board of Trade were naturally addicted to putting stays round about the furnaces, while the builders and the superintending engineers were just as anxious that these stays should not be put there, as they interfered with the accessibility of the boiler. So he said to me, "Well, I will forego that; you need not put that stay in. When the water test comes on, if there is a certain amount of deflection, and it does not exceed a certain amount, we will let it go. If it exceeds a certain amount we will have to put a stay." I think that was a reasonable way to put it. At one time we used to put all the stay tubes in of one thickness. A thought occurred to me, and that was that in many parts we were putting in additional weight and expense, so I conceived the idea of putting stay tubes in according to the loads that came on them. We had $\frac{3}{8}$ inch stay tubes, and they were called 6; $\frac{5}{16}$ inch were called 5; and $\frac{1}{4}$ inch were known as 4. When these came in from the makers they were marked. That alteration alone at that period, which is over 25 years ago, had saved £22 in the cost of an ordinary single-ended boiler in the price of tubes alone. The standardisation of furnaces presents many difficulties.

Mr. John McLaren: One point that strikes me is that it would be a good idea if all tank and bilge connections were standardised, as it is quite a problem sometimes, when dealing with a fleet of ships from all different makers, to trace the forementioned connections. Mr. Lang did not touch upon this point; that, I consider, is most important. I have been interested in the opinions expressed with regard to eccentrics. One of the most successful ships that I was in had no eccentrics at all; we had patent valve gear. There was no trouble of any sort, and, of course, no bent eccentric rods. I quite agree with Mr. Fielding where he condemns the short tail end shaft. My experience of these is that they continually give trouble; also, there is a considerable lot of trouble with the couplings at the extreme end of the tunnel, and there is great trouble in drawing the shaft in and out, as there is no room to work. With regard to the details of engines and boilers, Mr. Fielding uses the same words that I used some years ago in the Institute—that was, that the shipowner usually gets what he pays for. If you are dealing with a firm of first-class builders they will turn you out a first-class job, if paid for; but there are so many cases of cheeseparing and cutting of prices that usually the ship or engine builder supply exactly what he is being paid for. In my experience, the most well-known ship and engine builders have their own standards, and you can usually get any spares by giving due notice. No doubt when we get back to normal times we shall see greater competition than ever among ship and engine builders. New ideas will crop up and new methods. I am of the opinion that we are wandering from the subject under discussion, namely, the standardisation of ships. At the present moment standardisation is adopted to a very great extent by shipbuilders and engineers. Since the beginning of the war we have heard more about the standardisation of ships than ever. In my opinion the scheme is a very good one, but there are many difficulties in the way before it can be put into working order. Mr. Lang confesses in his valuable paper that he does not know how standardisation is to be brought about. The only thing that we can do is to put forth our views and opinions to some committee or authority and let them deal with the scheme; then they in their turn will draw up the specifications, &c., and get in touch with all the shipbuilders and engineers, who would require certain guarantees, as it must be borne in mind that a great amount of capital would be at stake, and before a shipbuilder or engineer can be asked to adopt new and different methods, they must have some guarantee against financial losses. The method of supplying spare parts by a shipbuilder or engineer as required is a matter of arrangement between the builders and the owners, because if the shipowners are willing to pay, the shipbuilder will be quite willing to stock any parts that he may require. I should regret to see in normal times the entire standardisation of ships or engines, as in my opinion it would stop progress and competition, because after all we have only got our high state of efficiency in shipbuilding and engineering through competition, and we must see that the best brains in the country are kept busy in finding out the cheapest method of production. I consider that in these troubled times that the Government should adopt standardisation of ships. I consider that we are indebted to Mr. Lang for bringing before the Institute such a valuable paper, as we know that it is all put together in his spare time, and we also know that he has very little time at his disposal. I am very sorry to hear some of the remarks that have been made upon Mr. Lang's paper to-night; the criticism has been very severe, and quite away from the point of the discussion. Again, I wish to express my appreciation of Mr. Lang's paper.

The CHAIRMAN: I must thank you all for coming here to-night. As Mr. Balfour has said, the subject was well worthy of an extended discussion, and it has been most instructive. Notwithstanding the adverse criticism some members have made, I am sure it is very flattering to the author. He has brought forward a subject in which we are all interested. I perfectly agree with several remarks made by some members about the impossibility of universal standardisation for marine engines. But I must emphasise that Mr. Vesey Lang draws particular attention to the cargo steamer alone, and in my opinion a great deal could be done in standardisation of engines for this type of ship. I think he says about two-thirds of the merchant service is comprised of tramp steamers. This class of ship goes to any part of the world, she carries any cargo, and does her work well. If the engines of tramp steamers could be standardised to some extent, in my opinion it would be a great assistance to the management and to superintendents if renewable parts could be got without difficulty and at short notice. With these few remarks, I just want to thank you all again for coming here to-night and contributing to this valuable discussion. I also invite any of you to send in your further remarks as correspondence. When these are put before Mr. Vesey Lang he will be able to put a very interesting reply before us. In connection with materials, Mr. Balfour has emphasised the necessity of knowing what bronze, cast iron, and brass really are. I want to draw your attention to the fact that this day week we are going to have a paper on this subject by Mr. J. T. Milton, Vice-President. The subject is "Brass and other Copper Alloys used in Marine Engineering." I want you all to make this known to your friends, and let us have a bumper meeting. I think we should make a special effort to come and hear Mr. Milton read his paper next Tuesday night. I know Mr. Milton has devoted a great deal of time to its preparation, and I am sure it will be one of great value to the members of this Institute and to the whole of our profession throughout the country. We know far too little, as engineers, of the quality of metals. So I emphasise the necessity of all attending next meeting.

Mr. Sharp: What we want particularly to know, in connection with this paper, is: "As an Institute and a body are we to take any part in this new enterprise; and, if so, what shape it should take; and what should be our attitude to the other institutions that are considering this subject? Has anything been said about co-laborating with them?"

The Chairman: There is nothing arranged, but I think there is an opportunity if considered desirable.

Mr. Sharp: Is there any intention on the part of the Institute to follow this up beyond the scope of the paper?

The Chairman: You can propose that the Council should consider the question.

Mr. Fielden: I suggest that it be proposed at the Annual General Meeting next month. There is time set apart for other business. I think that is the time to consider whether standardisation should be considered by the Institute.

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Notes.

Bearing on the discussion which took place on Mr. W. Veysey Lang's paper, the following editorial appeared in *The Shipbuilding and Shipping Record* of May 17th, 1917. It may, however, be noted that the author of the paper dealt with sea conditions from his own experience, and not with estimated theoretical or calculated results:—

FULNESS AND SPEED.

In his reply to the discussion on his paper on "Standardization of Marine Engines for Cargo Steamers," Mr. Veysey Lang made some striking and interesting remarks regarding the influence of coefficient of fineness on the speed and power of full cargo ships. He said:—"The same deadweight with the same horse-power would propel at speeds that varied as the coefficient of the submerged hull. For instance, a ship of, say, 8,000 tons and 375 ft. length with a coefficient of ·79 would steam $8\frac{1}{2}$ knots; a similar deadweight at 400 ft. length and ·78 coefficient at $9\frac{1}{2}$ knots; and a 425 ft. length ship and ·77 coefficient, $10\frac{1}{2}$ knots, all with the same power." From a casual investigation of the figures given, one is inclined to the opinion that Mr. Veysey Lang has rather overstated the case in favour of the fine ship. If it be assumed that a deadweight displacement ratio of ·71 be obtained in the ship of ·79 block, of ·70 in the ship of ·78 block, and ·69 in the finest vessel, the displacements become respectively (1) 11,280 tons, (2) 11,440 tons, (3) 11,600 tons. Assume now as low a constant as 200 in the case of the slowest ship, the horse-power required would be 1,540 for $8\frac{1}{2}$ knots. This power for the ship of ·78 block at $9\frac{1}{2}$ knots speed would give a constant of 285, and for the ·77 ship at $10\frac{1}{2}$ knots speed a constant of 382. For calm water conditions the differences given are far too great. Considerable attention has recently been given, however, to the effect of sea conditions on the performances of full ships, and when the records of voyages are examined, the figures submitted by Mr. Lang receive more justification. In our Special Issue of January 3 of this year we published curves given by Mr. Hamilton, of Liverpool, showing the effect of fulness on sea speeds. From these it is gathered that with a given deadweight (differing only slightly in three cases) the average speeds on 15,000 mile voyages for practically the same coal consumption per day were (1) for a ship of ·765 block, 10·2 knots, (2) for a ship ·777 block, 9·16 knots, and (3) for a vessel ·806 block, 8·1 knots. These are very striking figures, and bear out Mr. Lang's rather forcible illustration.

THE STANDARDIZATION OF ENGINEERING MATERIALS.

This subject was taken by Sir John Wolfe Barry for the James Forrest lecture for 1917, which he delivered to the Institution of Civil Engineers. He dealt specially with the work of the Engineering Standards' Committee and the importance of the recommendations from a national point of view. The following report of the lecture appeared in *The Shipbuilding and Shipping Record* of May 10th :—

Sir John Wolfe Barry, K.C.B., F.R.S., delivered the 25th James Forrest lecture before the Institution of Civil Engineers, and chose the above as his subject. After an appreciative reference to the work of the late James Forrest, the author gave a resumé of the work, past, present and future of the Engineering Standards' Committee, and a consideration of the general subject, which is nowadays embraced under the word "standardisation." The first notable step taken in this direction was by Sir Joseph Whitworth, about 1841, when he urged and obtained the adoption of the Whitworth screw threads, which came to be adopted here and in all countries. They remain as standards to this day, though extensions and modifications of the Whitworth original series have been found to be desirable and have been made.

The extension of the principles of standardisation, however, slumbered in our country, and nothing of a general nature was set on foot until January, 1901, when the author brought before the Council of the Institution of Civil Engineers the urgent need of systematic standards to replace the increasing confusion in engineeirng manufactures due to engineers who designed the work, and manufacturers who executed it, being without general guidance as to the readily available form and composition of the manufactured articles or their component parts. Such being the ordinary conditions of the engineering industries, the truth of which became still better known as the subject was investigated, on the author's suggestion, a committee was appointed to consider the subject fully and to report. This committee, after careful study, recommended that a commencement should be made by drawing up standards for rolled sections of iron and steel for structural works and shipbuilding, and suggested that, together with other societies, the Institution of Naval Architects should be asked to co-operate, which invitation was cordially accepted. It was agreed that the committee should not be merely an academic body, but one in the closest touch with the practical requirements of consumers and producers through the engineering profession, and through the managers and chief officers of the great manufacturing undertakings, and in close touch with modern scientific knowledge and discoveries. What was of the utmost importance, it was agreed that the work of the committee should at all times be subject to revision, so that improvements could be incorporated, and that the various trades should not become hide-bound, nor their methods stereotyped.

The whole subject of standardisation began to stand out as one of national importance, and it was decided to approach the Government to join in the movement by their support and financial assistance; as a result of this, the Treasury expressed their willingness to include the sum of £3,000 in the Estimates for 1903-4 as a contribution to the funds of the committee for that year. This financial support was subsequently extended over the years 1904-5-6 by a grant-in-aid, equal to the amount contributed by the supporting institutions, with an unfortunate maximum of £500, and a further grant on the same conditions is being continued for the three years ending March, 1919. The Indian Government also made a grant of £1,000 towards the general expenses of the committee in recognition of the work done in the interests of the country. The total contributions towards the expenses received gives an average of £2,150 per annum, and the total expenditure of the Committee since its formation in 1901 to March 31, 1916, gives an average of about £3,400 per annum, not a large sum in view of the work accomplished, and contrasting somewhat strangely with the very liberal expenditure of the Bureau of Standards in the United States. The balance of the expenditure is made up from the sales of its publications, which have to be kept undesirably high in order to make both ends meet.

Demands have recently arisen for the standardisation of cargo ships and of agricultural machinery. * In neither case have the demands assumed, as yet, an official character, but if such takes place the Standards Committee will no doubt be prepared to act. Arising out of the War, the Standards Committee have arrived at the conclusion that there is urgent need for steps that will assist our engineering manufacturers in competing successfully in foreign markets, and certain recommendations have been made with this end in view. The developments thus agreed upon will cost money, both in the first place and annually; to meet this, the Government have made a grant of £10,000 towards the expenses of the new departure, and the trades concerned have contributed a sum of close on £13,000, thus enabling the publications of

* Steps have been taken now to deal with the machinery of cargo steamers, and a Committee has been formed to deal with the subject.—J.A.

the committee to be translated into French, Russian and Spanish, with metrical equivalents for the British measurements and formulæ, and the cost of all publications to be reduced to a flat rate of 1s.

The following letter appeared in *The Marine Engineer and Naval Architect* for August, 1917:—

STANDARDISING MARINE ENGINES.

Dear Sir,—I see that the North-East Coast Institution have issued their revised plans of the above specification, and note the alterations generally are, I consider, an improvement over the original draft, and which I trust will be generally adopted. Of course, it can only be expected in cases where new designs are being evolved, or where patterns are so worn out as to enable the improvements to be adopted, because you cannot expect an engine to be standardised like Whitworth threads. Personally, I cannot understand why this was not done long ago, and so have saved the Superintending Engineer's time, which is usually taken up with the old work. No doubt the Consulting Engineer will be needed more than ever, because the owner will be persuaded to take a certain standard engine which may not be at all suitable for the ship; in fact, the Manchester Canal Bridge restrictions are causing more "White Elephants" than the owner and his Superintendent realises, whilst the blame is put on the boiler. It would be well to seriously consider Mr. Veysey Lang's paper also on this subject, read before the Institute of Marine Engineers, and which generally disposes of any further comments I would make on the practical side of the question. I might, however, here say that Marine Engines are altered in size for every 200 h.p. below 1,000 h.p., with an increase of variation of proportionate difference at every successive 1,000 h.p.

I understand that it is only the maker of the cargo boat engine that will be expected to adopt this specification.

Yours truly,

EXPECTA CUNCTA SUBERNE.

Election of Members.

Members elected at a meeting of the Council held on Tuesday, August 14th, 1917 :—

As Members.

J. E. Annear, Merthyr House, Cardiff.

Harold Bullen, 53, Market Street, Ashby-de-la-Zouch, Leicester.

Peter Watkin Clarke, 121, Bedford Hill, Balham, S.W.12.

James Stanley Erskine, 2, Hunter Terrace, Sunderland.

Peter McFarlane Marshall, Alpine Villa, Cardross Road, Dumbarton.

W. Stoddart, 14, Heidelberg Road, Southsea.

As Associate Member.

Sydney Pearson Inman, 13, Plashet Grove, East Ham.