Our President is a welcome successor to those who have preceded him in the office and his address will be read with interest.

Born on March 9th, 1877, he was educated at Eton, a King's scholar, and afterwards at Trinity College, Oxford. He rowed for Eton in an VIII that won the Ladies' Plate at Henley in 1895, and stroked for Trinity College fours that won races in 1896 and 1897.

His Father was J. G. S. Anderson of Messrs. Anderson, Anderson & Co., and his Mother Elizabeth Garrett Anderson, M.D.—the first English medical woman.

After leaving Oxford in 1897, he entered the office of Messrs. Anderson, Anderson & Co., Managers of the Orient Line, he became a partner in 1900, and afterwards Director and Deputy Governor of the Bank of England, and Director of the London, Midland & Scottish Railway.

In settling to work in London he joined the London Scottish. In 1916/17 he was Vice-Chairman of the Royal Commission wheat supplies. Chairman of the Wheat Executive which bought and regulated the supply of wheat and grain to Gt. Britain, France and Italy, for the arrangements in connection with this, he went to America with Lord Balfour in 1917. In 1917/8 he was Controller in the Admiralty, and later was Vice-Chairman of the Food Council, with Mr. Clynes as Chairman.

In 1922 he served as High Sheriff of the County of London, Renter Warden of The Fishmonger's Company, and Hon. Secretary of King Edward's Hospital Fund, Chairman of Hospital Savings Association; Hon. Treasurer London School of Medicine for Women; Vice-Chairman Re-union of British War Missions to the U.S.A. He served for a term on the Board of Trade Advisory Committee to September, 1926; as Chairman of the British National Committee of the International Chamber of Commerce, 1925/6, and President of the International Chamber of Commerce, 1926/7, prior to which, 1924/5, he was President of the Chamber of Shipping.

THE PRESIDENT.

SIR ALAN G. ANDERSON, K.B.E., Officer Legion of Honour Commander, Order of Crown of Italy.

INSTITUTE OF MARINE ENGINEERS

INCORPORATED.

Patron: HIS MAJESTY THE KING.

SESSION 1928.

President: SIR ALAN G. ANDERSON, K.B.E.

VOLUME XL.

Presidential Address.

BY SIR ALAN G. ANDERSON, K.B.E.

DELIVERED ON

Tuesday, September 18, 1928, *at* 6.30 *p.m.*

You have made me your President and I thank you. To be for a year the official head of the Society of the Marine Engineers is an honour which any shipowner would appreciate. And for personal reasons your invitation was for me particularly pleasant. Since I made my first long ocean voyage more than 40 years ago I have known many marine engineers, each man with a difference from the others, but all more true to type than is usual in most professions, and I feel that I know and like and trust the marine engineer. I am, therefore, particularly glad to be permitted for this one year to rank myself as one of you.

It is your custom to choose in turn as President a professional engineer and an "ignoramus," and as last year you chose that distinguished engineer, Captain Onyon, you will not expect me to pretend to technical knowledge; but I do know that on your profession my trade of ships depends and that without it the civilisation of the modern world could not have been built up.

Just as your President is not always professional, so it seems to me the marine engineer is distinguished from other professional men. Generally the professional man differs from the trader, not only by his learning or by his dignity or his black coat, but still more because he may be supreme in his profession, a great thinker, and by his thought the father of enterprise, but in practice remote from the bread and butter troubles of the world. Not so the marine engineer. He must always keep one foot at least on a solid platform of fact. Half of him may theorise but the other half must be a man of affairs controlling men and machines and money, disposing to the best advantage of strictly limited resources.

The Chief Engineer must at once satisfy himself and keep touch with a shipowner ashore and the captain afloat, but when the Chief Engineer is a fair sample of his profession, the task of accommodating three distinct views without a clash is reduced from a complex to a simple problem. Here the professional man in the marine engineer steps forward. The " BEST " will satisfy him and if the owner or captain want something else, they must, in fact, if not in form argue their case before the professional judge, and sometimes the professional must agree. The " BEST " may cost too much in time or money, and time and money spell risk in business and navigation, so that what seems the " BEST " may prove disaster. Professionally there is an absolute best, but in business the better may be the enemy of the good. It is sometimes urged in every business that the technical expert ought to take charge and as in the business of ships the marine engineer is an indispensable expert, more technical and more specially trained than any other officer afloat or ashore, ought he then to be supreme on the ship and on the same argument in the Boardroom? The idea of expert control is attractive and is constantly being discovered afresh. Why should not the surgeon preside over the hospital, the civil servant be Chancellor of the Exchequer, the mechanical or civil engineer control the railway, and in our trade of the sea the marine engineer command the ship, and either he or the navigator become Chairman of the Shipping Company? I don't myself agree with this theory of technical control, but to be fair to it, the command of ships seems to have moved away from amateur towards expert control.

Four hundred years ago the Commander of a warship or a navy could not be a marine engineer—for the best of reasons—but he was not even a navigator and often not a seaman. The

Duke of Medina Sidonia, a first-class grandee, had no liking for the sea—no skill in handling ships. If his wife is to be believed, he was unfitted to be trusted with any critical undertaking, and he seems to have shared his wife's view, at least about this particular command: " From my small experience of the water," he wrote to King Philip's Secretary, " I know that I am always seasick. The Expedition is of such importance that the person in charge ought to understand navigation and sea fighting, and I know nothing of either. . . . The Adelantado of Castile would do better than I; our Lord would help him, for he is a good Christian and has fought in naval battles." In spite of this convincing reluctance the Duke of Medina Sidonia was in our modern phrase " for it "; he was a grandee and that was enough. Our British Admiral, Lord Howard, was a soldier too, and though his conduct has been criticised and his victory credited to Drake, he was less at sea than his Spanish rival in the crisis—perhaps because he had in his life been more " at sea." I venture this pun to explain the failure at sea of non-technical control which has succeeded ashore. The whole life of the sea, the language in which the sea states its problems are so alien to a landsman that his helplessness in the new element has been fixed in our language like a fly in amber;—he is " at sea "; for this reason the attempt to use a landsman to manage at sea a ship or a navy failed. Nowadays a seaman controls with general assent, but only after long trial of the other plan. The first fleet of three merchant ships to carry British trade overseas in the reign of Edward VI. was commanded by Sir Hugh Willoughby. Poor Willoughby! he was brave but he had not grasped the great rule which every seaman or shipowner or marine engineer must learn who meets forces greater than man can control and risks that man cannot foretell. To keep his ship or his life or his trade his policy must square with facts. He must confess mistakes even to himself, he must know that he " does not know " and has only guessed and may have guessed wrong. None of us would blame a man who could not know because his guess was wrong but, unfortunately, at sea, if you guess wrong and obstinately act upon your wrong guess, you will probably die and that is what happened to Sir Hugh Willoughby. The ship was held in ice, he and his whole complement perished because poor Willoughby had sworn that the North East passage to Cathay existed and he refused to listen to the sea when it told him he was wrong. The other ship commanded by a man of less distinction ashore forgot about the North East passage and discovered Russia and our trade to the East.

Speaking to marine engineers I use this early expedition to check what the steam engine has done for us. The fleet of merchant adventurers of London left the Thames in May and did not finally clear Orford Ness for six weeks. At that speed how immense the world was before the marine engine! The other day a tablet was placed at Blackwall to commemorate the start of the first settlers of Virginia 300 years ago. They sailed in three ships, the biggest only 105 tons and it took them four months to get to America.

Then nations were separated by the sea which now unites them and because they were separated what they thought comfortable we should not think decent. Here is one spot light on the past. In the Middle Ages two principal imports of the United Kingdom were spices and perfumes. Our ancestors lived on such of their summer food as they could salt or cure or dry and very bad it was—so nasty that the wealthy bought for their own weight in gold spices that came from the East in caravans and then by ships of Venice or overland. Thus, instead of hiring a Sanitary Inspector to nose out and condemn bad meat and fish, our ancestors used spice to hide its badness, and on the same theory they used perfumes instead of soap. It appears from the chronicles that Queen Elizabeth—a woman in advance of her times—had a bath in her palace and used it once a month whether she needed it or not. History is so busy about wars and laws that it forgets the bad fish and bad smells, which would mean so much if we suddenly woke up in the Middle Ages—but to marine engineers I need not explain to whom it is that we owe the cheapness and plenty of good meat and fruit and bread.

Even if we remember how far we forget how fast the steamer has carried the world towards comfort and civilisation. Steamers began after Napoleon's wars. Sailing ships tonnage was still growing until after the Franco-Prussian war in 1870. The modern age of good food and cheap comfort which corresponds with steam at sea is therefore scarcely yet one lifetime. The motor ship at sea and motor transport ashore will, to our successors, date their maturity from the end of yet another Great War, but the marine engineer accommodates himself to each change of engine and, if necessary, he will go aloft and navigate the air instead of the sea. The mechanical transport which began perhaps 80 years ago is not threatened by developments of to-day, but progress is hastened.

To show how fast and far we have moved in these last 80 years—in 1847 sailing ships carried almost the whole over-sea trade of the world. 3,000,000 tons of sail in that year and less than 150,000 tons of steam. The population of the British Isles was then 27,000,000 and is now 45,500,000, an increase of 68 per cent. The great population of to-day is living notably better than the small population of 80 years ago. For a population that has not doubled we import nearly 20 times as much butter, to say nothing of other dairy products.

Each of our predecessors 80 years ago ate three foreign eggs in the year; to-day each of us eats 84 foreign eggs, as eggs or in buns, etc.

Of wool we are importing 14 times as much as 80 years ago. If the steamer is responsible for the better living of the world, it is responsible also for taking the population to, and the wool from, Australia and for halving the distance that separates that new continent from the world.

Eighty years ago we imported practically no meat, whereas last year we imported over 30 million cwt. of meat.

Even the figures of an alleged decayed industry such as whaling are fairly large. We imported in 1927 of whale oil over 53,000 tons.

If anyone thinks that these figures simply mean that we are buying more abroad and producing less at home, let him consider luxury imports as a test of our standards of living. Sugar has risen from 34 lbs. a head to 58 lbs. a head and tobacco from 1·3 to 5·8 lbs., while even of wine—and our grandfathers are not supposed to have stinted themselves in wine—we import to-day more than double their imports.

So much for figures of comfort. The marine engineer does not claim the whole credit for this notable advance in the steam age. But, as the inventor lights up dark places, the marine engineer keeps the light burning and needs not only brains but the heart and understanding which make a happy ship and a successful business. Last year your President spoke about personnel. I touch no controversy when I say that every year as our mechanical knowledge improves the marine engineer grows in importance relative and absolute. To be healthy a profession must reward its votaries. If the pay and position of the marine engineer do not keep pace with the marine engine, if the right men are not tempted to serve, the marine engine will suffer and not the engine alone. All of us depend on sea-transport and we shall all suffer.

I have given you a few general figures to show the effect of the steam age on our comfort. Here are some technical figures. Forty years ago my firm chartered sailing ships for grain at rates 30% higher than are charged by a modern steamer to-day, and as each £ to-day is only worth about 11s. 6d. of 40 years ago, the real comparison is not between a rate of 35s. now and 46s. then, but between 20s. 1d. now and 46s. then. The difference in risk and time cannot easily be expressed in money, but imagine what the producer and underwriter and banker would say if they were told to-day that, instead of shipping in a steamer, they must entrust their precious cargo or their lives to a clipper ship and pay more than twice as much for a voyage at about one third the speed at a risk how much greater I hesitate to guess. To keep the prosaic steamer and avoid the romantic sailing ship there is no boon that the world would not gladly pay if the engineers of the world could hold the world to ransom. I suggest this merely as a test of the value of the marine engine and the marine engineer and not as a practical policy of blackmail.

You know better than I do how technical progress in engines at sea has gone ahead and prepared the way for less cost at less risk and more speed. In my lifetime the steam pressure has risen from the compound at 60 lbs. per square inch to the triple at 120 to 180 lbs. per square inch, to the quadruple and the turbine at 215 lbs. per square inch and economy has kept step with and justified this technical progress. The indicated H.P. which cost 2 lbs. to $2\frac{1}{2}$ lbs. of coal per hour in the old compound and $1\frac{3}{4}$ lbs. in triple, $1\frac{1}{2}$ lbs. in quadruple, has now gone down to little more than 1 lb. in geared turbine and we watch with interest to see whether high pressure steam with water tube boilers and a consumption of 0·66 lbs. of oil per shaft H.P. or the electric drive to link and get the best out of the fast turbine and the deliberate propeller or the internal explosion engine with consumption down to 0·4 per S.H.P. hour will prove best in use.

Apart from the main engines it would shock the Chief Engineer of 20 years ago to see the electrical plant his successor of to-day handles. My first voyage to Australia was on the first Orient ship with electric light, and on rough nights it went out. Twenty years ago electricity was allowed to ring bells and light lamps, but was "uncertain, coy, and hard to please"—something feminine and scarcely fit for hard work. Now fans, hoists, winches, cooking, capstans, windlass—all these electricity takes in hand and by this change the first cost of the ship has gone up and modern economy in fuel has been reached. By electricity and by the marine engineer who can keep this plant in order the engine has been revolutionised. If consumption has been divided by four or five the responsibility of the marine engineer has steadily risen and the men have as steadily risen to the occasion and fitted themselves for their new duties. These are the men and this is the profession for which your Institution speaks and over it I am proud to preside.

Mr. W. E. FARENDEN (Chairman of Council): It is my pleasing duty and pleasure as Chairman of the Council to propose a hearty vote of thanks to our President, Sir Alan Anderson, for the very interesting and instructive address he has given us this evening. I feel quite sure that our members, afloat and ashore, who are unable to be with us to-night, will read our President's address with much interest.

We are fortunate in having Sir Alan for our President, he being associated with the Orient Steamship Company for so many years, and having such a wide and varied experience in the shipping world. We thank you, Sir Alan, for the very kind reference you have made to the Marine Engineer, and we too are proud to have you as our President.

Mr. GEO. ADAMS (Vice-President): Gentlemen, it is with great pleasure that I rise to second the vote of thanks proposed by the Chairman of Council. It is indeed a pleasure to us of this Institute, as already stated by the Chairman, to have as our President one who occupies such an eminent position in the shipping world, and moreover one who is sympathetic towards the aims and aspirations of the members of our profession. We have noticed that the address which he has given us this evening is a retrospect and a resumé of experiences in the past, many of which we older members of the Institute will recall. The advances which have been made in the types of engines, and the experiences of good and bad machinery to which Sir Alan has referred come home to many of us, and through these necessities for improvement the younger members of to-day enter into their heritage. Sir Alan occupies a worthy place amongst those gentlemen who appreciate the difficulties of marine engineering. Shipowners such as he and marine engineers work together with one purpose. Sir Alan refers in his paper to a "happy" ship. Probably many of those present, like myself, have been in happy ships and otherwise. If otherwise, it arose from the fact that there did not seem to be that bond of sympathy between the engineers and the owners. The engineers were there to get the best they could out of the plant at their disposal, and to do the best for their owners and to show that as engineers they were endeavouring to find the greatest value of the coal supplied to them (always twenty hundredweights to the ton !), remembering that owners, as Sir Alan has said, should recognise that the labourer is worthy of his hire, and that the hope of reward sweetens all labour. When we find owners such as Sir Alan, no wonder we can account for the smile on the faces of the engineers when we go down to that wandering place, the Tilbury Docks, when we recognise that the spirit of harmony has descended from the City here and gone right down to the docks and the ships. We are fortunate in having with us Mr. Peacock, while others of the Orient Line who served us as Vice-Presidents and good workers in the past have gone to the Great Beyond. When we think of those, both past and present, we always remember that they are members of the Company whose ship His Majesty the King thought THE ship in which to make his memorable voyage to Australia. In conclusion, I will only ask you to respond generously to this vote of thanks, and to share my hope that at the end of his term of office Sir Alan will feel that it has been a pleasure to be for one year the President of the Institute of Marine Engineers. (Hearty applause).

The PRESIDENT: I thank the proposer and seconder and yourselves for your very generous vote of thanks. I have already thanked you for allowing me to be your President, and now I thank you for thanking me for being here! Reference has been made to the effect of sympathy between the various personal units of a shipping company in all its undertakings (Loud applause.)

Sir J. Fortescue Flannery (P.P.), Engr.-Capt. W. Onyon (P.P.), A. E. Laslett (V.P.), H. G. Dixon (Vice-Chairman of Council), and Jas. M. Dewar (V.P.), expressed regrets that they were unable on account of other calls away from London, to be present to-night to welcome the President.

At the close of the meeting an adjournment was made to the Library, led by the President, who remained a short time, having another meeting to attend. Refreshments were served and opportunity was afforded for conversation with members who had not met for some time. A sample of pulverised fuel was kindly exhibited by Mr Geo. Adams, to those who were interested in it, and the process through which it had passed, described, with also the arrangements for its service in the boilers.

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Notes.

In a letter to "The Times," September 10th, Mr. Ernest J. P. Benn, referring to the divergent views expressed by writers and speakers on the causes contributing to the lapse of industry and consequent unemployment, quotes the following from Defoe:—"An Englishman who had lived long in the City of Casan upon the Wolga, and was, it seems, concerned in the great Salt Mines there, had observed with regret the great vast luggage boats, as we might call them, and which he called Ballatoons, carrying goods by the river from Astracan and from the Caspian Sea, and perhaps from Persia, to Moscow; these boats, as the relater told me, carried a prodigious burden, from 100 tons to near twice as much; but were unwieldy, heavy, ungoverned things, and required, as they might well do, a great many hands to guide, and perhaps to tow them up against the stream of that mighty river, and the distance being above 1,800 miles too, they were in proportion a long time on the voyage. The Englishman fancied with himself that he could contrive a kind of vessel, that though it should not carry quite as much burthen, should yet carry 100 tons, and should by the help of sails and good management, perform the voyage in much shorter time and with much fewer people.

N.B.—These Ballatoons, it seems, had each 100 to 120 men employed in them to drag them along, and the Englishman proposed to do the same work with 18 or 20 men, and perform the voyage in about one-third of the time.

Big with his project and expecting to be very well accepted at Court and rewarded too, away goes the Englishman to Moscow, where after some attendance and making known to some of the Bozars and Great Men, that he had a proposal to make to the Great Duke, that would be very much to the advantage of their country and for the advantage of the capital city, and the like, he obtained audience, and laid the whole scheme before his Majesty.

The Grand Duke (for they did not then call him Emperor) took the thing very readily, and at the second and third audience, called him to him and began to question him about several particulars, but chiefly this: "How many men were employed in those boats before?" And then the Englishman answered "120." "And how many will you perform it with?" says the Grand Duke. "18 or 20 men at most," says the Projector. "And how long time are my subjects performing the voyage now?" say his Russian Majesty. "About 4 or 5 months," says the Englishman. "And how long will you perform it in?" says his Majesty. "In about two months," says the Englishman.

Upon this the Great Duke stopped and looked angrily, but seemed to be musing, as if he was calculating the thing; after some pause, he turns to the Englishman, "And what countryman are you?" say his Ducal Majesty. "An Englishman," says the Projector. "Very well," say his Majesty, "'tis well for you that you are not one of my subjects; do you come hither to set up projects to starve my people? Get you gone forthwith, and with the utmost expedition, out of my dominions upon pain of death. You perform that work with 18 men which now 120 men are employed and get their bread by! What must the 102 men do that are to be turned out of their business; must they perish and be starved for want of employmen? Get you gone," add his Majesty, "And see my Court no more;" and immediately gave orders for having him carried away directly to Novogovod on the frontier of Muscovy, towards Livonia and the Swedish dominions, lest he should propagate such dangerous inventions as should lessen the employment and labour of his subject.

The foregoing calls to mind the enterprising experience of Peter the Great; also the troublous days when machinery inventions came into being at the cotton Mills.

The following article by Engineer-Capt. W. Onyon, Past President, was published in "The Shipping World" of June 27th:—

Steam *v.* Internal Combustion Engines.—A Review of the Present Situation.—*The most important contribution

* At the Centenary Celebration of the Institution of Civil Engineers.

to the discussion on the paper by Lord Weir and Mr. Harold Yarrow on "High Pressure Superheated Steam: Its Generation and Utilisation for Marine Propulsion," and Professor Hawkes's paper on "Progress in the Adoption of the Internal Combustion Engine for Marine Purposes," was that by Mr. John Johnson, the chief superintendent engineer of Canadian Pacific Steamships, Ltd. Mr. Johnson has shown the world that it has been established beyond doubt that high pressure watertube boilers can be successfully and safely operated under all conditions experienced in the mercantile marine. Pure distilled feed water is the crux of the situation and has been the practice of the Navy; distilled water only is recognised as the one possible safe boiler feed water.

The advent of a reliable condenser tube has made the necessary conditions possible, and the cupro nickel tube, containing 30 per cent. of pure nickel and no zinc, has proved itself up to the present, and after several years' tests, to be perfectly satisfactory. It is, however, expensive. There are several other compositions under tests, including (in a British cruiser) a melloid tube, the material of which also excludes zinc, and which melloid material was supplied by Messrs. Bull and Co., of Yoker. This has the advantage of comparative cheapness.

The reduction in the cost of marine transport referred to in Lord Weir's paper depends—as Mr. Johnson points out—chiefly on the first cost and the fuel bill of a vessel. Mr. Johnson gives us some most interesting figures showing the fuel consumption of the *Empress of Australia* and the *Duchess of Bedford* respectively. In the latter case, watertube boilers with 350 lb. pressure and steam of 680° Fahr. temperature, have been adopted, and in conjunction with six watertube Yarrow boilers, two Scotch boilers are used, working at medium pressure, from which "steam supply," water losses of the main watertube boilers are replenished, all auxiliary condensate and the whole of the make-up feed required for the whole system being led to the Scotch boilers. With this arrangement Mr. Johnson claims that not only are the water losses in the main system automatically replenished with additional pure condensate, but by means of a connection from the Scotch boilers to the main condensers through a reducing valve, distilled water may be made in bulk at sea or in port, for filling reserve feed tank or boilers.

Mr. Johnson also compares costs and weights, and states definitely that at each stage of the steam developments with which he is associated, after careful comparison of costs with alternatives based on the use of motorships, the advantages lie unquestionably with high pressure watertube boilers and steam turbines.

A Brilliant Innovation.—The idea of the installation and combination of high pressure watertube boilers and Scotch boilers, under the methods adopted by Mr. Johnson—and quite differently arranged from the method at one time adopted in our Navy—is unquestionably brilliant and quite novel, and such an idea carried into practice, as has been done in the case of Canadian Pacific Steamships, shows that in the chief superintendent engineer of this large and important company, we have a man of initiative who has shown his pluck in breaking away from old traditions.

The figure shown as the fuel consumption in the *Duchess of Bedford*, viz, 0·64 lb. of oil fuel per shaft horse power hour, *for all purposes*, which is a substantial improvement on the figure for the *Empress of Australia* (fitted with cylindrical boilers), viz., 0·74 lb., is easily a " best on record."

During the discussion in 1925 on Sir John Bile's paper, at the Institution of Naval Architects, on Relative Commercial Efficiency of Internal Combustion and Steam Engines for High Speed Passenger Vessels, the author of this article stated as follows:—

The steamer *Conte Verde* runs at a speed of 19 knots per 16,500 s.h.p. and uses 155 tons of oil fuel for all purposes per 24 hours. If we are allowed to fit Diesel generators and drive all our auxiliaries electrically, and if we can fit pre-heaters in the boilers, we can get down from 155 tons to 124 tons per day. That is from 0·876 lb. per s.h.p. hour to exactly 0·7 lb. per s.h.p. hour.

Mr. Johnson has adopted both these improvements and has gone one better by fitting watertube boilers with high pressures and high superheat, which combination gives him the wonderful result of 0·64 lb. of oil per s.h.p. hour for all purposes. He is to be heartily congratulated. In the discussion which followed the papers to which reference has been made, Mr. Stanley Cook, technical director of Messrs. Parsons Marine Steam Turbine Company, Ltd., quoted a figure given by Sir Charles Parsons for consumption of oil fuel per s.h.p. hour for turbines alone as 0·57 lb. as a best possible under certain conditions. With electric auxiliaries and oil electric generators, Mr. Cook calculated an "overall" consumption of 0·62 lb. per s.h.p. hour, which Mr. Johnson's figure closely approaches.

Steam Drums.—Mr. Arthur Spyer, head of the marine department of Messrs. Babcock and Wilcox, Ltd., stated that the use of coal was a national matter. Hand firing was out of date and mechanical stokers were available. Mr. Spyer also referred to "solid drawn" drums, but suggested that riveted drums could certainly be made for pressures up to 650 lb. per sq. in., and were in use in land boilers of 800 lb. pressure. It would seem that if it is possible to forge the drums from the solid, this is preferable. With a solid drawn steam drum, it is possible to have one manhole only at one end of the boiler, the other end being solid; but as a matter of convenience in tubing boilers, the boiler maker prefers to have a manhole at each end.

Mr. Andrew Hamilton of Liverpool stated that the measure of the machinery installation was "the ability of the third engineer to run it." Such a remark, it is submitted, applies equally in the case of an internal combustion-engined ship, and perhaps even more so. It is recognised that the members of the engineering staff have a pretty hard life at sea; and in harbour get few chances of visiting the shore. They, therefore, want every consideration, and should be well paid and highly trained.

I advocate the use of steam dryers in all watertube boilers, to prevent the possibility of disaster if priming occurs. In my remarks on these two important contributions to this history of marine engineering I referred to the results of Italian liners' recent voyages to South American ports. It is a fact that the high speed steamship from Genoa to Buenos Aires has made for three years, eight round voyages a year with ease without a day's delay or hitch anywhere, while the two motorships of similar high speed design, after two voyages each, disappeared from the route and were laid up for repairs.

To sum up, the impressions formed from the discussions on the two papers referred to, were, that both internal combustion engines and steam turbines with watertube boilers and high pressures and high superheat, had their uses; but that for high speeds, the Canadian Pacific vessels designed for steam pressures with watertube boilers of 350 lb. per sq. in. and upwards, and steam temperatures of 680° Fahr. have shown us—if it were really necessary to demonstrate the fact—that for high speeds it is not necessary to look for any other form of drive, and that for lower speeds the watertube boiler with high pressure and temperature with automatic stokers burning British coal, will, in future, prove a great rival to the Diesel engine.

From the "Marine Review," New York, January issue : :—

GEARED TURBINES PROVE RELIABLE. JAPANESE INSTALL SET OF AMERICAN MADE TURBINES WITHOUT DRAWINGS OR INSTRUCTIONS. OPERATE VESSEL OVER LONG PERIOD WITH ENTIRE SUCCESS. By Carl. J. Lamb*.—In the March, 1927, issue of the "Marine Review" appeared the "Seven Year Record of S.S. *Algic*. The recent arrival of the Japanese S.S. *Tohsei Maru* in New York brought to light the history of a geared turbine propelling unit, which, from the viewpoint of simplicity, rigidness and reliability, will equal the record of the *Algic* and will attract the interest of all ship operators and marine engineers.

Back in October, 1919, Takata and Co., representative in Japan at that time for the Westinghouse Electric International Co., sold to the Uraga Dockyards a complete steam propelling unit which was quite similar to those of the merchant class installed aboard the S.S. *Algic Ala*, and some 120 other war-built vessels of the same type. This machinery, when delivered, was not installed, as the hull planned was not then complete. It was later used in the *Tohsei Maru*.

The remarkable thing about the geared turbines in the *Tohsei Maru* is not so much the recorded mileage and freedom from trouble, but the fact that, after being delivered in March, 1920, this equipment remained in a warehouse until 1925, when it was installed by native Japanese mechanics under Mr. Tomali, now chief engineer of the *Tohsei Maru*, unaided by blueprints, records, installation instructions, or any person who had ever installed, operated, or even seen this type of turbine before, and was then operated 50,000 miles, without any service, advice, visits, or operating instructions from the designer and builder of the machinery.

When the earthquake occurred in Japan during August, 1924, considerable damage was occasioned at the shipyard, and particularly to the warehouse in which the machinery which went into the *Tohsei Maru* was stored, some of the smaller

* The author, Carl J. Lamb, is a member of the engineering staff of the Westinghouse Electric & Mfg. Co. at its South Philadelphia Works.

fittings of the turbines being injured as a result. The plans, installation instructions and operating instructions were destroyed completely.

Mr. Tomali, the present chief engineer of the vessel, who had been detailed by the Yamashita Co., which had contracted with Uraga Dock Yard for the building of the *Tohsei Maru*, to inspect the installation of machinery in the vessel, also actually supervised the work as well. He has reported that all of the propelling and auxilliary machinery was easily installed, with less time and labour than is usually attendant upon the erection of typical reciprocating steam machinery such as is found in the average Japanese merchant vessel.

Unlike the *Algic*, the *Tohsei Maru* is not on a scheduled steady run, but visits various ports of the world, wherever profitable cargoes can be obtained. When she recently entered at New York in September, she carried a full cargo of lumber from Vancouver, B.C., to Wilford and McKay. After receiving partial cargo in New York, she departed to complete loading at Providence, R.I., whence she sailed for the West Coast and the Far East.

An inspection of the vessel by the writer brought forth the preceding and subsequent facts from the chief engineer, who further remarked that, up to the time of the interview, there had never been a breakdown of any of the American-built machinery herein described, nor had any repairs been made to it, other than routine maintenance overhauls. Mr. Tomali also stated that the Yamashita Co., which operates a fleet of twenty cargo vessels under the Japanese flag, had just about decided to abandon a previously planned programme of Diesel propelled vessels and stick to geared turbine propulsion for future construction because of the established economy, reliability and rigidness of the geared turbines in the *Tohesi Maru* over a two-year operating period.

The appearance of the entire ship, as an examination of the photographs taken at the time indicate, was excellent, cleanliness and good order prevailing, without signs of deterioration, throughout the hull, on deck, or in the engine room spaces.

Although of the same general design as the merchant ship type of geared turbines built for the United States Shipping Board, the unit in question represents later engineering practice, being among the first marine installations to have the Westinghouse patented (Schmidt) oil governors.

Due to the slower propeller speed of 70 revolutions per minute, the gear reduction is greater, the ratio being 51·4 to 1. The second reduction gear elements have a tooth pressure of 995 pounds per inch length of active tooth face at the designed 3,000-shaft horse-power, and the first reduction elements have a tooth pressure of 510 pounds per inch length. These gears, in conformity with the builder's standard practice, are of the famous flexible pinion frame design, invented in 1907 by Admiral Melville, formerly engineer-in-chief, United States Navy, and Mr. McAlpine, and first installed in the collier U.S.S. *Neptune*. It is worthy of note here that the Japanese Navy has had installed in three very large fighting vessels, quadruple shafts driven by turbines through exceedingly large gears, partly manufactured by the same company and partly manufactured by Mitsubishi Zosen Kabushiki Kaishi to the flexible frame design, and which have been operating without trouble and with entire satisfaction for a number of years.

To all engineers the record installation and operation of the propulsion unit of the S.S. *Tohsei Maru*, especially in view of the circumstances immediately preceding the erection, and because of the ease with which the equipment has been so well operated and maintained by a personnel which has had no aid, service or instructions pertaining to any of the American-built equipment, is of more than usual interest. Such an installation of American-designed and built apparatus, made on the other side of the world by a people entirely unacquainted with the details, erection and operation of the geared turbines illustrated, aside from being an index of proper and reliable design, calls attention to the ability and efficiency of the Japanese mechanics and engineers responsible.

From "The Syren and Shipping" of August 19th, 1903, and republished August 15th, 1928:—"We have to apologise to the War Office. . . . We are induced to this position by a message sent from Aden by the correspondent of the "Daily Telegraph," advising the arrival and departure thence for Berbera of three chaplains. The origin of their arrival was simply a demand from General Egerton for three Parsons' pumps. The gentleman who opens the letters at the War Office did not know what these might be, so he handed the requisition to somebody skilled in such matters*, who discovered

* Evidently an engineer was lacking on the Board.

'pumps' to be a synonym for 'shoes.' But what was the use of sending out three? He determined to send three pairs, and as information taught him that there were not three Parsons at Berbera, he decided to fill the order, and also the shoes, by sending the outfit complete. Now mark the touch of genius which invested the filling of the order with artistic merit. The official sent one Romish, one Church of England, and one Scottish Padre!"

(Although the foregoing contains little of material interest to the shipping world, the story which has surely been beaten in the last quarter of a century, is too good to be missed).

"The Fuel Economist" has had several articles dealing with Pulverised Fuel, and in the January issue, the various works and power stations where the system has been adopted are tabulated, with a few details and comparisons. There have been during recent months some interesting articles on the subject in American, British and Continental Journals, these have been studied by members in the Reading Room.

The good results reported as attained on the first voyage to and from South America by the Blue Star Refrigerator Cargo Steamer *Stuart Star*, shows that pulverised fuel is giving a good bid in the markets and commending its advantages to the owners.

The following article by the Duke of Montrose is from "Fairplay" of July 5th:—

POWDERED FUEL FOR SHIPS.—One of the prime needs of man to-day is cheap and swift mechanical transport, either electrically or thermally driven, on land and sea or in the air. At present the mobility of electrically-driven vehicles is limited, and we depend upon thermal power, thus necessitating the consumption of either coal or oil fuel. Coal for many years had the monopoly in power production by the conversion through heat of water into steam, and in 1857 the total world's production of petroleum oil was only 282 tons as compared with 145 million tons in 1926. For purposes of transport coal is rapidly being supplanted by oil, to the detriment of those countries a large portion of whose wealth lies in their coal deposits.

It is, however, a fact that coal is still the cheapest fuel on the basis of British thermal units purchased per £1 sterling, and the reason it is being ousted by oil is largely because of the facility with which oil can be handled and burnt in comparison with coal. For marine purposes oil is burned either under the boilers (a wasteful way of using oil) or for internal combustion engines. Coal is burned under the boilers in conjunction with reciprocating engines or turbines. Now, it may be borne in mind that oil burned as fuel is only essential for the internal combustion engine and that the internal combustion engine is only essential for motor vehicles and aircraft; further, the greater the use made of oil for non-essential purposes, the more this country is dependent on a foreign product.

The gross tonnage of new vessels launched in 1927 showed:—

Coal fired	297,948
Oil fired	275,889
Oil engines (the motorship) ...	393,225

whilst the gross tonnage afloat in the same year came to:—

Coal fired	40,415,719
Oil fired	18,481,759
The motorship	4,270,824

It is unlikely, except for naval purposes, that there will be any increase in oil--fired vessels, and the great fight for supremacy will be between coal-fired vessels and the motor ship. For years past there has been a steady improvement in the engines that use steam; the invention of the steam turbine—geared, exhaust and otherwise—was a great step forward in engineering practice. Simultaneously came the demand for increased boiler efficiency, and the advent of high-pressure super-heated steam has made out a case for the use of water-tube boilers for marine purposes. Obviously, such boilers must be worked under the highest conditions of combustion efficiency, and it follows that the ancient system of hand firing must be abandoned. .

What are the alternatives? Fuel oil burned under the boilers is, as already pointed out, extravagant and unlikely to be continued, and mechanical stokers are being used with success, but I venture to prophesy that in the near future hand firing, mechanical stokers and fuel oil will all have to give way to pulverised coal either raw or in the form of residue from a coal distillation plant. When that time comes, and it cannot be long, the motor ship will indeed have to look to its laurels.

I was privileged recently to see an ordinary Scotch marine boiler burning powdered fuel, and I confess to have been amazed at its efficiency. As far as appearance went it might have been fuel oil I saw burning; there was neither smoke nor dust, and as all the ash was recovered none came out of the funnel to blow about and be a nuisance. This boiler, under ordinary conditions, burned 460 lb. of coal per hour when hand-fired, and had an efficiency of 60 per cent. Under the pulverised fuel system, the amount of similar fuel consumed was 330 lb., with an efficiency of 80 per cent.

Granted that technically all difficulties in burning powdered fuel have been overcome, there remains the acid test of cost, and I have examined figures which conclusively prove that here again the motor ship is beaten. As is the case with all new processes, there are still many details to work out, and prejudices to be overcome. In the first instance, pulverisers will probably be installed on board the vessels so that there will be no economy in bunkering, but I am convinced that in the future pulverising will be carried out at depots, and ships will be bunkered with powdered coal pumped through pipe lines as is the case with oil fuel to-day.

In this short article I have dealt chiefly with pulverised fuel for marine purposes, but I also look forward to seeing the locomotives of this country being driven by powdered fuel stored in tank wagons and pumped into the furnaces of locomotives like oil, whilst for factories and furnaces there is for powdered fuel an almost illimitable field.

P.S.—When this article was written the S.S. *Mercer*, of the United States Shipping Board, was the only vessel known by the writer to be at sea and fired by pulverised fuel; but now a second vessel has been fitted, viz., the S.S. *Lingan*, 4,677 tons, of the Dominion S.S. Co., Canada. A third vessel belonging to the Blue Star Line of England is projected. The rush for pulverised fuel firing in the merchant marine has evidently begun.

The number of British vessels which have been sold during the six months ending June, 1928, are listed for each month with the names, tonnage, engines, date when built, and prices obtained, with the country of the buyers.

In January 14	were sold,	4	being	for	breaking	up.
,, February 22	,, ,,	1	,,	,,	,,	
,, March 25	,, ,,	1	,,	,,	,,	
,, April 3	,, ,,	4	,,	,,	,,	
,, May 32	,, ,,	3	,,	,,	,,	
,, June 18	,, ,,	3	,,	,,	,,	

There is also a list of the foreign vessels sold from January to June, with the details given in a similar list, and the total number sold is 180, and of these 18 were for breaking up.

From "The Morning Post" of June 16th:—

New French Steam Invention. Plan to Tap Energy of Tropical Seas. From our own Correspondent, Paris.—Starting from the principle that water will "boil" in a rarefied atmosphere at a low temperature, two French scientists, MM. Claude and Boucherot, have built at Ougres, near Liége, a steam engine which will work without stoking and without a furnace. With its help they hope to tap the latent energy of the tropical seas by utilising the difference between the heated water of the surface and the cold water beneath.

The heated surface water, on being introduced into a partial vacuum, "boils," and is condensed again by the cold water pumped from the depths. The difference between the water in the boiler and the water in the condenser was 10 degrees Centigrade when the experiment was conducted on June 1st, and only one-quarter of the energy produced was absorbed in pumping and expelling the water.

In the tropics the difference in temperature is frequently as much as 30 degrees. Not only will this engine provide power in tropical districts, but the water expelled from the condenser will still be considerably colder than the atmosphere, and on being passed in pipes round the buildings, or even in the streets, will reduce the temperature and make living bearable in districts formerly considered almost uninhabitable.

A Liquid Air Bomb.—M. Claude during the war invented a liquid air bomb that was discarded as too dangerous to handle. He got one of his bombs dropped, however, from an aeroplane within the German lines, where it exploded and wrought terrific damage; had it been dropped a quarter of an hour earlier it would have blown up the German Emperor.

It is believed that the Claude-Boucherot power-producing plant will effect a change in the world greater than that made by the steam engine itself. It might change the centre of gravity of the world's production.

The power producer referred to is commented on in "The Syren and Shipping" of Sept. 5th.

From "The Marine Engineering Journal," New York, of March, 1928. The descriptive article is by B. T. Hughes:—

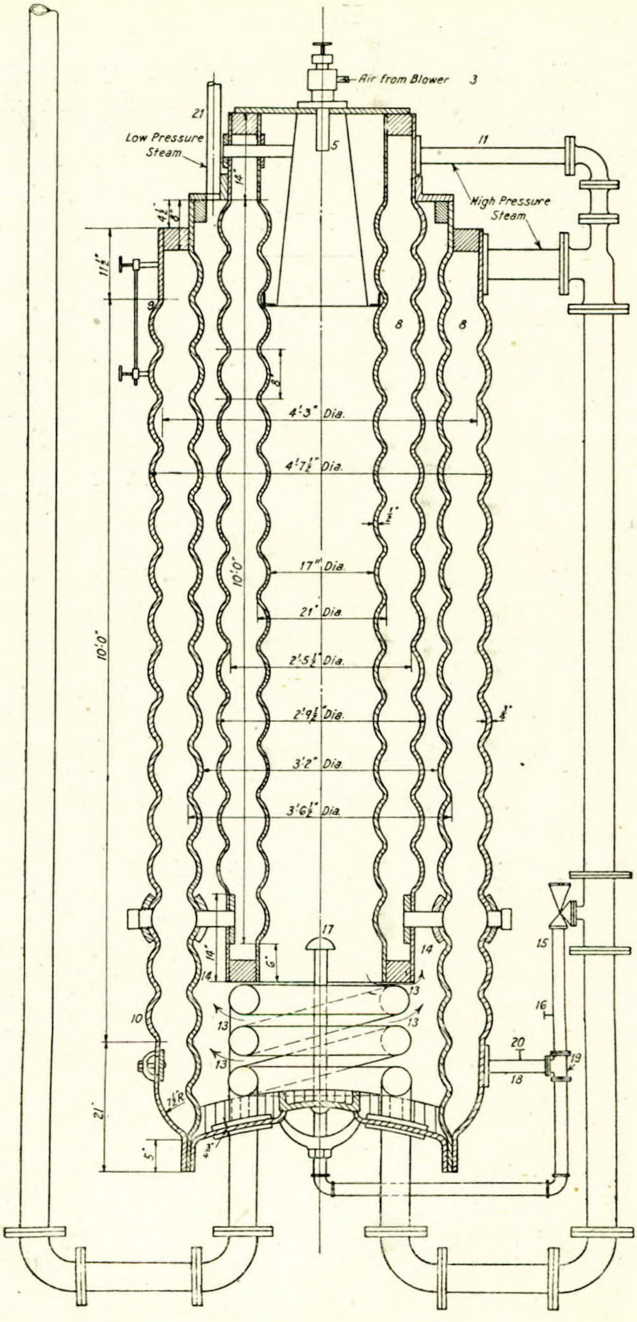
An Interesting Internal Combustion Boiler.—Within recent years we have all become familiar with the internal combustion engine, but here we have an entirely new departure from usual engineering practice—a practical and highly efficient internal combustion boiler that has worked well under demonstration. This boiler, which is now undergoing final tests at a Brooklyn ship repair yard, is so constructed that combustion takes place entirely inside of the boiler in direct contact with the steam, and it appears that by this method the well known advantages of the steam engine have been combined with the equally important advantages of the internal combustion engine.

There are many novel features about this new internal combustion boiler that will undoubtedly appeal to the Marine Engineer. The boiler is designed to give a very high degree of combustion and head losses are practically negligible. There is no smoke-stack and the entire device is compressed into very small space.

A Boiler without a Smokestack. — Reference to the detail drawing of the boiler which accompanies this article, discloses the fact that there is no smokestack — a time-honoured accessory of all boilers — which, in this particular case, has been entirely dispensed with. Another important feature of the new internal combustion boiler is the remarkably small space into which an efficient unit capable of producing great power can be installed. But we hasten to describe this latest development in boiler design in more detail.

Very Complete Combustion. — In the internal combustion engine there is very complete combustion, due to the fact that the combustible mixture is first compressed before it is ignited. This new boiler also burns fuel under compression, though, while in the oil engine the combustion gases expand in the

Schwartz Internal Combustion Boiler



cylinder and furnish the actual motive force; in the new boiler these gases also pass through the cylinder together with steam —and the combined expansion of steam and combustion gases drive the engine. Unlike the oil engine, however, the cylinders are not cooled by external water jackets—a method which permits much unavoidable loss of heat—but under the new method the combustion gases are cooled by water atomised by steam, and every heat unit passes through the engine.

In the oil engine the exhaust gases carry off a great deal of heat—flames sometimes actually leaving the exhaust; whereas, in this new boiler arrangement, a part of the heat having been transferred from the gases to the steam and an average normal steam pressure having been established, gases and steam leave the engine at a very low temperature. The heat transfer in the new boiler takes place partially in the same manner as it does in the conventional type of boiler—50 to 75 per cent. of the heat being transferred to the water for the production of ordinary steam, which in the triple expansion engine, for example, is used in the high pressure and intermediate cylinders. The low pressure cylinder receives the mixture of steam and gas. In a single cylinder engine both steam and gas can be passed through one cylinder and any number of combinations can be made. For example, the exhaust of an intermediate cylinder can be passed through the combustion chamber together with the combustion gases and then enter the low pressure cylinder. Steam from any boiler can be passed through this new device and can be superheated to any desired degree.

The accompanying diagram illustrates a vertical type boiler. An oil burner (1) is supplied by means of the exhauster (2) with air from the pressure blower (3) at say 20 lbs. pressure. The air enters the combustion chamber through the Venturi tube (5)—oil entering at the same time through the port(6). This oil also enters at a pressure of 20 lbs. The mixture is ignited by the spark plug (7), or by any other suitable means. Steam is generated in the jackets (8), which are filled with water to a level indicated by (9) through the feed water supply line (10). This steam leaves through pipe lines (11) and goes through an engine unit by way of the continuation of pipe line (11).

The combustion gases continue through the port openings (13) into the outer jacket (14). Just before the combustion gases leave through the port openings (13), another portion of steam from pipe line (11) is supplied to pipe line (15), controlled by the valve (16) and reflected by the umbrella (17). This steam is mixed with the combustion gases.

In order to control the temperature of these gases and in order that the heat may be fully utilised, a water line (18), coming from a suitable source of pre-heated water, is connected to the injector (19) and controlled by valve (20). By means of this valve the operator may control the steam temperature in accordance with the requirements. This steam gas mixture leaves the outer jacket through line (21) and may go directly to an engine unit or be used for other duty.

Marine Application.—The advantages of this steam generator, particularly for marine use, appear to be numerous. The boiler weighs less than ·1 of the ordinary boiler of equal capacity. It occupies only a fraction of the space, and operates a steam engine with Diesel engine economy. It can be installed in connection with any type of steam engine or turbine, and last, but by no means least, the boiler has no smoke-stack and all fire hazard in connection with its use is entirely absent.

Under this system, a 1,000 h.p. boiler weighs three tons as against sixty tons, estimated as the average weight of a Scotch marine boiler of equal power. It is estimated, therefore, that the cost of installation of such a boiler will be from $\frac{1}{4}$ to $\frac{1}{3}$ that of a boiler of the conventional type. In converting marine floating equipment from the old to the new type a large amount of space will become immediately available.

Can Use Old Engines.—One of the most interesting aspects of this new boiler is the fact that the old engine equipment may be used. For example:—

There are records of estimates for the conversion of some steam boats into Diesel-driven boats, which run into the neighbourhood of $600,000 for 4,000 h.p. equipment. It is conservatively estimated that by the use of the new boiler the same economy looked for through Diesel installation may be accomplished with the use of much less space at a cost of less than $50,000. The fuel cost will range from ·5 of one pound of oil with economical engines to about one pound of oil per indicated horse-power, when applied to engines constructed along less economical lines. The new boiler will generate steam within five minutes after the burner is lit; therefore, no banked fires are needed. The control is entirely automatic and is regulated by the increased steam pressure; fire regulation is unnecessary.

Outstanding Features. — Summarising the outstanding features of this new boiler, it appears to have all the advantages of the oil engine without many of the disadvantages. It also provides steam engine efficiency with oil engine economy. The summation shows that there is a total absence of vibration, no smokestack nor exhaust losses, large economy of space as compared with the conventional boiler and absolutely no fire hazard. In addition, there are other favourable factors, such as elimination of labour, automatic control, reduced weight, low first cost of installation, low cost of operation and reduced cost of upkeep. All of these important points are claimed for the device by its inventor and sponsor, who also stated that the boiler may be used on either reciprocating engines or turbines.

Low Installation Cost.—The fitting of oil engines is very often considered when it is necessary to recondition vessels that are in good condition as to hull and where only machinery changes are to be calculated. But it frequently happens that these ships are not adaptable to oil engine machinery installations, while they are suitable for steam installations. With this new boiler, these latter types of vessels can be equipped with steam plants at a very small cost as compared with the large figures demanded for all oil installations. And, moreover, it will not be necessary to alter the superstructure of the ship to install this new type of boiler, for it can be slipped in through any hatchway because of its small size and light weight.

A small working unit of this boiler has already been installed at one of the local shipyards and a larger unit, which will be connected to a triple expansion engine, is now in course of erection. This installation will be finished within the next few weeks. It is also planned to install a 1,000 h.p. boiler of this new type in a tug-boat which will be ready for trial trips and inspections within the next two months. This event will undoubtedly be of much interest to the shipping world and will serve to draw attention to a remarkable device from which many economies are expected.

In the Board of Trade Journal of March 29th, the proposed utilisation of water power on the Upper Dordogne, is referred to and the text of the law (in French) can be consulted on application to the Department of Overseas Trade, 35, Old Queen Street, London, S.W. The concession runs from the boundary of the concession up stream granted in 1920, to the Paris Orleans Railway Co. to the neighbourhood of Argentat down stream. A company to work the concession is to be formed within a period of two years, the share capital being found as to one-half by the public bodies of the district as to the other half by distributors of power and users. It is intended that three falls should be harnessed with a total power of 250,000 kilowatts, capable of supplying about 600 million k.w. per annum, and as the estimated cost was 255 million francs and the interest on capital 8·5%, the cost of power per k.w. hour would work out at less than six centimes. The undertaking will be an important source of water-power for France.

The question of harnessing the Thames has often been discussed during the last 45 years, but the difficulties in the way and the costs involved have been too great.

An interesting lecture and demonstration by illustrations were given at Exmouth last October by Mr. W. B. Shepherd, of Chichester, on the harnessing of the water of the Exe Estuary to utilise it by means of turbines or wheels for the purpose of supplying power and electric current, the estimated cost of which would be about ·13d. per unit, based on the estimated outlay of about £63,000. There was a report of the lecture in "The Naval and Military Record" of October 19th.

At the Centenary Congress of The Institution of Civil Engineers, the subject was dealt with in a paper by Prof. A. H. Gibson, D.Sc. entitled "Tidal Power and Turbines suitable for its utilisation." It is desirable to make use of the elements at our disposal, where it is possible to do so with a reduction on outlay.

Comments have been made from time to time on the proposal made many years ago to harness the Severn to provide power for the service of works and light. Plans were drawn and investigations made, costing about £90,000. The original proposal and drawings date back about 80 years.

The Claude-Boucherot invention comes before us as we look out upon the possibilities of the river waters.

The following is from the supplement to the "Journal of Commerce and Shipping Telegraph" of July 12th, and there is a special reference in it which emphasises the desirability of studying the subject with a view to a paper being contributed under the H. Akroyd-Stuart Legacy Award:—

DIESEL NOMENCLATURE.—Perusual of any recent discussion on marine internal combustion engines cannot fail to produce in the reader a feeling that it is time some general effort was made to abridge for everyday use the complicated descriptive titles of the main types of engine. There should be some generally accepted and largely self-explanatory abbreviations that would do away with, for example, such verbal constructions as "six-cylinder four-stroke cycle single-acting airless injection internal-combustion engines;" something as compact as the numerals which locomotive engineers use to denominate the wheel arrangements of railway engines. It is now some years since similar complications troubled the marine steam engineer, although a candidate for Board of Trade ticket is still expected, it is understood, when asked to describe the propelling machinery in his last ship, to recite that it was "a three-cylinder inverted direct-acting triple-expansion engine" (if such was the case) with due care not to omit the "inverted." For all ordinary purposes, however, it is deemed sufficient to say that such a ship has "triple engines;" and in the absence of detailed qualification, the rest is tacitly assumed. If only (to continue with the original example) "four-stroke cycle single-acting" could by common agreement be cut down to "four-single," the saving in time, space, breath, patience and other useful commodities would be well worth the slight jar that the senses of our engineering purists would undoubtedly sustain. If, by a further *entente cordiale* amongst the Diesel-worshipping peoples, the number of cylinders could first be indicated, we should be appreciably near the happy comprehensiveness of the railway classification. The example taken would then become a "six four-single." Incidentally, the persistence of the word "Diesel," despite its well-known inaccuracy, is probably due mainly to the fact that it is so much easier to say than "heavy-oil-internal-combustion-engine" or any of the numerous alternatives. In matters of this kind it is of little use to run counter to popular usage. If the public wants to call a thing a "Diesel," it will do so; the survival of the name "America" is an object lesson on that point for all time. It is extremely likely that the word "Diesel" will outlast all its competitors, so that we might as well make the best of it. It does not seem necessary, however, that any mention of the method of injection should appear in an ordinary reference, any more than the railway engineer needs to mention whether his engine is hand or stoker-fired. Such particulars can always be added if the occasion demands it. By this process of simplication the original " six-cylinder four-stroke cycle single-acting airless injection internal-combustion engine" has become contracted to a " six-four-single Diesel "—a reduction in length of description of over 70 per cent. In most of its modern forms, we have adopted the engine from the Continent; but there is no real reason why we should also adopt the house-that-Jack-built method of referring to it that is a characteristic of Dr. Diesel's mother-tongue

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The following address by Mr. C. A. Newcombe, to the students of Sibley, America, is from the " Sibley Journal of Engineering " :—

The viewpoint of man on life is a matter of perspective. The elevation at which he is placed determines the range of his vision, his depth, and his capacity. The steps to an elevation by which his perspective is measured, are education, training, and experience, and the greatest of these is experience.

The lawyer and the doctor, through their training, education, and experience, become specialists elevated to a point which gives them a great perspective on life, on humanity, and its structure, mental and physical, with its trials and tribulations, hopes and ambitions.

The engineer, through his education, training and experience, is also elevated to a height whereby his perspective and range of vision are broadened and increased, and he becomes a specialist, not only in his chosen field of science and application of the unlimited phenomena of nature, but also of humanity, its needs and desires, catering to its comfort and welfare.

Nature has unlimited gifts to bestow on mankind, stored away in its treasure chest, and the man of science, the engineer, is the man with the key. Consequently, a great responsibility lies upon his shoulders. And because of the engineers many and valuable accomplishments, he holds deservedly, a great pride in his profession, its romances and traditions, and possesses a sense of the ethical, second to that of no other profession.

What is meant by professional ethics? Usually we hear of it in the case of a negative application,—wherein the performance of some act, the issuing of a statement, or the expression of an opinion, is refused, on the ground that to do so would amount to a violation of the code of ethics of the profession.

The moral precepts of the code of ethics for the engineering profession are few, and simple, and honour is the chief motivating force of each.

One can do no better than to quote the following comprehensive, yet concise code of ethics for engineers, recommended for adoption by the various engineering societies, and compiled after deliberate consideration by the Joint Committee, consisting of representatives of the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, appointed to consider a Code of Ethics for engineers: —

1. The engineer will carry on his professional work in a spirit of fairness to employees and contractors, fidelity to clients and employers, loyalty to his country, and devotion to high ideals of courtesy and personal honour.

2. He will refrain from associating himself with, or allowing the use of his name by an enterprise of questionable character.

3. He will regard as confidential any information obtained by him as to business affairs and technical methods of a client or employer.

4. He will advertise only in a dignified manner, being careful to avoid misleading statements.

5. He will inform an employer or client of any business connections, interests or affiliations, which might influence his judgment or impair the disinterested quality of his services.

6. He will refrain from using any improper or questionable methods of soliciting professional work and will decline to pay or to accept commissions for securing such work.

7. He will accept compensation financial or otherwise, for a particular service, from one source only, except with the knowledge and consent of all interested parties.

8. He will not use unfair means to win professional advancement or to injure the chances of another engineer to secure and hold employment.

9. He will co-operate in upbuilding the engineering profession by exchanging general information and experience with his fellow engineers and students of engineering and also by contributing to the work of engineering societies, schools of applied science and the technical press.

10. He will interest himself in the public welfare on behalf of which he will be ready to apply his special knowledge, skill and training for the use and benefit of mankind.

This code of ethics creates a wonderful standard for our profession, and adherence to its precepts entitles every engineer to a great pride in the knowledge that he is one of the great army of science.

To sum it up, as I said before, the motivating force is Honour. Do unto others as you would have them treat you. BUT, *Do it first.*

That policy, coupled with a highly cultivated sense of loyalty to yourself and your profession, and those with whom you have dealings, will certainly place our great profession in an unassailable position, admired, honoured, and respected by all.

In " The Shipping World " of July 4th, the description of a new boiler is given. It is called the " Hera " Boiler, and is similar to the ordinary marine type, except that the combustion chamber backs are not built into the boiler back plates in the usual way with water space between and stayed to suit, but left open and then closed up by fire-resisting material which can be readily removed when desired, then replaced. The design is by Dutch builders and the object is to admit of repairs and overhaul being dealt with in the combustion chamber under a more open atmosphere than in the ordinary closed up type. The top and bottom connecting plates from the tube plate and the furnace are rounded to avoid the need of stays, and flanged and riveted to the boiler back plate inside. There are tubes in the back end connecting the crown of the combustion chamber with the bottom plate, thus increasing the circulation. A " Hera " Boiler was fitted in the *Maria van Hattum*, a Dutch cargo steamer, built by the Hera Maschinenfabric of

Yminden, Holland. It is claimed that there is a saving of weight, an increase of heating surface—due to the tubes—and fuel economy gain, added to the better facilities for cleaning and overhauling the back ends.

The cases which have come under notice for medical treatment, of engineers serving in oil-engined ships, emphasises the importance of the best systematic arrangement for ventilation, with elimination of fumes detrimental to the human frame. The following article on the subject is from the "Motorship," New York:—

Ventilating the Motorship's Engine Room. (Proper Study of Individual Ship and Engine Types Necessary for Good Ventilation and Better Operating Conditions). By Chief Engineer.—Machinery spaces of motorships have a peculiar odour not at all like the sweet damp smell which greets the nostrils upon entering the engine-room of a steamship. The latter must be credited with such advantages as are justly due her and on this account it is just possible that under certain conditions her power-plant compartment is a more healthy working place, in spite of the greater heat, than that of the motorship.

It may be argued that this comes within the province of medicine rather than that of marine engineering, yet it is questionable whether many medical men know a great deal about why odours are encountered in enginerooms even though a certain amount of discussion has recently been raised on that matter. Sea-going engineers generally consider the engine spaces in larger and more modern motorships to be freer of gases than those in the older and smaller ones.

It may be that in their zeal to develop perfect machinery layouts on motorships designers have failed, in some cases, to give sufficient attention to engineroom ventilation, and have merely copied the methods employed on steamships without considering whether or not such methods were equally applicable to motorships.

The fact that oil engines are constantly removing the air from the engine room and expelling it in a decomposed state through the exhaust pipe, thus creating a natural ventilating system may have been misleading. It is certainly true that the combined effort of the engines and the compressors is commonly great enough to change the air in an average motorship engine room every eight to ten minutes. Unfortunately the rate of escape of foul gas, no matter how bad the gas be, is not nearly proportionate.

When bad gases are troublesome the fault seems often to lie in the route which the air takes in its passage from the atmosphere to the engine breathers. In many instances clean air is released in the engine room at points which are quite conveniently reached from the open air by ventilator shafts. By this statement it is not inferred that ventilators merely pierce decks without being carried to the lower flats or set in the far corners. A complete disregard for the possible location of bad gas pockets, however, is quite common and certain parts of the engineroom are always more comfortable than others. That is possibly natural because places which are best ventilated are the places where the engineer should and does spend the most of his time. Thus conditions are more often than not far from being the worst possible, but in a perfect machinery space the gas pockets should be eliminated.

If this is to be a problem for ventilating engineers to solve they will have to take into account the fact that escaping gases should be directed back into the engine breathers or out to the atmosphere if the solution is to be found in the most economical way. It is not merely a question of driving more fresh air into the engine room; furthermore it is doubtful whether this could be done successfully, because it would merely mean that more air would become contaminated by bad gases and while the percentage of the latter would be proportionately less they would not be eliminated. Further space may be limited and much extra equipment would have to be carried. No shipowner wishes to have a lot of cumbersome air ducts installed in the engine room and certainly no engineer wishes to have more machinery to care for.

We call to mind one installation which had a very bad reputation for gases owing to expansion joints on the exhaust pipe. The deck over the engines was low and had a small skylight. The workshop for the routine overhaul of valves and other parts was under this deck and the engines were burning a fuel with a high sulphur content. The engineers constantly complained of sulphur fumes, the presence of which indicated the existence of gas pockets. Since carbon dioxide and carbon monoxide are practically odourless and neither had ever been present in sufficient quantity to be felt, it remained for the rancid smell of sulphur to reveal the presence of such gas mixtures.

The problem was partly solved by piping the engine breathers to the gas pockets and depending upon these to set up a natural flow of fresh air in that direction. Of course, there could be no excuse for the bad expansion joints, and in that respect the engine builders were solely at fault for repeated efforts on the part of the engineers to keep them tight had failed. Possibly the engine builders did not understand how important it was to stop these leaks, nor did they know how bad they were.

On another motorship the lubricating oil fumes gave trouble. The engines were high speed 2-cycle type with separate scavenge pumps, and had " breathers " from the crank-case to the engineroom. They were naturally hot machines, for the pistons were cooled with oil which fell back into the crankpits and was pumped from there to coolers. The entire compartment was exceptionally warm as compared to the average motorship engineroom.

The scavenge pumps took their air direct from the engineroom. The engine builders thought the air was too hot when it reached the engine and to reduce its temperature the breathers were piped to the open air. This was a clear case of thoughtlessness. If the scavenge air was too hot it should have been put through a cooler, but on no account should the natural method of ventilation in the engineroom have been disturbed.

We have noticed two very good systems of eliminating bad fumes on small motor vessels. One was a tug and one was a Sound passenger-boat. The crank-case of the trunk-piston type engines, fitted on each ship, were tight. On both sets of engines a hole was cut in each end of the crank-case. On the tug the engine breathers were piped to one of the holes, and air was drawn the length of the crank-case. On the other boat a small cowl ventilator on deck was piped to the front end of the crank-case, and an air duct was led from the after end to the stack, thus setting up a similar but less rapid circulation of air to that on the tug. In both instances the circulation of air through the crank-cases had a remarkable cooling effect upon the working parts enclosed.

Oil-engine manufacturers raised an objection to this method of deodorizing the engineroom and contended that the removal of fumes increased the lubricating oil consumption. They declared that the oil vapour if left in the crank-case would condense and become oil once more. This is possibly correct, but it is equally true that the vapours if allowed to escape through the crank-case breathers and inconvenienced the engineers would also constitute a form of oil loss.

Oil engines have a limited number of causes by which foul gases can escape. One is leaking exhaust pipes, another is gas blowing past the pistons, a third is the pungent odour of lubricating oil on hot surfaces, a fourth is the escape of gases from the valve stems and the last is caused by fuel oil spilled or leaking on the cylinder heads and possibly finding its way to the exhaust pipe elbows. With regard to the last two items, one is negligible and the other is up to the operating engineer.

Leaking exhaust pipes are the result of carelessness on the part of the designer, the man responsible for the installation or the operating engineer.. Theoretically, gases should not blow past the pistons; actually they do. Lubricating oil fumes do not appear to be very harmful but their elimination is desirable nevertheless. The biggest difficulty seems to be in connection with these two items.

It is readily apparent that this does not apply to all engines. The double-acting engine, for example, eliminates troubles with odours resulting from leaking rings. The small 2-cycle engine delivers all gases into the working cylinder. The large single-acting crosshead type of engine seldom has great heat in the crank-case and no fumes from there. Gases do escape by pistons, however, and the cylinder walls being comparatively hot also throw off an odour.

The trunk-piston type with a partly open crank-case presents another problem. Air is a cooling agent for these pistons, in most instances, and if it carries oil vapours they will become a troublesome gas. If the pistons are oil-cooled that will also throw off a gas.

It seems that we have the problem largely confined to the crank-cases of the 4-cycle trunk-piston type, the 2-cycle type with separate scavenge pumps and the crosshead type with open lower ends of the cylinders.

It is only necessary to close these spaces with comparatively tight doors and lead air ducts to the enclosure. Suction blowers can be placed in the air ducts and the gases blown to the atmosphere outside of the engineroom, up the stack for example. This would not prevent having doors that could be opened to inspect the various working parts within while the engine is running. There would be only an inrush of fresh air at such openings while the doors were removed.

When a ship is on the sunny side of the pier at places such as Singapore, Cartagena, Colombia or Tampico, forced ventilation is a blessing to the engineers, and is equally welcome in waters such as the Caribbean Sea and Indian Ocean when a following breeze alternates with no wind at all. At such times foul fumes seem to come creeping out of the bilges and off the hot floor plates, almost out of the ship's sides in fact.

It would appear that just so long as men go down to the sea in ships they will have to face certain hardships which are directly chargeable to the elements. To eliminate disagreeable conditions such as we have dealt with specifically in this article, appears to be not only desirable but entirely possible. That certain men are already thinking seriously along such lines is evidenced by the fact that a vapour extractor has been produced and is being marketed. For those who think along different lines mechanical devices are already available. Blowers are being applied to almost every such need, and it only remains for someone to install them in such a way as to not scatter the gases, but to pick them up at their source and deliver them to the open air where they can do no harm and cause no inconvenience. Experienced designers are attending to these matters.

The large venture made in Ireland by utilising the waters of the Shannon for purposes of transport by canal and also for the generation of power, has been remarked upon in the Press recently. The great resources available in Canada were pointed out by Sir Henry Thornton in his speech at the luncheon prior to the launch of the *Lady Drake*, at Birkenhead. He emphasised the three main factors for the advance of Canada as the developments of agriculture, of minerals, and of water power. The province of Quebec could bring six times the amount at present in use of harnessed water power and other parts of Canada could do more, and the whole combined area might yield about 40,000,000 h.p.

The following table was printed in the "Marine Journal," New York, of July 15th. It embraces the table given by Sir

J. H. Biles in the paper read at the spring meeting of the Institution of Naval Architects, modified by Dr. Bauer with two columns added.

ALTERNATIVE DRIVES FOR CARGO SHIPS — 3,600 SHAFT HORSE POWER

AUTHORITIES	1	2	3	4	5	6	7	8	9	10
SIR. J. H. BILES & DR. GUSTAV BAUER	ORDINARY TRIPLE EXPANSION RECIPROCATOR	ORDINARY TRIPLE EXPANSION SUPERHEAT STEAM	QUADRUPLE RECIPROCATOR SUPERHEAT STEAM	TURBINE SCOTCH BOILER SUPERHEAT STEAM	TURBINE HIGH PRESS. SUPERHEAT WATER TUBE BOILERS	TURBINE HIGH PRESS. SUPERHEAT W.T. BOILERS MEC. STOKERS	TURBINE HIGH PRESS. SUPERHEAT W.T. BOILERS PULVERIZERS	OIL ENGINES	ORDINARY TRIPLE RECIPROCATING EXHAUST TURBINE	ORDINARY TRIPLE RECIPROCATING SUPERHEAT EX. TURBINE
BOILER PRESSURE	200 LBS.	200 LBS.	200 LBS.	200 LBS.	525 LBS.	525 LBS.	525 LBS.		200 LBS.	200 LBS.
TEMPERATURE OF THE STEAM FAHR.	390°	590°	590°	590°	750°	750°	750°		390°	590°
WEIGHT OF MACHINERY	850 TONS 1,904,000 LBS.	850 TONS 1,904,000 LBS.	880 TONS 1,971,200 LBS.	750 TONS 1,680,000 LBS.	720 TONS 1,612,800 LBS.	740 TONS 1,657,600 LBS.	770 TONS 1,724,800 LBS.	825 TONS 1,848,000 LBS.	805 TONS 1,803,200 LBS.	805 TONS 1,803,200 LBS.
WEIGHT IN POUNDS PER SHAFT H.P.	528.89 LBS.	528.89 LBS.	547.56 LBS.	466.67 LBS.	448 LBS.	460.44 LBS.	479.11 LBS.	513.33 LBS.	500.89 LBS.	500.89 LBS.
COST OF MACHINERY INSTALLATION	$175,680	$193,248	$224,480	$273,280	$302,560	$309,880	$331,840	$414,800	$183,000	$200,080
COST PER SHAFT H.P.	$ 48.80	$ 53.68	$ 62.37	$ 75.91	$ 84.03	$ 86.08	$ 92.13	$115.22	$ 50.83	$ 55.58
COST PER POUND	9.23 CENTS	10.15 CTS.	11.39 CTS.	16.27 CTS.	18.76 CTS.	18.69 CTS.	19.24 CTS.	22.45 CTS.	10.15 CTS.	11.10 CTS.
CONSUMPTION FUEL TONS PER 24 HOURS	62 COAL	56 COAL	52.5 COAL	44.5 COAL	40.5 COAL	38.5 COAL	36.5 COAL	17.5 OIL	49 COAL	41.5 COAL
POUNDS OF FUEL PER S.H. HOUR	1.6 COAL	1.45 COAL	1.36 COAL	1.15 COAL	1.05 COAL	1.00 COAL	0.95 COAL	0.42 OIL	1.24 COAL	1.04 COAL
YEARLY SAVING OVER ORDINARY TRIPLE	BASIS OF COMPARISON	SAVING $8,555	SAVING $8,052	SAVING $20,984	SAVING $24,839	SAVING $26,415	SAVING $24,790	LOSS $7,393	SAVING $26,205	SAVING $37,698

In "Marine Engineering and Shipping Age" of March, New York, the staff on the *Leviathan* is given as follows:—

Deck Dept.: Captain,. Staff Captain, 14 licensed Mates, Crew 88 = 102 all told.

Engine Dept.: Chief Engineer, Staff Chief, 43 licensed Engineers, 3 Junior Engineers, 3 Fan Engineers, 3 Hydraulic Engineers, 3 Deck Engineers, 4 Refrigerating Engineers, 11 Electricians, 6 Plumbers, 6 Machinists, 4 Storekeepers, 2 Yeomen, 30 Oilers, 24 Water Tenders, 48 Firemen, 30 Wipers, 6 Joiners, 6 Painters, 2 Upholsterers, and 3 Boilermakers = 228 all told.

Medical Dept.: 3 Doctors, 1 Pharmacist, 2 Nurses and 3 Attendants.

Stewards' Dept. has 700 all told, consisting of Chief Steward, Assistants, Stewardesses, Bell-boys, Waiters, Cooks, Butchers, Bakers, Printers, etc.

Additional to the foregoing there are 7 Pursers, 2 Pursers' Clerks, 4 Mail Clerks, 3 Baggage Masters, 1 Swimming Instructress, 1 Recreation Director, an Orchestra of 12, 1 Food Controller, 6 Barbers, 2 Hairdressers, and 6 Radio Operators.

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Boiler Explosion Acts.

Report No. 2,873. S.S. *Dragoon*.

Report No. 2,873 deals with an explosion in the combustion chamber of the boiler on the *Dragoon*, the investigation was conducted by Mr. J. Fairley, Board of Trade Surveyor, Liverpool. The diameter of the Boiler is 13ft. 6in. diameter x 10ft. 6in. long, with three plain furnaces, 3ft. 3 1/16th in. diameter, each having a single combustion chamber, the back plate being 19/32nd. in., the screw stays $1\frac{5}{8}$in. diameter fitted with nuts, the marginal stays being $1\frac{3}{4}$in., pitched $8\frac{1}{4}$in. horizontally, and $8\frac{1}{2}$in. vertically. Steam pressure 180 lbs. per square inch.

In July, 1927, the lower manholes were reinforced by welding and the doors refitted. Some reinforcing by welding was carried out also on the forward circumferential seam at the boiler bottom, where damp ashes had caused corrosion. The boiler was on July 13th hydraulically tested to 270 lbs. per sq. in. On July 30th, about 8 p.m., the explosion took place when the *Dragoon* was about 16 miles N.N.W. of the Bar Lightship near the mouth of the Mersey.

Examination showed that the combustion chamber back plate was corroded on the fire side, and that this was due to leakage from a defective stay near the plate, a hole about 1in. x 3/16th inch developed, through which the water escaped; fortunately no one was injured. An attempt was made to keep the water up to the mark by the donkey pump, but as this could not be done the vessel was anchored and the boiler emptied. A temporary bolted patch was fitted and they steamed to Birkenhead, where the lower part of the combustion chamber back was renewed satisfactorily.

Early in June, 1927, while on a voyage from Southampton to Jersey, the *Dragoon* struck a submerged rock near St. Helier and considerable damage was sustained by the bottom plating forward and in way of the stokehold. By the time the vessel got alongside St. Helier the water had so risen in the stokehold that the centre fire was extinguished. The water continued to rise until at high tide the engines and boilers were submerged. The vessel was beached and temporary repairs made to enable her to reach the Mersey, where a thorough overhaul was carried out. The boiler was examined and seemed in good condition, however, the hydraulic test referred to was carried out and on July 20th the *Dragoon* left Birkenhead for Irvine, Ayrshire, when the combustion chamber gave out a few hours after leaving.

The observations of Mr. Laslett, Engineer-in-Chief, were that the boiler had been examined a short time before the explosion occurred and apparently the local wasting escaped notice and was not revealed by the hydraulic test. It was, however, though small in area, sufficient to put the boiler out of action, and illustrates the importance of making the inspection of boilers in a very thorough manner.

Report No. 2,878. S.S. *Monksville*.

Report No. 2,878 deals with an explosion which occurred on the boiler of the *Monksville* on July 6th, 1927, when the vessel was on a coasting voyage from Belfast to Liverpool. The investigation was conducted and the report made by Mr. J. F. Blenkinsop, Board of Trade Surveyor, Liverpool. The boiler was 13ft. diam. x 11ft. 6in. long, shell plates 1 11/64th inch thick, designed working pressure 200 lbs. There were three corrugated furnaces. Repairs and survey previously carried out were December 18th, 1925, put into Belfast on way from Aberdeen to Dublin, December 21st, 1925, expanded 36 tubes in three combustion chambers January 27th, 1926; surveyed by Board of Trade at Birkenhead (no repairs) May 1st, 1926. New set of double shut-off cocks fitted in new position on boilers as recommended by Surveyor; January 17th, 1927, at Silloth, four tubes in centre combustion chamber repaired; July 5th, 1927, at Belfast, five centre combustion chamber stay nuts removed, caulked and rejointed.

The explosion—fortunately no one was injured—was caused by grooving and corrosion at the neck of the furnace, and the plate at this place became so weak that it was unable to withstand the boiler pressure. A hole $\frac{3}{8}$in. wide x 2in. long formed at the lower part of the neck of the centre furnace, through which the contents of the boiler escaped.

The *Monksville* was employed on home trade cargo service, and was propelled by a set of triple expansion engines. Steam for propelling and cargo purposes at a pressure of 180 lbs. was supplied by one boiler which was worked with forced draught.

The boiler was originally fitted in the Patrol Boat *Kildress* but was taken out and fitted in the SS. *Slievenamon* in 1921. This vessel was purchased by the present owners in November, 1924, and renamed the S.S. *Monksville*. In December, 1925, the vessel, while on passage from Aberdeen to Dublin, put into Belfast with boiler defects. The smoke-tubes were found to be leaking and 36 tubes were re-expanded. This casualty was reported, and in January, 1926, the vessel was visited by a Surveyor to the Board of Trade, and at the same time the boiler was surveyed by a Surveyor to Lloyd's Registry. The lead of the water-gauge pipes extended for the whole length of the boiler, and it was recommended that these connections be moved nearer to the water-gauge, in order to give a more reliable reading of the water level. This recommendation was carried out in May, 1926.

In July, 1927, when the vessel was on passage to Belfast, a leakage of water was noticed in the centre combustion chamber, and on examination several stays in the combustion chamber back plate were found defective. Five stay nuts were removed at Belfast by shore labour, the stays caulked and nuts rejointed. Steam was raised on the boiler on 5th July and the vessel left Belfast at 9.20 a.m. on the 6th July bound for Liverpool. At 4.30

p.m. on the same day the fireman on duty reported to the engineman that water was issuing from the centre furnace ashpit door, and when the engineman opened the ashpit door a considerable quantity of water flowed out. He reported to the master of the vessel that the boiler was leaking and advised the making of the nearest port. Extra water was pumped into the boiler by the auxiliary feed pump but the water level fell rapidly in the gauge glass and the fires had to be drawn out of the furnaces.

The vessel was then about 10 miles from the Calf of Man, and signals of distress were hoisted. Assistance was rendered by a Manx trawler and the vessel was towed into Peel, Isle of Man, arriving there about 9 p.m.

The vessel was later towed to Liverpool, where the defective furnace was examined. A hole was found to have formed in the neck of the centre furnace and grooving accompanied by corrosion extended two feet in length circumferentially. The necks of the wing furnaces were not affected.

The boiler was often under banked fires conditions, and, as excepting when raising steam from cold water, circulating is not resorted to, such conditions of service would cause severe grooving on the low furnace of the boiler. Sea water is principally used for " make up " feed and the dirty state of the heating surfaces would tend to aggravate this action.

The defective plate was cut away and a new plate flanged and fitted, being riveted to the combustion chamber and welded to the furnace, after which a satisfactory hydraulic test was carried out.

Observations of the Engineer Surveyor-in-Chief.

The conditions under which vessels in the coasting trade work, in which the boilers are frequently kept under banked fires, no doubt aggravate such troubles as were experienced in this ship. The grooving at the neck of the furnace which ultimately caused the formation of a hole, fortunately of small dimensions, is difficult to prevent in such cases, but can be reduced to some extent by careful treatment and especially by circulation of the boiler water when standing under banked fires, so as to maintain equal temperature throughout the boiler.

REPORT No. 2,919. S.T. *Bessie*.

This dealt with an explosion which occurred on board the Steam Trawler *Bessie*, and the case was investigated by Commissioners specially appointed to examine into the facts and trace the cause of the explosion.

In accordance with our appointments dated the 4th day of May, 1928, we held a formal investigation at the Town Hall, Grimsby, on the 16th and 17th May, 1928. There were present Mr. G. C. Vaux, who appeared on behalf of the Board of Trade, Mr. James Patrick Turnbull, Engineer-Surveyor of Board of Trade, Mr. Henry Ibbotson, owner and skipper of S.T. *Bessie*, and Mr. J. King, boiler maker, both of Grimsby. The two last named persons were parties and were not legally represented.

Having heard and considered the evidence, and having examined some corroded fragments of the exterior of the boiler, we beg to report as follows:—

The explosion, which was of a violent nature, occurred at about 8 p.m. on the 8th of November, 1927, when the vessel was lying to, about four miles from Spurn Point in the North Sea.

Mr. Henry Ibbotson, of 54, Albert Street, Grimsby, was the owner of the boiler and it was not insured.

Henry Cook, second engine-man, was scalded to death and George Edward Gaunt, first engine-man, was scalded and died in hospital on the 11th November, 1927, from shock following on scalding and exposure.

The boiler was of the ordinary cylindrical multi-tubular type and was made of steel. It was 7 feet 6 inches in diameter internally, and 7 feet 6 inches in overall length. The thickness of the shell plating appears to have been originally half-inch. The boiler was fitted with one plain furnace, 3 feet in diameter. A manhole was provided in the top half of the shell for the purpose of internal examination, and two sight holes each $7\frac{3}{4}$ inches by 5 inches were provided in the front end plate. The following mountings were fitted:—

One water gauge with cocks fitted direct on front end plate; two test cocks; one main feed check valve; one donkey feed check valve.

One four-way casting, to which was fitted—one main stop valve; one steam valve to whistle; one steam valve to donkey pump; one steam valve to deck winch; one cock to pressure gauge; a pair of spring loaded safety valves set to lift at 90 lbs. per square inch, was also fitted direct on the shell plate.

The boiler appears to have been made by Martin Graham, Govan, Glasgow, in 1886, and was therefore upwards of 40 years old.

Early repairs, if any, are now unascertainable. There was an indication on the boiler front end plate to this effect: "re-tested for 90 lbs., 1918." In March, 1923, 30 plain tubes were renewed. In August, 1923, two cracks in the upper curve of the furnace adjoining the combustion chamber were welded. In January, 1924, the same cracks gave trouble and were cut out and re-welded. In January, 1925, weakness developed in the bottom of the combustion chamber and the place was welded. About the same time four plain tubes were stopped and filled solid with cement. In April or May the same tubes were renewed but some others remained solidly filled. In Sept., 1927, 15 tubes were renewed and four tube stoppers fitted to other tubes; when steam was raised to 40 lbs. two other tubes failed; and after experiences of the same kind all the remaining tubes were renewed. Further small repairs were effected at or about the same date.

The cause of the explosion was due to weakness of the boiler due to age and deterioration, and absence of competent supervision.

At the conclusion of the evidence and on the 17th day of May, 1928, the following statement was made by us:—

In this formal investigation we have to ascertain the cause of, and responsibility for, an explosion that occurred from the boiler of the S.T. *Bessie*, O.N. 93356, of Grimsby, on the 8th day of November, 1927, at 8 p.m., when the trawler was not under way, about four miles off Spurn Head. The case involves the following amongst other considerations: It appears that a vessel of this class, a trawler of about 44 tons gross tonnage, can be allowed to proceed to sea in an unseaworthy condition and with a boiler absolutely unfit for the generation of steam. The boiler was one of extreme age and was deteriorated to the uttermost. There is no record of any qualified inspection for years past; it was controlled by inexperienced people unversed in the technicalities of boilers. Owing to the ignorance of those on board, such a boiler as that which forms the subject of this investigation becomes a source of danger to those in charge of it. The circumstances appear to call for periodical surveys of uninsured ships of this class. Two lives were sacrificed absolutely needlessly. Such periodical surveys should be held by qualified surveyors attached to some corporate body or society invested with powers which do not at present exist.

With these preliminary observations we will proceed to deal with the facts as they appear in evidence.

The S.T. *Bessie* was built as a yacht in 1881, and was fitted with a compound direct acting engine, and with one steel boiler for a working pressure of 90 lbs. per square inch. The boiler was fitted in 1886. We are not concerned with her history until November, 1915, when she was bought by one, Charles Jeffs, of Grimsby, and used as a fishing vessel from Grimsby. In December, 1922, the vessel was bought from one, John Adams, by Francis Vincent, of 25 years' experience as a first engine-man. Trouble was found with the front end seam of the boiler, the seam having been previously welded, and a layer of cement was used internally, 2 inches thick and 6 inches wide. In March, 1923, some of the tubes gave trouble and Francis Vincent fitted 30 plain tubes. In June, 1924, cracks again showed, and in the following month Francis Vincent sold the ship to his brother David, but continued to look after the vessel as his brother David was ill, and is now in hospital owing to serious illness. In 1925, Francis Vincent found weakness in the bottom plate and a hammer, used to test it, went through the metal. To show what was going on, it should be stated that four plain tubes were treated with cement; and in 1926 only two or three trips were made. In August of that year the vessel was laid up and disused. Then Mrs. E. G. Cribb became owner and in August, 1927, sold to Henry Ibbotson, the owner at the date of the explosion. He held a master-mariner's certificate and paid £50 for his purchase.

From August to the 8th of November, 1927, when the explosion occurred, the record of repairs is one of considerable length. It is necessary to deal with them because an effort was made to place responsibility for the explosion and loss of life on the shoulders of the person employed to make these repairs, a contention we consider to be unjustified. Ibbotson soon found that some tubes were stopped and with steam pressure at 40 lbs. to the square inch other tubes gave out. Cement was found solid below the combustion chamber. John King, boiler-maker, was called in and ordered to replace 10 defective tubes. Towards the end of September, 1927, King also welded a defect on the starboard manhole face. No hydraulic test was applied at this time. On the 2nd of November it was considered safe for the trawler to make a voyage, with Ibbotson in charge, but the winch broke down and the *Bessie* returned to port on the 4th November. The boiler was worked at 90 lbs. to the square inch and the safety valve lifted. The winch being repaired, the ship left Grimsby for the fishing with two engine hands and a boy. Gaunt, first engine hand and fisherman, held a first engine-man's certificate, not granted by the Board of Trade but by an Insurance Society's board. Gaunt called his skipper's attention to the fact that he could not "get his vacuum" nor raise more than 60 lbs. pressure and the vessel lay to to make a liner for one of the bearings. A few minutes later the safety valve blew off and in a few minutes again the explosion from the boiler occurred. Gaunt was badly scalded and died later, and his mate, Cook, was found dead. We will now describe the boiler that exploded. Reference should be made to the diagrams accompanying our Report.

The boiler was of the ordinary cylindrical multi-tubular type and was made of steel. It was 7 feet 6 inches in diameter internally and 7 feet 6 inches in overall length. The thickness of the shell plating appears to have been originally half an inch. The boiler was fitted with one plain furnace, 3 feet in diameter. A manhole was provided in the top half of the shell for the purpose of internal examination, and two sight holes, each $7\frac{3}{4}$ inches by 5 inches, provided in the front end plate. The following mountings were fitted:—

One water gauge, with cocks, fitted direct on front end plate; two test cocks; one main feed check valve; one donkey feed check valve; one four-way casting, to which was fitted one main stop valve; one steam valve to whistle; one steam valve to donkey pump; one steam valve to deck winch; one cock to pressure gauge; and a pair of spring loaded safety valves set to lift at 90 lbs. per square inch was also fitted direct on the shell plate.

After the explosion, on close examination there was found a ragged hole on the port side, towards the front—see plan annexed hereto.

A piece of the boiler shell was blown out, leaving a jagged hole and the surrounding part showed great deterioration. It is assumed that at one time a cock or valve had been fitted on this part of the boiler, but the cock or valve had been removed for some reason unknown. There was every evidence of a centre hole to receive a spigot, surrounded by $\frac{5}{8}$in. studs. No doubt these studs were for the purpose of bolting the flange of the cock or valve to the shell plate. On examination after the explosion it was found that all the studs had broken off, either having been cut off on purpose or else corroded off, and all were flush with the boiler shell plate. To all appearances it was as if, when the cock or valve had been removed, a screwed fine threaded plug had been fitted into the centre hole where the spigot of the cock or valve must have been placed. It must be assumed that corrosion had gone on on the shell plate around the screwed plug until this part became so thin and weak that it could not withstand the pressure it was put to when under steam. Therefore it blew out the whole centre of the corroded part, including the screwed plug. The suggestion was made that the spigot hole was kept tight by cement only, but we do not consider this to have been really likely.

Having thus described in great detail the history of the boiler and of the accident that happened to it, we have only to call attention again to the fact that it was absolutely unsafe to allow a trawler to proceed to sea with its boiler in such a dilapidated condition as that of the S.T. *Bessie*. Some of these matters will recur in our answers to the questions addressed to us by Mr. Vaux, on behalf of the Board of Trade; and with these we will now deal.

Question 1: When, by whom, and for what working pressure was the boiler which exploded made? *Answer*: The boiler was made in 1886 by Martin Graham, of Govan, Glasgow, for the working pressure of 90 lbs. to the square inch.

Question 2: During what period of time were the vessel and the boiler owner by Mr. Francis Vincent and Mr. David Vincent respectively? Whilst in their possession—(1) was the boiler thoroughly inspected by a competent person? (2) Was it insured? (3) What repairs, if any, were effected to it? (4) At what pressure was it worked? *Answer*: Francis Vincent owned the vessel and boiler from December, 1922, to July, 1924, at which last date they were sold to his brother, David Vincent, until August, 1927. Whilst in their possession it was not thoroughly inspected by a competent person, then or at any time later. It was not insured whilst in their possession, nor later. The repairs effected related to a crack in the furnace crown (in 1924) and to the tubes (in 1924) and to the bottom plate of the combustion chamber (January, 1925) and to the tubes (April and May, 1925) and to the tubes again (in 1926). The pressure at which the boiler was worked during this period was 90 lbs. to the square inch.

Question 3: When and for what length of time was the S.T. *Bessie* laid up? *Answer*: The *Bessie* was laid up in August, 1926, until August, 1927, and until John King had effected the repairs ordered by Henry Ibbotson.

Question 4: When, from whom, and for what sum of money did Mr. Henry Ibbotson acquire the S.T. *Bessie* and the boiler? What repairs were effected to the boiler thereafter, by whom were they executed, and what was the cost of them? *Answer*: Ibbotson acquired her in August, 1927, from Mrs. E. G. Cribb, for £50, " laid up." As to the repairs: these related to tubes which were either cemented up or renewed. In particular 10 tubes were renewed at a contract price of £5. Other small defects came to light and a total expenditure of £41 11s. was incurred. A crack in the bottom of the combustion chamber was re-welded and included in the price named; and in September, 1927, the starboard manhole face was built up by welding. John King, boilermaker, did the work ordered.

Question 5: Did Mr. J. King, boilermaker, make examinations of the boiler? Did he advise Mr. Henry Ibbotson as to what repairs to it were necessary? Did he see the boiler under steam after such repairs were executed?—Did he tell Mr. Henry Ibbotson at that time that he was satisfied as to the condition of the boiler, or by anything he said, did he lead him to believe that the boiler was in a safe working condition? *Answer*: J. King, boilermaker, did not make examinations of the boiler, not being authorised to do so. He did not advise Ibbotson what repairs were necessary, but only carried out his instructions. He saw the boiler under steam after repairs. As to the conversation between Ibbotson and King, we consider the evidence showed that King guaranteed his own work only, as the general condition of the boiler was not within the scope of his work.

Question 6: Was the boiler thoroughly examined by a competent person after Mr. Henry Ibbotson acquired it? *Answer*: No.

Question 7: Before working the boiler did Mr. Henry Ibbotson take proper and adequate measures to ensure that it was safe for the steam pressure at which it was intended to work it? *Answer*: No.

Question 8: At what pressure of steam was the boiler worked? *Answer*: The boiler of the S.T. *Bessie* was worked at 90 lbs. to the square inch on the journey which ended in the breaking of the winch and return to port on November 4th.

Question 9: When the vessel left Grimsby on the 8th November, 1927—(*a*) Was the working of the boiler entrusted to a person competent to work it properly? (*b*) Was the boiler safe for a working pressure of 90 lbs. per square inch? *Answer*: (*a*) Yes, Gaunt was quite capable. (*b*) The boiler was not safe for the pressure indicated in the question.

Question 10: What was the cause of the explosion of the boiler at or about 7.35 p.m. on the 8th November, 1927? *Answer*: The cause of the explosion from the boiler was the wasting, due to age and corrosion, which reduced the thickness of the shell plating at the position indicated on the plan attached hereto, and the shell was too weak to withstand the pressure to which the boiler was subject.

Question 11: Are Mr. Henry Ibbotson, skipper and owner, Mr. J. King, boilermaker, or is either, and if so, which of them, to blame for the explosion? Should they, or either of them, pay any, and if so, what part, of the costs of this formal investigation? *Answer*: We find that there was negligence leading directly to loss of life and Mr. Henry Ibbotson was alone, to blame for the explosion; and this court orders that Mr. Henry Ibbotson, of 54, Albert Street, Grimsby, pay the sum of £50 towards the cost of this formal investigation.

We wish to express our deep sympathy with the relatives of the two men, George Edward Gaunt and Henry Cook, who lost their lives. We also wish to express our thanks to Mr. G. C. Vaux for his able conduct of the case, and to Mr. James Patrick Turnbull, engineer surveyor to the Board of Trade, at Grimsby, for his valuable and impartial evidence.

A. B. Bence Jones,
John McLaren,
Commissioners.

Dated the twenty-second day of May, 1928.

Report No. 2,921. S.S. *Roker*.

The case of a burst steam pipe on the *Roker* was investigated and reported upon by Mr. John A. Oxberry, Board of

Trade Surveyor, Bristol. The *Roker* is a single screw cargo steamer of 3,449 tons gross by 360ft. long, with a set of triple expansion engines and two single-ended boilers with a w.p. of 160 lbs., separate main steam pipes being led from each boiler to a junction piece attached to the engine stop valve. The vessel was built in 1918. The main steam pipes were of solid drawn copper 5in. diam. outside and 4½in. inside.

On 28th September, 1927, the vessel sailed from the Tyne with a cargo of light wood goods for Alexandria. During the voyage, average winter weather conditions were encountered, with south-westerly gales in the English Channel and the Bay of Biscay. There was slight racing of the engines during the bad weather, but the vibration was not excessive, and it was not necessary to control the engines by means of the throttle valve.

At 9 a.m. on 6th October, when the vessel was about midway between Cape St. Vincent and Gibraltar, a slight leakage of steam was observed coming from the port main steam pipe near to the flange by which it was connected to the junction piece. An inspection revealed that a fracture about one inch in length had developed through which the steam was escaping. The pressure in the main boilers was immediately reduced to 130 pounds per square inch, and the boiler stop valves closed down until they were only about one turn open in order to facilitate shutting off steam should the leakage become more serious. It was decided to proceed to Gibraltar for repairs. The vessel arrived safely, and the local Surveyor to Lloyd's Register of Shipping was notified of the defect. To effect a repair, a length of about 2½ inches was cut off the defective end of the pipe. The old flange was bored out and re-brazed to the shortened pipe. This repair was executed by a firm of engineers at Gibraltar. The pipe was annealed and afterwards tested to 320 pounds per square inch hydraulic pressure, which it satisfactorily withstood, the test being witnessed by the chief engineer and Surveyor to Lloyd's Register. The ship's engineers replaced the pipe in position. A cast gunmetal distance piece about 2½ inches in thickness was inserted between the flanges to make up for the amount the pipe had been shortened.

There were no signs of leakage after steam was admitted to the pipe, and the vessel proceeded on her voyage at 5 p.m. on 8th October. Steam at a pressure of 160 pounds per square inch was carried in the boilers, and the vessel arrived at Alexandria on 17th October. No trouble was experienced during this part of the voyage and there was no racing of the engines. At Alexandria the cargo was discharged and steam was shut off the main steam pipe lines from the time of the vessel's arrival until the engines were warmed through prior to sailing on 25th October for Poti. After three days' steaming in moderately fine weather, when the vessel was in the vicinity of Chanak, steam was again observed coming from the repaired pipe at the same relative position as on the former occasion. The steam pressure was reduced to 130 pounds per square inch and the boiler stop valves partially closed as before. The vessel anchored off Constantinople the following day, 29th October, at 9 a.m. A Surveyor to Lloyd's Register was called in, and it was then decided to renew the defective length of steam pipe. A new solid drawn copper pipe was shaped and fitted with flanges by a firm of engineers at Constantinople and before delivery was tested to 360 pounds per square inch in the presence of the chief engineer and the Surveyor. The old pipe, which had been taken ashore as a pattern for making the new one, was not returned to the ship. Since the new pipe was fitted no further trouble has been experienced.

Mr. John William Laidler, who has been chief engineer of this vessel for the past 17 years, stated in his evidence that there had been no defects in the main steam pipes since he joined the vessel until the first leakage was observed on 6th October last. The pipes had been annealed and tested at different times, usually when the vessel was undergoing survey for classification purposes. There were never any indications of water-hammer in the main steam pipes nor did priming ever occur. In 1916 extensive repairs to the engine seating were executed, and since that time there had been no undue vibration of the engines.

When the pipe was removed from the range to be taken ashore at Gibraltar, the chief engineer examined it and, so far as he could see, it did not appear to be worn or corroded either externally or internally at the position where it fractured. The fracture had, however, increased to nearly three inches in length. After examining the repair and seeing the pipe tested he had every confidence in its efficiency. When it failed on the second occasion he came to the conclusion that the material was fatigued, and as it was decided to fit a new pipe he did not examine it minutely.

As the pipe which failed is not available for inspection or test, to assign the cause of failure is a matter of conjecture. So far as I can ascertain the fractured pipe was one of the original ones fitted in the ship when she was built and had been in use for 29 years without requiring any repairs with the exception of occasional annealing. It therefore appears that the pipe lines were sufficiently flexible to cope with the vibration of the engines. After the pipe was repaired at Gibraltar it satisfactorily withstood the usual tests, and yet after being in use for about 20 days it again failed. The new pipe fitted at Constantinople was made as near as possible to the shape of the one which failed. It has been in use for six months and is satisfactory. It seems, therefore, that the copper of which the pipe was made had become fatigued through long usage and unable to withstand the ordinary stresses to which it was subjected.

I discussed with the superintendent engineer the condition of the other lengths of the main steam piping; they had received the same treatment as the one which failed and possibly the material would also be fatigued. He agreed to have them annealed and tested before the vessel sailed. I understand that, after annealing, a test of 300 pounds per square inch was applied, the test being witnessed by a Surveyor to Lloyd's Register of Shipping and by the superintendent engineer.

The observations of the Engineer Surveyor-in-Chief were that the pipe appears to have given satisfactory service for many years, and it is unfortunate that it is not available for close examination which would probably have revealed the actual cause of the deterioration which resulted in the failures, both of which occurred near to one end of the pipe. Great care is necessary when such pipes are annealed, or they may be seriously damaged in the process.

In July issue on p. 342, 4th paragraph, author's reply, the amount of linseed required is stated to be one penny per 100 gals., this should be per 1,000 gals. for the boilers.

Books Added to the Library.

British Standard Tables of Pipe Flanges (For Land Use).—Part I. "Flanges for working gas pressures up to 30 lb. per square inch and working water pressures up to 175 lb. per square inch."

"The three tables contained in this section of the British Standard Tables of Pipe Flanges supersede Table I of the 1904 edition so far as it relates to water pressures up to 200 lb. per square inch.

In the tables now issued, Standard Flanges are provided for pipes up to 72 inches nominal bore for working water pressures up to 50lb. and up to 48 inches nominal bore for working water pressures up to 130lb. and 175lb. respectively.

The usual particulars of diameter of bolt circle, number and diameter of bolts are provided, and the appendix contains a useful table of metric equivalents of the flange dimensions."

"THE MOTORSHIP MANUAL AND REGISTER OF MOTOR VESSELS, 1928." Edited by A. C. Hardy, B.Sc. Published by National Trade Journals Inc., 101 West 31st Street, New York, N.J. Price $3.00 delivered anywhere.

This is a compendium of up-to-date information on motor shipping throughout the world. The evergrowing list of motor ships in the Register reflects the increasing tendency to fitt new tonnage with internal combustion engines. Another notable feature of the Register particulars is the increase in horse-power, which starting in the hundreds, has now reached the order of 24,000. We do not think, however, that this justifies the statement that installations for 60,000 and 100,000 shaft horse-power have been designed and are ready for construction. It is suggested that the latter installation is intended for the new White Star liner; but even the most optimistic Diesel enthusiast would hesitate to take such a risk.

There are a number of useful and informative articles for the Engineer "standing by" and the man in charge.

"NICKEL AND ITS ALLOYS."—Publications of the Research and Development Department, The Mond Nickel Coy., Ltd., Victoria Station House, London, S.W.1.

The aim of the Company in producing these publications is to disseminate among those interested the very latest information regarding the use of the element nickel and its properties. The intensive research into new combinations of metals is followed by such rapid changes in established practice that to keep constantly up-to-date is a matter of difficulty. In order to meet this the research department are arranging to publish a monthly bulletin containing the latest information available on all matters relating to nickels, its alloys, properties, method of treatment, etc.

The first series of pamphlets published are enclosed in a loose-leaf binder having a ready means of indexing the contents. These already received deal briefly with the history of the metal and generally with its properties in alloyed and unalloyed state. A fund of information is available on the electro-deposition of nickel, and its use when alloyed with steel, iron, copper, etc. The information is authoritative, not speculative.

The service is offered freely to all who are interested and they have good reason to congratulate themselves on the availability of such an efficient service.

THE USES OF NICKEL DEPOSITS FOR ENGINEERING PURPOSES. By C. H. Faris, A.M.I.Mech.E. Reprinted from the Transactions of the Institution of Engineers and Shipbuilders in Scotland.

In this paper the author deals with a new method of electrolytically depositing nickel on various metals. This does not refer to ordinary nickel plating, but to an entirely new process whereby nickel is deposited and perfectly amalgamated to the metal upon which it is imposed. Particulars of the system are not given; but a number of tests are described which were carried out to prove the adhesive qualities of the deposit. A plain steel stud one inch in diameter was built up over one inch of its length by nickel to a diameter of 1 5/32nds inch. A load of 11·95 tons or 17·6 tons per square inch was subsequently required to move the deposit from the stud. An inspection of the inner surface of the ring deposit disclosed a film of steel amalgamated with the nickel, proving that the surface of the steel had sheared before the adhesion broke down. The system can be applied successfully to almost anv of the usual metals and to any part which may be badly worn or is likely to be subject to heavy wear. The deposited nickel has better wearing properties than steel and is resistant to corrosion; this has been determined in actual practice.

This method of building up worn machine parts appears to have infinite economic possibilities. The author is most convincing in his accounts of the success of the system which has now been apparently well tried.

THE STATIC BALANCING OF ROTORS. By Professor B. P. Haigh, D.Sc., Royal Naval College, Greenwich. Reprinted from "The Engineer."

In this paper the author shows that a rotor which may be statically and dynamically balanced may yet be in a state of internal unbalance and he submits the case to mathematical proof. It is also shown that certain types of balancing machines do not in fact do their work accurately, and the reasons are given. An example is also quoted of a turbine which persistently wore out its bearings and caused considerable trouble to the owners of the vessel. The rotor had been balanced in the ordinary machine, but when tested in the new Martin balancing machine it was found to be two foot pounds out of balance. The machine is fully explained, including the underlying mathematical principle.

Centenary Celebrations—June 3rd to 7th, 1928—of The Institution of Civil Engineers. Historical account of rise and progress

Centenary of the Bureau veritas Classification Society, 1828—1928. The origin of the Society and its advancement to the present day.

Purchased.—"Deterioration of Structures in Seawater." Second (Interim) Report of the Committee of the Institution of Civil Engineers, 1921, 2/6 net.

Third Report, 1922, 3/- net.

Fourth Report, 1923, 3/6 net.

Fifth Report, 1924, 3/6 net.

Sixth Report, 1925, 2/- net.

Eighth Report, 1927, 3/- net.

Note.—The First and Seventh Reports were previously in the Library.

Published by H.M. Stationery Office, London.

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Election of Members.

List of those elected at Council Meeting of 10th September, 1928:—

Members.

Leonard Harry Almond, 7218, Narrows Avenue, Brooklyn, New York, U.S.A.

Robert Austin, Supt. of Machinery, P.W.D., Singapore, S.S.

William Bathgate Tierney Blue, 72, Shakespeare Crescent, Manor Park, E.12.

Leonard Timothy Brosnahan, 58, Selwyn Street, Timaru, N.Z.

Frederick Reynold Butterworth, 1, Rhos Road, Benyffordd, near Chester.

Edward Norris Calder, 69, Jeanfield Road, Perth, Scotland.

David Patterson Craig, 3, Walrond Street, Maryfield, Dundee.

James Gardner, China Nav. Co., *c/o* Messrs. Butterfield and Swire, Shanghai, China.

Jack Clifford Gilling, "Beverley," London Road, St. Albans, Herts.

John Arthur Gladstone, *c/o* B.I.S.N. Co., Ltd., 122, Leadenhall Street, E.C.3.

John Lee Godfrey, H.M.T. *Nevasa*, B.I.S.N. Co., Ltd., 122, Leadenhall Street, E.C.3.

Edwin Goodson, 50, Palmerston Road, Parkstone, Dorset.

George William Grant, Institute of Marine and Power Engineers, 246a, George Street, Brisbane, Queensland.

Philip Gregson, M.A., Debden, West Byfleet, Surrey.

Marcus Gunn, Myosotis, Riversdale Road, Rivervale, Western Australia.

Charles Henry George Hayward, St. Vincent, 4, Abbotsleigh Road, Streatham, S.W.16.

Edgar Oxley Kingston, 168, Windmill Street, Gravesend, Kent.

Robert Lamb, 3, Oakhurst Terrace, Benton, Northumberland.

Hugh Thomson Lawson, *c/o* Turner, Morrison and Co., Ltd., 16, Bank Street, Bombay.

Thomas B. Lawson, 14, Rainton Street, Sunderland.

Eric James Rutherford Lees, Strathboro, Worrin Road, Shenfield, Essex.

John Shepherd MacLean, 29, Sunbourne Road, St. Michaels, Liverpool.

Harry Melville, *c/o* Escombe McGrath and Co., 18, Canute Road, Southampton.

Ernest Victor Newing, 52, Heathfield Avenue, Dover.

Harold Partington, 2, Eskdale Avenue, Oldham.

Alexander Robertson Rae, 28, Greenbank Avenue, St. Jude's, Plymouth.

John William Hampson Stileman, Tower House, Belvedene Road, Upper Norwood, S.E.19.

William George Suffield, Petersham Lodge, New Malden, Surrey.

Charles Thooris, 89, Boulevard de Strasbourg, au Havre.

Companion.

John William Muirhead, *c/o* Norman Stewart and Co., 9, Clive Street, Calcutta, India.

Associate-Members.

Walter Harforth Reevell, 67, Percy Street, Bootle, Liverpool.

Robert John Alexander Reid, Steamers Dept., Khartoum North, Sudan.

William Aubrey Robb, Riseholme, Kings Road, Westcliff-on-Sea.

Thomas Charles Felix Stott, 60, Aldersey Gardens, Faircross, New Barking, Essex.

Jack William Burr Towler, 72, Patrick Road, E.13.

Frank Lewis Turner, Peverel, Southend Road, Grays, Essex.

Harold Reginald Clayton, 6, Pelham Road, Wallasey, Cheshire.

Associates.

Edward Thomas Marshall, 29, Peel Road, Wolverton, Bucks.

Jack Wilson Webb, 134, Tower Street, Brightlingsea, Essex.

George Gee, 29, Sun Street, Birkenhead.

Graduate.

James Denning Pearson, 35, Victoria Park Road East, Cardiff.

Transferred from Associate-Member to Member.

George Gall, Western Cottage, Severn Avenue, Gidea Park, Essex.

Ernest Thomas Walcroft, 98, Arodene Road, Brixton, S.W.2.

Transferred from Graduate to Member.

Reginald Charles Crouch, 26, Alpha Road, Millwall, E.14.

Transferred from Associate to Associate-Member.

George L. Rischmiller, 6, Staunton Street, Deptford, S.E.

Board of Trade Examinations.

List of Candidates who are reported as having passed examination under the provisions of the Merchant Shipping Acts.

For week ended 4th August, 1928 :—

NAME.	GRADE.	PORT OF EXAMINATION.
Boyes, Matthew C.	1.C.	Glasgow
King, James M.	1.C.	,,
Macniven, Hugh	1.C.	,,
Docherty, John	2.C.	,,
Kirkman, Joseph E. S.	2.C.	,,
McGregor, William J.	2.C.	,,
Munn, John M.	2.C.	,,
Orr, Archibald	1.C.M.	,,
Angell, Edwin J.	1.C.	London
Strelley, Keith D. A.	1.C.	,,
Brown, Ernest	2.C.	,,
Golightly, George T.	2.C.	,,
Patterson, Lionel J.	2.C.	,,
Plummer, Edward P.	2.C.	,,
Whitfield, Albert	2.C.	,,
McGuiness, Thomas F.	2.C.M.	,,
Allen, Joseph C.	1.C.	Liverpool
Bennett, James	1.C.	,,
Partington, Harold...	1.C.	,,
Armstrong, Charles F.	2.C.	,,
Harding, John	2.C.	,,
Hutchinson, William H.	2.C.	,,
Jones, John B.	2.C.	,,
Amer, Stephen K.	2.C.M.	,,
Cumming, Keith P.	1.C.	North Shields
Lawrence, Mortimer J.	1.C.	,,
Douglas, William S.	2.C.M.	,,

The Board of Trade Journal reports that the total number of examinations for Engineer Certificates of all grades, both ordinary and motor, during 1927 was 4,196, of which 2,640 (representing the attempts of only 898 individuals) resulted in failure. The total number of individual candidates examined was 2,454, and of these 1,556 succeeded after one or more attempts in obtaining certificates during the year as against 1,428 in 1926.