The Carriage of Edible Oil and Similar Bulk Cargoes

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Edible oil and similar bulk cargoes are usually carried in ships' deep tanks which are constructed and fitted out for the purpose; successful carriage depends principally on the preparation of the tanks prior to shipment and, in the case of solid fats, on temperature control during the voyage.

The main object of this paper is to provide the seagoing personnel, and others connected with the practical side of the carriage of these cargoes, with a non-scientific background to the official instructions issued by shipowners and other authorities connected with the various trades.

The paper does not contain any new ideas but it presents in a condensed form experience gained over several years in the preparation and survey of deep tanks for these cargoes and it offers for consideration some remarks on matters which are often a cause of controversy.

It is hoped that this necessarily brief outline of the subject will promote discussion and induce others to add their contributions, and that the whole will provide a treatise on the carriage of these cargoes about which little of a general nature appears to have been written previously.

INTRODUCTION

Edible oils have been carried by sea in deep tanks for many years but the demand for these commodities has increased rapidly during the last quarter century and fresh sources of supply have had to be developed. These fresh sources of supply are generally remote from the countries in which the edible or cooking fat industries are situated and it will probably be necessary to transport ever-increasing quantities of the necessary raw material by sea.

The cooking fat industries depend largely on vegetable and animal fats for their raw material; the production and carriage of the principal marine mammal oil, i.e. whale oil, is now a specialized trade and it is not proposed to deal with it in this paper.

The tendency in the bulk mineral oil trade is to carry the oil in its crude state and to do all necessary refining and processing on arrival at its destination; in the case of mineral oils, the by-products are extremely valuable but in the case of vegetable oils the reverse is generally the case and the tendency is to refine vegetable oils as much as possible before shipment.

Furthermore, in the case of vegetable oils it is necessary to extract the oil from the vegetable matter as soon as possible after collection of the fruit or nuts in order to avoid deterioration. This deterioration generally takes the form of mould or mildew and it has been established that refined oil made from raw material affected by either of these diseases is more liable to go mouldy than oil made from sound material.

Vegetable oils vary considerably in different parts of the world in their freedom from solid matter or other adulteration when shipped but it will be assumed in this paper that they have been refined prior to shipment. It must be appreciated, however, that further processing of the oil and manufacture of the finished product takes place after discharge.

SOME INFORMATION ABOUT THE CARGOES

Vegetable oils are classified in various ways but it is probably simplest to classify them as solid fats, liquid fats and drying oils. This classification does not depend on chemical or scientific knowledge for interpretation and it affords a suitable explanation of some of the problems connected with their carriage in bulk.

The following are some of the vegetable oils in the various classes; the list is not comprehensive but it includes most of the oils which have been carried in bulk although some have been shipped only in small packages.

Solid fats:—Palm (fruit or kernel), coconut.

Liquid fats:—These are generally subdivided into non-drying and semi-drying oils:—

Non-drying oils:—Groundnut, almond, olive, castor, rapeseed, sesame, cottonseed.

Semi-drying oils:—Soyabean, sunflower.

Drying Oils:—Linseed, tung (chinese wood), candlenut, perilla, rubberseed.

Similar cargoes:—Animal and fish oils, marine mammal oils and latex (liquid natural rubber).

Vegetable fats (solid and liquid) vary in composition according to the conditions under which they are grown; given the same degree of cultivation, it will be found that temperature and rainfall influence the growth factors and that these in turn have a bearing on the use to which the oils are eventually put. It will also be found in practice that the growth factor in the case of some of the liquid fats affects their sub-division either as non-drying or semi-drying oils.

Palm fruit oil produced in West Africa is said to be poor

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in nutritional value and difficult to deodorize whereas similar oil produced in Malaya and Indonesia is said to be high in nutritional value and easily rendered edible. It should be clear from this that the use to which any particular oil will eventually be put depends to some extent on the source from which it comes as well as on the supply and demand position.

The solid fats and most of the liquid fats are used either in the manufacture of cooking fats and other foodstuffs or in the food canning industry, but where the nutritional value is low they may be used in the manufacture of soap and toilet requisites.

It must also be mentioned here that palm oil is used extensively in the tin plate industry; it is used to preserve the surface of the heated iron sheet from oxidation until the time comes for it to be dipped into the bath of molten tin; its excellent lubricating properties are made use of in the cold rolling process to reduce the heat generated by friction on the steel faced rollers and it is used in the actual tinning process to ensure that the coating is evenly regulated for thickness and uniformly spread over the surfaces of the plate.

Drying oils, i.e. oils which absorb oxygen freely when exposed to the atmosphere and form an elastic waterproof solid film are invariably seed fats and are mostly used in the manufacture of paints and varnishes. Some semi-drying oils are also used for these purposes.

Palm oil, coconut oil and latex form the bulk of the cargoes carried nowadays and, as they are probably the most difficult to carry satisfactorily, it may help to mention a few of their individual characteristics.

Palm oil is generally shipped in the unbleached state and is referred to as red palm oil to distinguish it from the bleached or white product. It is roughly of the consistency of margarine or vaseline at normal temperatures and is very difficult to remove from steelwork when in this condition. When fresh it is of a bright orange colour, its taste and smell are mild at normal temperatures but it has a very pungent smell when heated.

From the point of view of its carriage in bulk, the main difficulty is its consistency at medium temperatures. The melting point and the solidifying point vary in different grades but they may be taken as lying between:—

Solidifying point	88 deg. F. and 100 deg. F.
Melting point	100 deg. F. and 110 deg. F.

Coconut oil is a white or yellowish white fat with a lower solidifying point and a lower melting point than palm oil but the fact that it is near white in its natural state makes it more liable to discoloration and greater precautions must be taken to preserve the natural colour.

As in the case of palm oil, the solidifying point and the melting point vary in different grades of oil but they do make the carriage of coconut oil somewhat simpler because the oil can be more easily kept in the liquid state; the temperatures may be taken as lying between:—

Solidifying point	60 deg. F. and 73 deg. F.
Melting point	73 deg. F. and 80 deg. F.

The relevance of the following remarks will be more fully appreciated when the subject of coating deep tanks is discussed.

Palm oil and coconut oil are both liable to go rancid or develop off-flavours; this may be caused either by oxidation or by the action of fungous growths such as mould or mildew. Rancidity due to oxidation is more common than that due to fungous growths and is accelerated by heat and light, particularly when the oil is in contact with steel. Moulds and similar bacteria depend largely on moisture for existence but they are rarely encountered in good quality oil; poor quality oil, made from fruit or nuts which have been attacked by either mould or mildew before the oil was extracted, is particularly liable to turn rancid or develop mould if it is exposed to heat and humidity. Light and air both act as oxidizing agents and cause deterioration of oil in storage; this action can be prevented during carriage by filling the tanks as full as practicable and restricting the circulation of air through ventilators and air pipes.

Latex is the natural juice of the rubber tree or crude rubber in a commercial form. It looks very like thick milk or cream and behaves like it if attacked by bacteria; when

FIG. 1—*Sampling palm oil prior to discharge*

this happens, the rubber constituent coagulates and leaves a watery residue. Certain substances can be added to the raw latex to preserve it in its natural state; the one which is used when latex is to be carried in bulk in deep tanks is ammonia.

The dry rubber content of latex as tapped from the rubber tree varies and is roughly 30 per cent of the total weight but the dry rubber content can be increased by concentration prior to shipment. At the present time it has been found possible to increase the dry rubber content to 60 per cent and still keep the latex in a liquid state and suitable for shipment. It seems likely that this degree of concentration will be further increased in the future.

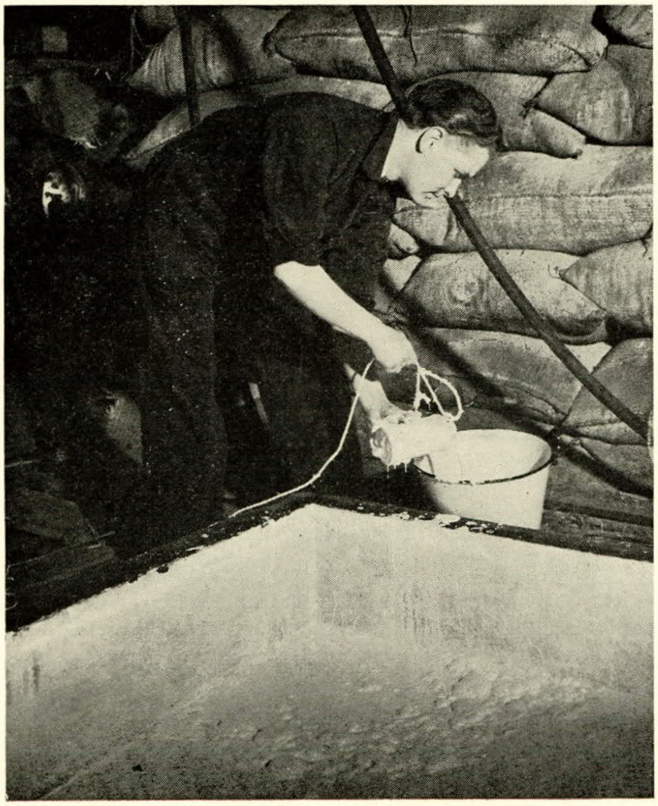


FIG. 2—*Sampling latex prior to discharge*

Scrupulous cleanliness is as essential at all stages of manufacture and shipment of latex as is the case with edible oil. Latex which has been treated with ammonia will dissolve iron, with subsequent formation of salts which give it a brownish colour; latex should be pure white and discoloration reduces its commercial value. To prevent this discoloration, all steelwork in the tank in which the latex is to be carried must be coated with a protective coating of wax or alkali-resisting paint. Latex drums are coated with bitumastic but high grade paraffin wax with a melting point of approximately 130 deg. F. is almost invariably used in ships' deep tanks.

Zinc and certain other non-ferrous metals, with their alloys, act as a poison to latex. It has been established that articles made from rubber containing the least trace of these metals are less durable than articles made from perfectly pure rubber and the use of non-ferrous or galvanized fittings in deep tanks must be carefully avoided. The action of ammonia on non-ferrous metals is well known to marine engineers, conversely it is understood that rubber technicians now attach so much importance to the deleterious effects of non-ferrous metals on latex that they are insisting on the removal of all non-ferrous fittings from latex installations although there is no possibility of direct contact with the latex.

Care must be taken to avoid aeration of latex during shipment and also during carriage. For this reason it is customary to fill the deep tank as full as possible in order to prevent surging; it might be mentioned here that the coefficient of expansion is said to be negligible and that no reports have been received of damage being caused or of loss being sustained by thus filling the tank.

Latex is usually shipped in tropical countries and its temperature should drop during the voyage but latex is affected adversely by high temperatures and, as a general rule, it should not be carried in tanks adjacent to compartments which will be maintained at a high temperature throughout the whole voyage.

Any deep tank fitted and constructed for the carriage of these three commodities should be capable of carrying all other edible oils. These three commodities have been described in some detail in order to help in an appreciation of the problems connected with their carriage in bulk.

CLASSIFICATION REQUIREMENTS FOR CONSTRUCTION AND CARRIAGE

References to Classification Rules and Requirements cannot easily be avoided in dealing with deep tanks intended for the carriage of these commodities; subsequent references will be to the Rules and Requirements of Lloyd's Register of Shipping but it must be emphasized that the views and opinions expressed are those of the author and they do not necessarily represent the opinions and views of Lloyd's Register of Shipping or of any other interested authority.

The first reference to these cargoes is in the chapter dealing with Classification Regulations; under the heading "Special Cargoes" it is stated:—"In dry cargo ships, any compartments intended for the carriage of liquid cargoes, such as vegetable or mineral oils having a flash point above 150 deg. F., are to be in accordance with the requirements of the Construction Rules relating thereto; in such cases, an appropriate class notation will be entered in the Register Book."

Vegetable oils and similar cargoes are occasionally carried in compartments, i.e. deep tanks, which do not have the appropriate notation in the Register Book and Classification surveyors do issue "loading certificates" to classed ships for tanks which do not have the appropriate notation. The loading certificates issued in the case of such tanks merely state that the tanks are fit to receive cargo; where tanks do have the appropriate notation, the loading certificate will state that the tanks are fit to receive and carry the cargo.

It is not proposed to deal with the Construction Rules in detail but deep tanks and peak tanks carrying vegetable and similar oils as cargo may be constructed in accordance either with the rules for ballast tanks or for oil fuel bunkers.

In the case of tanks constructed in accordance with the rules for ballast tanks, it is a requirement that a centre line bulkhead, intact or perforated as desired, be fitted and that the ventilation, drainage and control generally be as required for oil fuel bunkers. In this case, the notation made in the Register Book will be "Carrying vegetable oil in deep and (or) peak tanks."

When tanks are constructed in accordance with the rules for the carriage of oil fuel for ships' use, i.e. for oil fuel bunkers, the rules permit the omission of the centre line bulkhead and also some relaxation of the riveting requirements for oil fuel bunkers.

It must be made clear, however, that tanks constructed in accordance with the rules for ballast tanks, or with the modified form of the rules for oil bunkers, are not suitable for shipments which only partially fill the tanks.

Where it is intended that tanks shall only be partially filled at any time, the full requirements for oil fuel bunkers must be complied with. In these cases the notation made in the Register Book may be "Carrying oil F.P. above 150 deg. F. or vegetable oil in deep and (or) peak tanks."

The advantages of constructing tanks fully in accordance with the rules for oil fuel bunkers may not be obvious but shipowners cannot always be certain of sufficient oil being available at sailing time and it may be a case of half a loaf being better than no bread. Vegetable oils and latex are to some extent seasonal cargoes and it frequently happens after long periods of unseasonable or unusually dry weather that production is delayed and that there is a shortage of oil or latex at the bulking stations although the tank space for shipment is booked and is available.

Classification Rules require that the scantlings and arrangements for tanks which exceed 30 feet in length be specially considered and this probably accounts for the fact that the average capacity of these tanks, when a centre line bulkhead is fitted, is between 300 and 400 tons. This figure will vary with the breadth of the ship and the height of the deck which forms the top of the deep tank but intermediate figures can be obtained by the construction of 'tween deck tanks which can be used either independently or in conjunction with the hold deep tanks. Except in those cases where large shipments can be absolutely relied upon, it would appear to be desirable to fit centre line divisions in all hold and 'tween deck tanks. The word division is used deliberately because the advisability of fitting a cofferdam or similar structure may become apparent later.

Deep tanks such as these will usually be constructed either immediately forward or aft of the machinery space, for reasons which will be obvious. They will generally be designed for the carriage of dry cargo when bulk liquid is not avaliable and will, therefore, be fitted with large access hatches. The large access hatches offer many advantages in that easy access and reasonable ventilation are possible for tank cleaners, that loading of liquid cargoes is simplified and that no special facilities are necessary for the discharge of the liquid cargoes other than the shore pump and pipe lines which are the usual means adopted for the discharge of these cargoes. In most of the trades connected with these cargoes it is recognized practice for the discharging arrangements to be the responsibility of the consignee or receiving installation.

Peak tanks, tunnel side tanks and tanks between tunnels are often designed for the carriage of liquid cargoes in order to take advantage of spaces which are inconvenient for the stowage of dry cargo. Unless special consideration is given to their internal structure from the point of view of drainage and cleaning and to the access arrangements from the point of view of loading and discharging they cannot be considered entirely suitable for the carriage of solid fats or latex.

Tanks such as these are more suitable for the carriage of liquid fats which do not require to be heated and where cleanness is not of paramount importance. Some ships have been fitted with non-structural tanks or structural tanks in superstructure spaces for the carriage of small packages of special oils but these are not thought to be of sufficient general interest to merit further reference in this paper.

Whilst it is possible to construct and arrange peak and tunnel tanks to carry all of the cargoes under consideration, it does not appear to be a practicable proposition to carry any of them in double bottom tanks. The main drawback to their use is the difficulty of cleaning them satisfactorily and of arranging for their discharge; it will be seen later that the existing ballast lines, or any form of permanent piping installation, are most unsuitable for this purpose.

The following Classification requirements are worthy of mention and consideration at this stage:—

(1) Tanks intended for the carriage of vegetable and similar oils are to be designed and constructed with a view to their being cleaned with reasonable facility.

(2) Tanks carrying vegetable or similar oils are to be separated from those carrying oil fuel or fresh water by a cofferdam.

(3) Sparring or lining is to be fitted on the bulkheads in holds to prevent leakage of oil coming into contact with the cargo. Gutterways are to be arranged at the foot of these bulkheads to ensure that leakage shall have free drainage to the wells or limbers. Sparring or lining and gutterways need not be fitted where a bulkhead and its boundary connexions are wholly welded.

(4) If cargo or coal is carried in a compartment adjacent to an oil fuel settling tank which may be heated, the compartment side of the bulkhead or deck is to be insulated.

To consider the first of these points, facility of cleaning: welded construction would seem to offer many advantages but experience has shown that it is no more difficult to clean an all-riveted tank than an all-welded one if all the stiffening is fitted inside the tank. One of the main points to be considered is avoidance of inaccessible recesses or pockets between stiffening. All-welded tanks, forming part of the structure of the ship, have been built as clear of obstruction as an empty box; although such tanks have to be scaffolded, or staged, for the final cleaning the time taken must be less than with the more commonplace tank but it must also be remembered that such tanks require an appreciable surround of non-cargo carrying space and it is doubtful whether this would be considered an economical proposition by most shipowners.

The second point is the isolation of vegetable oil tanks from oil fuel or fresh water tanks by a cofferdam. The reason for this is clear and it presents no difficulty where thwartship or longitudinal bulkheads are concerned. However, hold deep tanks are built directly on top of double bottom tanks which may be designed to carry oil fuel and the difficulties of interposing a cofferdam between the double bottom tank and the deep tank need no explanation.

In such cases special arrangements should be made by the ship's personnel to ensure that no head of oil is applied to the double bottom tank while vegetable oil is carried in the deep tank above. It is just as important that the contents of the double bottom tank should not be contaminated by vegetable oil and for this reason fresh water intended for boiler feed or drinking purposes should not be carried in the double bottom tank.

The third and fourth requirements concern sparring, lining and insulation on bulkheads and they are probably best considered together. Sparring or lining should be fitted on the dry cargo side of deep tank bulkheads which are wholly or partially riveted. Some doubt exists as to whether the requirement that insulation is to be fitted on the bulkhead or deck of oil fuel settling tanks which may be heated is intended to apply equally to vegetable oil tanks which may be heated but it is safe to assume that insulation should be fitted if dry cargo liable to be affected by heat is to be carried in adjacent compartments. When lining or insulation is fitted, the bulkhead and its connexions cannot be examined satisfactorily under test and the surveyor who carries out the test for issue of a " loading certificate " must qualify his certificate accordingly. In the case of sparring, he may be able to see sufficient of the structure to justify issue of an unqualified certificate but, looked at solely from the point of view of the carriage of vegetable oil in bulk, these requirements do present a problem, as both shippers and underwriters are reluctant to accept a certificate which is qualified in any way.

Insulation and lining may be a source of danger because they can hide defects which are liable to cause serious damage. Minor defects are always liable to occur in either riveted or welded bulkheads; these may rust up or be sealed temporarily by the residue of a previous cargo with the result that no leakage is apparent when the test head is applied. An experienced surveyor ought to spot such minor defects if the bulkhead is fully exposed but he cannot be expected to do so when the bulkhead is covered completely. If the small defects are allowed to go undetected for a long period, serious leakage may develop after a cargo of heated vegetable oil or latex has been shipped in the tank. It is here suggested that consideration should always be given to the provision of an accessible and well ventilated cofferdam between deep tanks and cargo holds. There are other advantages in fitting such a cofferdam which it is hoped will be more apparent at a later stage.

FITTINGS AND ARRANGEMENTS FOR CARRIAGE OF BULK LIQUID CARGOES

This disposes of the main structure of the tanks but there are other details which experience has shown to require close consideration. Hatch coamings and their closing appliances are apt to get badly knocked about when dry cargo is carried in the deep tanks and they should be particularly robust; where specially constructed expansion or access trunks are not fitted the hatch coamings in spaces where freeboard regulations do not apply or do not call for deep coamings should always be made deep enough to provide adequate space for expansion. In practice the cover joint should not be under pressure other than that caused by surging of the liquid but it must be oil and gas tight and opinion is divided between the tanker type joint with thick hemp packing in a recess and the ordinary flat joint with through bolts. Much of the damage and distortion to covers can be avoided if they are permanently hinged and it will be found also that the risk of the joint being disturbed when the cover is being finally closed down is appreciably reduced with hinged covers; it is practically impossible to manœuvre and lower these heavy and unwieldy covers into position by means of derricks and winch gear without causing some damage or distortion. Questions are often asked as to the most suitable jointings for such covers; in the case of tanker type covers, dry woven hemp should be used, but if greased packing only is available all superfluous grease should be removed before the cover is finally closed down. Stranded spun yarn, soaked or moistened with the oil to be carried, is probably the most satisfactory and economical form of jointing for use with bolted joints; leather, cork, rubber, prepared jointing of all descriptions may be used but care must be taken that no jointing paste or liquid, other than the oil to be carried, is used. The jointing material should not be impregnated with any substance liable to contaminate the cargoes; it has been alleged that jointing materials alone are liable to contaminate cargo but when one considers the area actually in contact with the cargo, this allegation would seem to be open to argument.

Large hatch covers should always be provided with a proper manhole and ullage holes, with bolted covers, approximately four inches in diameter at the four corners of the hatchway; the latter are necessary for checking ullages, they serve as air pipes during final filling operations and they can be used for taking temperatures.

Tanks intended for the carriage of dry cargo must be efficiently ventilated and the ventilator trunks which pass through 'tween deck spaces must be watertight and accessible for pressure test with the deep tank itself. The trunks should also be capable of being rough cleaned internally and of being fitted with either plugs, baffles or relief valves; it is an advantage if they are of circular section with a perfectly straight lead to the weather deck coaming.

Air and sounding pipes require similar consideration and it is desirable to make all connexions inside the deep tank by means of heavy flanged joints with closely spaced bolts and not by means of welded joints or screwed couplings. If the goose neck portion of the air pipes is attached to the stand pipe on deck by means of a bolted flange, it can be removed to facilitate topping up of the deep tank for testing or it can be replaced by either a blank flange or pressure relieving device according to the nature of the cargo.

Gas relief valves, adjusted to lift at approximately 5 lb. per sq. in., must be fitted to tanks when latex is carried; the best position for these valves is at the upper end of an airpipe where any escaping gas can be dissipated freely. There is no need for these valves to be of complicated design; they must be of steel or iron throughout and should always be fitted in an accessible position where they cannot come in direct contact with the latex. Complicated systems of bypasses, cross connexions and blank flanges with relief valves interposed for the alternate carriage of dry cargo, vegetable oil or latex cannot be recommended. Simplicity and "foolproofness" should be the keynote in the arrangements for the carriage of these cargoes. Before leaving the subject of airpipes, mention should be made of the necessity for ample air or "breathing" holes being provided in the under deck structure, particularly in beams. When latex is carried it is essential that the tank be filled as full as possible and this cannot be done satisfactorily if adequate egress is not provided for trapped air; furthermore, the metal must be coated with wax and to ensure this the breathing holes must be of reasonable size. To facilitate discharge of liquid cargoes, adequate draining holes must also be provided in stringers, continuous gusset plates and similar structural details.

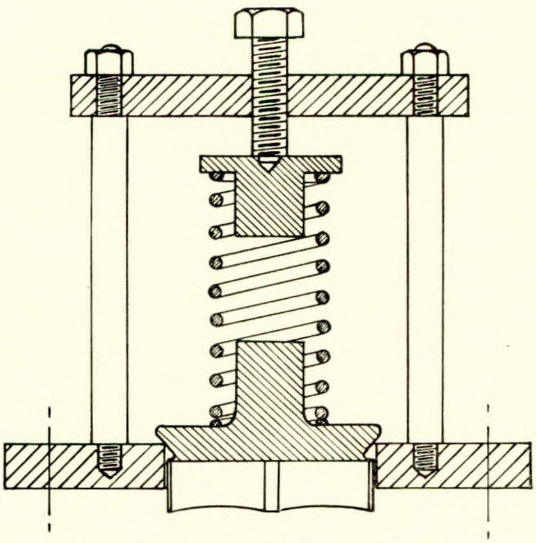


FIG. 3—*Pressure relief valve for latex*

When deep tanks can be used for the carriage of oil fuel, cargo oil, water ballast or dry cargo, provision must be made for blank flanging the oil and water ballast filling and suction pipes when the tank is used for dry cargo and for blank flanging the bilge suction pipes when the tank is used for oil or water ballast. When arrangements for discharge of vegetable oil by the ship's own pumps are fitted, the whole of the piping should be entirely independent of the usual pumping arrangements and it should be easily accessible for dismantling and cleaning; experience has shown that fixed piping cannot be satisfactorily cleaned in place and it is suggested that flexible pipes in easily handled lengths provide the best solution. The necessary bulkhead valves, and their tail pipes, can be cleaned at the same time as the tank and the outer end of the valve kept blank flanged until the oil is ready for discharge; one portable pipe line will serve for any number of tanks and when different cargoes have to be dealt with it can easily be cleaned after each different cargo. To take full advantage of this arrangement, the bulkhead valves must be accessible at all times and this can only be done in a multiple tank arrangement by fitting either a fore-and-aft cofferdam or pipe tunnel.

Heating coils are necessary if the tank is to carry all the different cargoes which are available. Arrangements must be provided for blank flanging the heating coils when they are not required for the liquid cargo or when dry cargo is carried and it is advisable to fit the coils with a view to their being easily removed; the coils should always be removed when latex is carried and the open ends inside the deep tank efficiently blank flanged in addition to fitting the usual blank flanges outside the deep tank.

Opinions differ widely on the amount of heating surface which should be provided; an average figure for a normally shaped tank is two square feet of surface per ton of space but it must be remembered that the overall efficiency of the coils depends largely on their layout.

The coils should be fitted as close to the ship's side and to the double bottom tank top plating as possible and those on the double bottom tank top should extend roughly from bulkhead to bulkhead; ship's side coils should cover at least one-third and preferably two-thirds of the depth of the tank and a coil should always be run along the upper side of stringers or similar shelves; in tanks with wing bilges the ship's side coils should extend as far down into the bilge as possible. Heating coils should not be fitted under or close to the deep tank deckhead, nor should they be fitted in expansion trunks; oil coming in contact with coils which are not permanently covered is liable to be scorched and contamination of the oil cargo will ensue.

Except in very small tanks, the installation should have a minimum of two separate circuits, disposed in such a way that if one circuit has to be put out of action for any reason the remaining circuit or circuits will still cover the whole of the tank. It is advisable to have approximately 40 per cent. of the total heating surface at the ship's side and to arrange for the steam to enter through the ship's side coils and pass from them to the double bottom tank top coils before leaving the tank.

It is suggested that higher steam pressure, say from 100 lb. to 200 lb. per sq. in., combined with heavy gauge piping, is preferable to lower steam pressure and light gauge piping. Light gauge piping is very liable to damage and defects due to corrosion are likely to be frequent and serious. The higher steam pressure is more likely to blow deposits of scale or other obstructions through the coils and, if the heavy gauge coils are arranged in grid form for easy assembly and dismantling, the risk of wastage or accidental damage is very small. Screwed union couplings are not as reliable in service as bolted flanges; special attention should be given to the design and position of flanges with a view to accessibility and, a point of great importance which is often overlooked, an adequate supply of suitable spanners, preferably of the universal type, should be provided for use by the ship's staff.

Little is to be gained from the higher steam pressure as regards heating of the oil during shipment. In practice it will be found that very little heat is required either to keep the oil at the required temperature during the voyage or to raise it to the required temperature for discharge at the end of the voyage. After shipping, the oil should be allowed to cool down to the temperature recommended for its carriage and then only sufficient steam should be supplied to keep it steady at that temperature. Towards the end of the voyage, sufficient heat should be applied to bring the oil gradually to the temperature required for its discharge and this recommended temperature should never be exceeded. The oil should never be allowed to solidify, it should never be overheated and frequent or rapid changes of temperature must be carefully avoided.

TESTS AND PREPARATION REQUIRED BY SHIPPERS

The carriage in bulk of these cargoes is usually covered by a contract which requires that the carrier or shipowner shall provide the shipper with a certificate from a "recognized surveyor" stating that the tank is fit, both as regards tightness and cleanness, to receive the cargo concerned. The shipowner is also required to supply the facilities necessary to keep the oil at the required temperature and to heat it as may be necessary for discharge. On the other hand, it is usual for the contract to require the shipper to provide all facilities necessary for loading the cargo and for the consignee, or his representatives, to supply all facilities, other than steam heating, necessary for discharge of the cargo.

The qualifications or professional ability of the "recognized surveyor" are not specified but it is obvious that he must be qualified to carry out the necessary tests and inspections and that, having been appointed by the shipowner, he must be acceptable to the shipper, to underwriters and to other interested parties.

The certificates are usually referred to as "loading certificates" but the exigencies of sailing schedules and other factors often compel the shipowner to spread the work of tank preparation, i.e., testing and cleaning, over two or more ports and it is obviously to the advantage of all parties to have the surveys carried out by experienced surveyors who are members of an impartial organization which is able, as a result of experience, either to advise or instruct its surveying staff when difficulties arise.

Classification Societies have recognized the need for these services and Classification surveyors are authorized to carry out such surveys on classed or unclassed ships, in accordance with the recognized practice, if they are requested to do so by the shipowner or his representatives. Generally speaking, loading certificates issued by Classification Society surveyors are acceptable to all interested parties but it must be clearly understood that the choice of surveyor rests with the shipowner and that, basically, the surveyor's sole duty is to satisfy himself that the tank is in fit condition as regards tightness and cleanness and to issue a certificate to the shipowner to this effect.

Loading certificates are not required by Classification Societies and no detailed rules are laid down by them for loading surveys. It is appreciated that the practice varies in different trades and Classification Societies are prepared to consider, but not necessarily recommend or approve, arrangements which are acceptable to all parties concerned. Misunderstandings frequently arise in this connexion and it must be made clear that the surveyor appointed to carry out the tests and inspections is unlikely to be the official representative of the shipper and that he has no authority to agree to any deviation from the recognized practice in the particular trade with which he is concerned. If the shipowner does not or cannot comply in all respects with the usual requirements, it is the surveyor's duty to advise the shipowner, or his representatives, accordingly and they must make the necessary arrangements with the shipper.

Failure to appreciate that the practice varies in different trades is at the root of many misunderstandings and it is a regrettable fact that most of the controversial points have never been the subject of a definite ruling but have become, through usage, either "unwritten laws" or "gentlemen's agreements." They can usually be traced to the necessity of spreading the preparation of the tanks over a period of time. As an example of the variation in practice in different trades, the period of validity of the tightness test certificate varies from twelve calendar months in the South American (River Plate) trade to two weeks in the Phillipines trade; in the Malayan and Indonesian trades the period is one calendar month. These figures bear no relation to the weather and other conditions under which the ship operates, but it should be understood that the acceptance or otherwise of the tightness test certificate by shippers is also dependent on the logbooks showing that the ship has not suffered stress of weather or been involved in any incident likely to affect the tightness of the tank.

The surveyor is expected to know and carry out the current requirements in the particular trade with which he is concerned but as already stated he has no authority to deviate from these requirements. The certificate which he issues must state in detail the tests and inspections which he has carried out and if the tests and inspections are complete and fully in accordance with the requirements of the trade he will state that it is his opinion that the tank is fit to receive the commodity concerned. In the case of a tank which has been specially approved for the carriage of cargo oil, a Classification surveyor will embody the particulars of the special notation in his certificate and he will state that it is his opinion that the tank is in fit condition to receive and carry the commodity concerned.

The shipper will appoint his own representative to verify that the loading certificates are in order and one of his representatives should inspect the tank immediately before loading commences to see that the tank is in fact fit to receive cargo. This should never be taken as a reflection on the competency of the surveyors but should be welcomed as an additional safeguard in the event of doubt being cast at a later date on the condition of the tank prior to loading.

It frequently happens that a considerable period of time elapses between the surveyor's final inspection and the commencement of loading and much can happen during that period. Under normal circumstances, agreement to load constitutes full acceptance of the tank by the shipper and he is entitled to satisfy himself that the condition of the tank is in fact in accordance with the usual requirements of the trade and with the surveyor's certificate.

TESTING PROCEDURE

The first requirement of the loading certificate is the test of the deep tank itself, usually referred to as the " tightness test." Strictly speaking, it should be carried out at the nearest port to the loading port but modern trading conditions make this difficult of achievement and the concessions mentioned previously have had to be made in connexion with this test. Sailing schedules do not allow enough time for all testing and cleaning to be carried out at the loading port and, in any case, repair and cleaning facilities are not always available at that port and finally dry cargo commitments may make it impossible to keep end bulkheads adjacent to dry cargo spaces and tank tops clear of cargo until the loading port is reached. In practice, the third of these considerations has the greatest influence upon the port at which the tightness test is carried out.

Sailing schedules can also be upset by unforeseen events and it can happen that a ship arrives at the loading port behind schedule and after the recognized period of validity for the tightness certificate has expired. In such cases the shipper may agree to load the cargo if the shipowner and shipper come to an agreement regarding liability for loss to or damage caused by the oil cargo in the event of leakage taking place. The most satisfactory solution is to retest the tank but it will generally be found impossible to test any bulkhead adjacent to dry cargo spaces if a thwartship cofferdam has not been provided.

The test head applied to deep tanks and to double bottom tanks in way should be the maximum which can come on the tank in practice and this is generally to the top of the ventilator coaming or airpipe on the weather deck above the deep tank; all bulkheads, tank top plating, hatches, ventilator trunks, air and sounding pipes and any other connexions should be clean and dry and accessible to the surveyor. The tank should be pressed up and all leaks should have been dealt with before the surveyor is called to witness the test, the only exception to this is when major repairs affecting Classification are necessary or where advice on how to deal with a defect is required. Two points are worthy of mention here; firstly, the safest and most satisfactory method of " topping up " a tank is by means of a hose running into the ventilator trunk or air pipe but plenty of time must be allowed to ensure that all pockets of air trapped in the underdeck structure have time to escape and, secondly, that repairs to riveted or welded structures should never be undertaken by inexperienced but willing members of the crew; the amount of damage they are capable of doing is incredible.

A recent development is the testing of tanks by air pressure; the advantages claimed for this method are reduction of time occupied in filling and emptying and elimination of contamination by dirty sea water. The tank and all connexions must be sealed and an initial air pressure of approximately 5 lb. per sq. in. is then applied by means of an air compressor; the pressure is registered on a sensitive gauge or liquid manometer and this is kept under observation for a predetermined period of time. The tank is considered to be tight if there is no apparent loss of pressure during the stipulated period of time.

Investigation of this method will reveal that the uniform air pressure in the tank does not reproduce the conditions to which the structure is subjected with a liquid cargo and that, unless a very high initial air pressure is applied, the lower parts of the tank are not subjected to anything like the pressure they will have to withstand in practice. To make such a test effective, it is necessary to seal hermetically all ventilator trunks, air pipes and sounding pipes whereas this is unnecessary when carrying out a hydraulic test; leakage of air from any of these parts may give a false impression, and again if a leak is indicated it will be no easy matter to trace it to its source with work going on all round. Dampness, however slight, can be seen if the structure has been cleaned and dried but a small air leak might prove very difficult to find and it would appear that if any leak is indicated on the gauge or manometer the surveyor would be justified in insisting on a water test; in most cases this would probably be the quickest means of tracing the leak.

A point which should be remembered in connexion with the testing of tanks is that drying and semi-drying oils can form a watertight film on the inner surface of the tank, that solid fats can form an effective seal at normal temperatures and that paraffin wax with a skin of dried latex can also form an effective seal. Normally tanks will have been rough cleaned before testing but the risk of a defect being sealed as described above and withstanding the test pressure is obviously greater with a uniform air pressure of 5 lb. per sq. in. than with the variable hydraulic pressure.

Whilst Classification Societies cannot refuse to accept this type of test when it has been agreed to by all interested parties, it is customary for the surveyor to word his certificate accordingly and indicate that the test was carried out in this manner at the request of the shipowner or his official representative.

When a block of tanks is involved it is customary to test each tank as a separate unit but in the event of a block being booked by one shipper for one grade of oil only and for one port of discharge, then the block of tanks may be tested as a unit and a certificate issued for the block. It is, however, preferable to test each tank as a unit in order to avoid complications if there should be any alteration in the original booking; this involves diagonal testing of the bulkheads but " back-tests," if satisfactory, are accepted.

The double bottom tank(s) in way of the deep tank should be tested to a head similar to that applied to the deep tank itself and this test may be carried out with either oil or water. The safest way of " topping up " the double bottom tank with sea water is to run it up to sea level and then finish off with a hose into the air or sounding pipe; if fuel oil is used, an initial head may be applied by allowing oil to run back from a deep bunker tank or settling tank and the final head applied by buckets of oil poured into the air or sounding pipes.

When a bilge suction well is incorporated in the double bottom tank top plating, it should be tested in conjunction with the double bottom tank. It is usual, however, to blank flange bilge suction wells because they are difficult to clean and coat satisfactorily and it is almost impossible to pump them out when solid fats or latex are carried. If the suction well is blanked off, it should be filled and tested as a double bottom tank; it is generally necessary to remove the suction pipe in order to blank off the well and, if this is done, the well is filled and tested with fresh water and allowed to remain full while the oil or latex cargo is carried. The blank for the suction well is frequently made in the form of an inverted top hat to provide a small sump for pumping purposes; the fitting of such a sump offers some advantages but is not obligatory. Suction pipes which pass through the deep tank should also be tested, the usual pressure applied being sea pressure. Suction pipes which lead to the deep tank itself will be dealt with when cleaning of the tank is discussed.

Whenever possible, the tests referred to in the previous two paragraphs and the test of the steam heating coils should be arranged to coincide with the internal examination of the deep tank itself for cleanness. By combining all these operations, much time and duplication of labour can be saved.

Steam heating coils should always be tested to the maximum pressure to which they may be subjected in service and the test should always be made with steam. It is just as important that the flow of steam through the coils should be checked as it is to ensure that the coils are sound and tight and this cannot be checked reliably when the coils are tested hydraulically. Sluggish steam flow generally indicates a blockage, either partial or complete; steam may circulate slowly for other reasons but, if any doubt exists, the coils should be opened out wherever a blockage is suspected. Exhaust valves and the bottom bends of ships' side coils are the places most likely to be affected but blockage can occur anywhere unless special precautions are taken to prevent foreign matter getting into the coils when they are removed from the tank and stowed in dry cargo spaces.

Failure of a heating coil can be a very serious matter when solid fats are being carried; with heavy gauge piping, adequately clipped to prevent vibration, there should be no trouble if the tests have been properly carried out.

CLEANING PROCEDURE

Reference has been made to the requirement that tanks are to be designed with a view to their being cleaned with reasonable facility. If this point has received adequate attention, the final cleaning for the carriage of any of the cargoes should not present any difficulty when properly organized and supervised labour is engaged. Experience has shown that the final cleaning can only be carried out satisfactorily by manual labour operating under trained supervisors or foremen.

It is customary, and advisable, to rough clean tanks as soon as possible after any of these cargoes have been discharged. The extent of the rough cleaning usually depends on the cargo carried and on the use to which the tank is to be put on the succeeding passage, but it has been found that the residue from vegetable oil and latex cargoes when mixed with sea water used for ballast purposes sets up chemical action in the tanks which may make the final cleaning of the tank a more difficult proposition. Further reference will be made to this but it may now be said that it is advisable to remove all traces of palm or coconut oil as soon as possible after discharge either by means of steam or by one of the tank cleaning processes which are now available at most ports and, in the case of latex, to scrape off all wax and dried out latex adhering to it.

Wax and latex scrapings and solid fat residue should be taken out through the hatch and should never be allowed to get into bilge or ballast lines.

Final cleaning and preparation must be carried out as near as possible to the loading port and usually they have to be carried out in a minimum of time. It will be clear from this that everything possible should be done to reduce the final cleaning to a minimum. If tanks which carry oil regularly have been rough cleaned after discharge as suggested previously they should not require much in the way of final cleaning but if ballast water has been mixed with the residue of a palm oil cargo, final cleaning may be a formidable task. It is more than likely that the whole of the tank will be thickly coated with a black slimy sludge which will be difficult to remove; in some cases the steel will continue to produce this black deposit long after cleaning has been completed, no matter what method of cleaning the tank has been adopted.

Heavy scale is not often met with in tanks which carry these cargoes regularly but if it is there it should be removed before the tank is submitted for the tightness test. If chipping or beating is found necessary after the tightness test, the tank must be retested.

It should be appreciated at the outset that the final cleaning of these tanks is not a job for nondescript or inexperienced labour. The men engaged for the job must know what is required and they must have all the necessary tools and equipment. In recognized cleaning ports there are cleaning contractors who will give a reliable estimate of the time necessary to clean a tank, who will provide the men, material and supervision necessary for the job and, what is most important to the shipowner, who will complete the job satisfactorily in the estimated time. These contractors, to a very great extent, depend on the experience and skill of their foremen to achieve their results; experienced Asian foremen alone are able to supervise and control the large numbers of men necessary to carry out the work in the minimum of time.

Adequate staging is essential if the men are to work satisfactorily. Staging should be arranged so that every man working on it can give all his attention to his task; it should also be arranged so that fastenings do not interfere with, or prevent, cleaning and coating being thoroughly effected. Staging can be erected in any number of ways but experience has shown that an erection of poles and planks is probably the most satisfactory. Poles and planks are light enough to be handled by one man, or woman in Asian countries, and these materials are very adaptable to irregularly shaped tanks; when properly erected they can carry all the weight necessary. This type of staging can be erected and dismantled rapidly without any mechanical aids and if hooks are used as described later there is no risk of uncleaned and uncoated patches being overlooked or of odd bits of frayed lashings being left hanging from the structure of the tank.

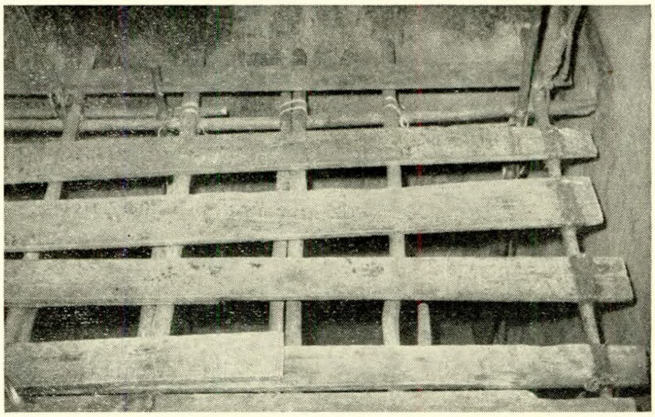


FIG. 4—*Top platform of cleaners' staging in deep tank*

First, a substantial framework of poles should be built up from the double bottom tank top, using rotan or other strong fibre for lashings, and this framework should not depend on any attachment to the structure of the tank. A top platform about four feet below the deep tank top should be arranged, and the framework or joists for this should consist of double poles lashed together. Planks, of comparatively light weight, should be spread over the joists in such a way that there is no space large enough for a man to fall through and every individual plank should be lashed securely in place to prevent it sliding or being moved. Additional platforms can be arranged at intermediate heights around the bulkheads but advantage should be taken of stringers wherever these are fitted.

When the staging has been erected, some additional lashings may be necessary for extra security but they should be attached to the structure by means of hooks which will allow them to be removed and refitted by the cleaner responsible for the area with which they interfere.

Suggestions have been made from time to time that the tubular type of steel scaffolding now so common in this country should be used but it does not appear to offer any advantages over pole and plank staging. A tank of approximately 400-tons capacity can be staged as described above, without the use of any mechanical lifting power, in less than four hours and the staging can be dismantled and all loose dirt such as chips and lashings removed in less than one hour. From observations made recently it is doubtful whether either job could be done with steel scaffolding in less than three times as long and certainly some mechanical lifting power would be necessary. It is admitted that the pole and plank type of staging would not be acceptable in this country but one can have every confidence in it when it is erected by experienced riggers.

Adequate lighting is the next essential and cleaning contractors should provide all necessary electric light leads and lamps with a distribution board suitable for connexion to the ship's supply; good contractors now supply blower or extractor fans and there is no doubt that these help immeasurably towards the final result. The use of candles or oil lamps should not be permitted; they are both dirty and dangerous.

The tools necessary for cleaning are scrapers of various shapes and sizes, wire brushes of various shapes and sizes,

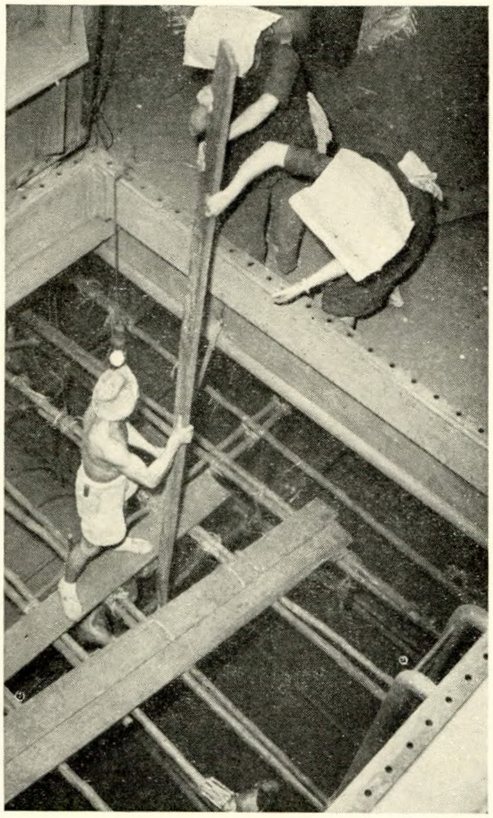


FIG. 5—*Dismantling staging prior to loading palm oil*

scrubbers for use with caustic or detergents and rags in large quantities. The large flat scrapers usually associated with tank cleaning are almost useless, small scrapers with a scraping edge about one inch broad at one end and a pointed half arrowhead at the other end are probably the most useful tools; pull throughs for passing behind joggles should be available, large and small wire brushes suitable for getting into corners are necessary, but none of these tools are of much use unless they are kept in good condition. Good contractors always have men on the job whose only duty is to keep the tools in order.

The standard of cleanness required is usually covered by the formula that all old oil, deposit, dirt, loose rust and moisture must be removed but it is evident that this is open to widely different interpretations. It will be found that the standard varies in different trades but investigation will show that the standard demanded does depend on the quality of the oil to be shipped and the purpose for which it is to be used. The decision in these matters has to be left to the surveyor, who is neither a scientist nor a chemist, and it is his duty to ensure that no harm will come to the cargo to be carried. In the absence of recognized rules or tests he must base his decision on his experience and knowledge of the oils with which he is dealing; nobody appreciates better than he does that a deep tank cannot be made as clean and hygienic as an operating theatre.

Nothing liable to contaminate or discolour the cargo should be left in the tank but unfortunately it is not possible to suggest any hard and fast rule for assessing the cleanness of the tank. Frequent misunderstandings and disputes arise in connexion with this subject but most of them can be attributed to the seagoing personnel having had experience of one particular trade before being transferred to a trade where higher standards are rightly demanded. In the case of refined edible oils, a surveyor should be able to examine several tanks without soiling his hands unduly and he should be able to rub any part of the tank with a clean white rag and it should not show more than a very slight discoloration.

Experience has shown that the steelwork of various tanks reacts in different ways to the treatment it receives when tanks are engaged in the carriage of these cargoes. In some cases the steel appears to develop a protective skin or oil impregnated surface which either impedes or prevents the formation of rust and which is not broken down by steaming out or by any of the usual cleaning processes. In other cases, the steel is completely bared by the cleaning process and this is followed by a continuous process of rust formation which is not arrested by the final cleaning; this rust formation may vary from a light powder to a heavy granular deposit in extreme cases. And yet, in other cases, the steel appears to develop a contaminated surface which does not respond to any of the usual cleaning processes and continues to exude a black greasy deposit even after cleaning has been completed. There is very strong evidence that this condition is caused and aggravated by using tanks for ballast purposes before the residue of the last oil cargo has been removed.

The following case will demonstrate some of the problems encountered in this connexion; it should be of particular interest to all who think that there is an easy solution to this question of tank cleaning.

A block of four adjacent tanks in a comparatively new ship was cleaned and presented for inspection. Three of the tanks, which had carried two or three vegetable oil cargoes previously, were in perfect condition with no trace of rust, but the fourth tank, which had never carried vegetable oil and was said to have been filled frequently with fresh water for trimming purposes, was covered with heavy brown granular rust. The tanks were not to be loaded at the cleaning port and instructions had been given that the tanks were to be coated with coconut oil; the cleaning contractor was advised to pay particular attention to the fourth tank and to see that all rust was removed before the coconut oil was applied. When the tanks were re-examined after coating, it was obvious that granular rust was still forming under the oil coating of the fourth tank and that it would be in bad condition by the time the ship arrived at the loading port. It ought to be mentioned here that the prevailing weather conditions were all against satisfactory cleaning and coating in that there was continuous tropical rain resulting in very high humidity in the tanks. In the light of past experience the owner's representative was advised not to undertake any further cleaning but to take the ship to the loading port and review the position there. On arrival at the loading port about ten days later, the first three tanks were still in perfect condition, the coconut oil coating was like clear varnish and these tanks were loaded without question. The fourth tank was entirely covered with a thick brown " paste " formed of coconut oil and granular rust particles. In order to avoid unnecessary expense and delay, the inside of the hatch coaming was again thoroughly cleaned as an experiment and coated with coconut oil supplied by the shippers but after a trial period of twelve hours it was again covered with a heavy brown deposit of oil and rust and the tank was rejected by the shippers.

This undoubtedly was an extreme case; dozens of suggestions were put forward but, except for the carriage of fresh water previously, the question invariably was " Why were the other three tanks not affected similarly? " Chemical analyses of the deposit, made by different authorities, could offer no suggestions as to the actual cause of the rapid rust formation and it remained more or less a mystery. There is little doubt that as much attention should be paid to the steelwork of tanks during periods when oil cargoes are not regularly available as is given to them during periods of regular use for these cargoes.

When tanks are cleaned in tropical climates, where the humidity is high, it is almost impossible to eliminate rust completely and the author agrees with those shippers who prefer tanks with a light powdering of rust to tanks coated with oil. One can be sure that all old oil has been removed when the tank is completely covered with a light coating of

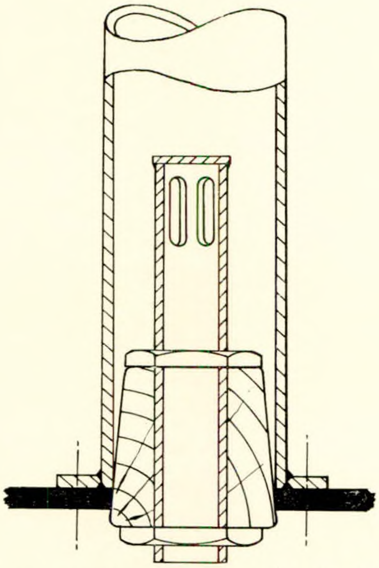


FIG. 6—*A simple dirt trap for air pipes*

If the slotted pipe is a good fit in the wood plug, the fastening arrangement is unnecessary. The portion below the tank top should be kept to a minimum. Drilled holes may be substituted for slots (see Fig. 7). All types of dirt trap must be waxed inside and outside when latex is carried.

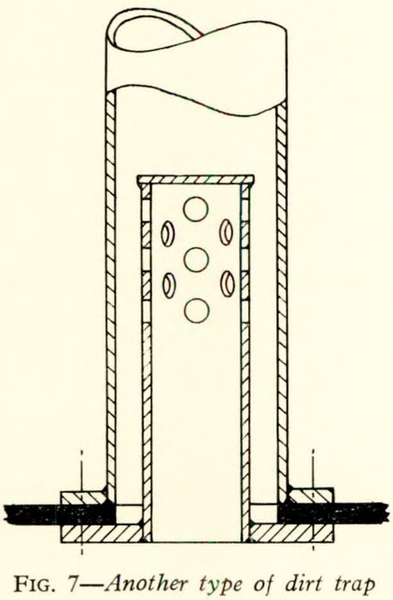


FIG. 7—*Another type of dirt trap*

This type of trap may be bolted or studded to the underside of the tank top but it should never be attached by welding.

rust but one naturally thinks that a coating of oil is covering a multitude of sins, particularly if it has a black or brown tinge when rubbed with a bare hand or clean rag

It is suggested that the total weight of rust in a light powdery coating spread over the whole tank is infinitesimal compared with the total weight of oil and that its effect would be negligible. The formation of rust will certainly be arrested as soon as the tank is filled and whatever rust had formed in the interval between the examination for cleanness and the loading of the oil would undoubtedly sink to the bottom of the tank where it would be dealt with as bottom settlings or scrapings and probably not discharged with the bulk of the oil.

It is now the accepted practice in most trades to fill all

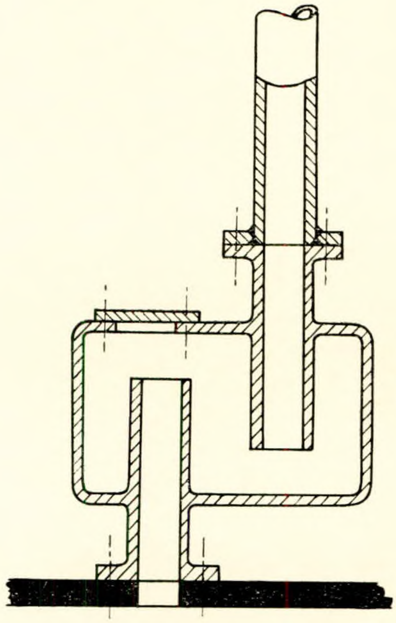


FIG. 8—*Permanent type of dirt trap*

This type of trap is fitted above the deep tank top; it will hold water used for testing purposes and it must be opened and cleaned before any liquid cargo is loaded.

small cavities in joggles at frames and beams and at bracket connexions with good quality cement. This prevents oil and dirt from entering and accordingly reduces the time and labour necessary for cleaning; if any such fillings are found to be damp or oily when the tank is cleaned they should be chipped out and renewed but this is an infrequent occurrence when the filling is properly carried out in the first place.

Tanks which are to be used for the carriage of edible oils should not be used for the carriage of heavy mineral oils—creosote, asphalte or similar cargoes. No matter what method of cleaning is employed, traces of such cargoes will persist in appearing from behind laps and joggles or from the surface of uneven welding; the only satisfactory way of removing all trace of such cargoes would appear to be the carriage of one or more shipments of light mineral oil. In fact, a shipment of one cargo of light mineral oil is probably the best method of reconditioning a tank with a surface contaminated as previously described; provided a realistic view of the subsequent light rust formation is taken, no further trouble is likely to be experienced.

Ventilator trunks, airpipes and sounding pipes cannot be adequately cleaned internally but they should be scraped and washed as far as possible and provided with some means of preventing dirt and rust from falling into the tank. It is customary to fit screwed caps or wooden plugs at the bottom of all sounding pipes; this does not interfere with their use as thermometer tubes if they are required for this purpose. Airpipes should be fitted with some form of dirt trap where they enter the tank; these fittings may be either permanent or temporary but they must be capable of being removed or opened out for cleaning before a cargo of oil is loaded. Ventilator trunks should be provided with some form of baffle or plug at the bottom; this fitting must be firmly attached to prevent it being disturbed by surging oil when the ship is in a seaway and it must not permit oil to surge into the ventilator trunk and wash off trapped rust or dirt.

Means should be provided to prevent sea and spray entering at the top of all these openings; sounding pipes and ventilator trunks should be made watertight and airtight but airpipes should never be hermetically sealed when edible oils are carried. Most of these oils are loaded through an open hatch or manhole and the airpipes are not essential during

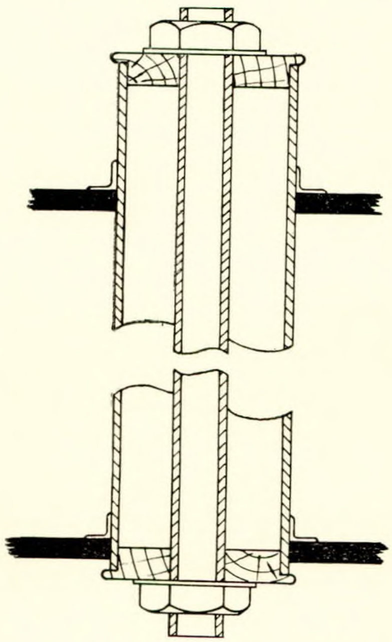


FIG. 9—*Combined ventilator plug and thermometer pipe*

If the thermometer pipe is not required, a screwed bar or wire rope with a stretching screw may be substituted. Alternatively, the bottom plug may be kept in place by clamps bolted to the underside of the tank top.

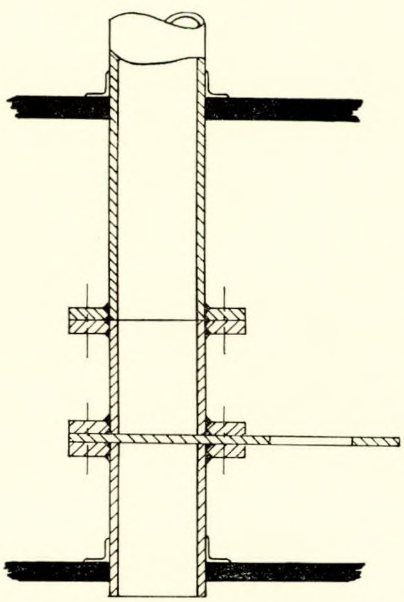


FIG. 10—*Removable bobbin piece for ventilator*

When dry cargo is carried in the deep tank, the open eye of the spectacle piece should be in place. When edible oil or latex is carried, the blind eye should be in place and the bobbin piece removed. When latex is carried, a pressure relief valve may be fitted in the ventilator trunk on a diaphragm plate only if there is no risk of latex coming in contact with it.

filling operations but they must be able to deal with variations in the volume of air caused by change of temperature or movement of the oil when the ship is in a seaway. When vegetable oil is carried, it is good practice to fit the airpipes with any of the patent valves which open to either a pressure or vacuum; the ordinary gooseneck or mushroom cowl fitted with a weatherproof hood, however, is adequate for the purpose.

All open ended bilge or ballast pipes inside the tank must be dealt with. The best way of dealing with these is to blank flange the tail pipes efficiently; there is then no necessity to clean them inside or to open out the bulkhead valves for cleaning and there is no risk of oil remaining in the pipes after cargo has been discharged and perhaps causing serious trouble later. Some shipmasters and shipping companies prefer, however, to leave these pipes available for use in an emergency and, in this case, all suction pipes inside the tank and the

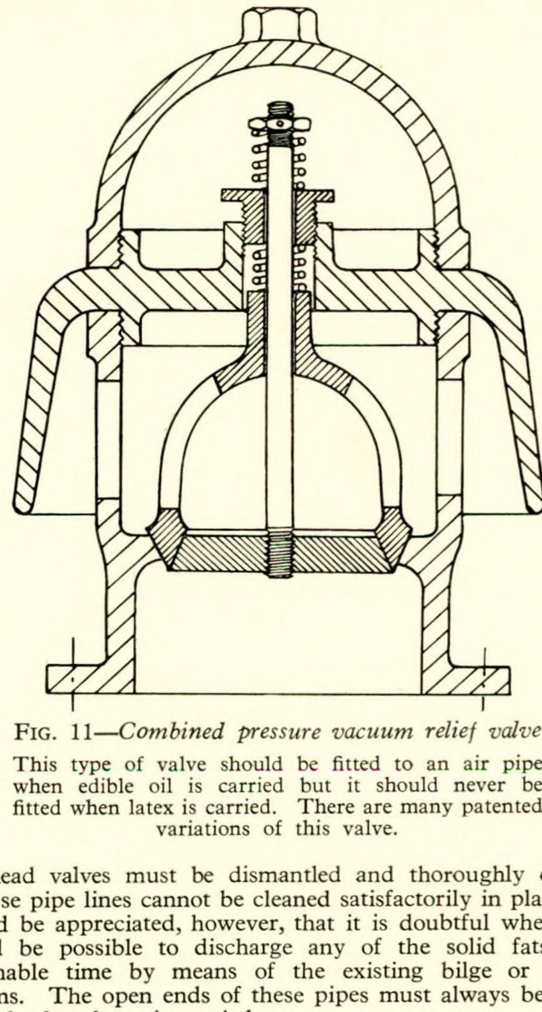


FIG. 11—*Combined pressure vacuum relief valve*

This type of valve should be fitted to an air pipe when edible oil is carried but it should never be fitted when latex is carried. There are many patented variations of this valve.

bulkhead valves must be dismantled and thoroughly cleaned as these pipe lines cannot be cleaned satisfactorily in place. It should be appreciated, however, that it is doubtful whether it would be possible to discharge any of the solid fats in a reasonable time by means of the existing bilge or ballast systems. The open ends of these pipes must always be blank flanged when latex is carried.

COATING OF TANKS

When cleaning has been completed, it is the practice in some trades to coat the tank with some of the oil which is to be shipped if shipment is not to take place immediately. The coating is intended to prevent rust formation but experience has shown that it is not always effective and shippers themselves are not agreed upon its efficacy. Some shippers prefer a tank with a fine powdering of rust, others stipulate that the coating must not be applied more than forty-eight hours before shipment and others are prepared to accept a coated tank without any qualification other than that the coating is still in good condition.

Vegetable oil as shipped is not a reliable rust inhibitor, particularly when moisture is also present, and the application of vegetable oil to steelwork appears in some cases to accelerate rust formation. The reason for this is not clear but it is probable that the oil film absorbs a large amount of moisture from the atmosphere, and probably some perspiration from the men who apply it, and that it does not form an airtight film; this, combined with the hot and humid atmosphere of the tank, provides conditions favourable to rust formation.

Reference has been made to mould and mildew and cases have been reported of tanks arriving at a loading port looking and smelling like a "penicillin factory." This is not a common complaint and it is suggested that it will never occur if first quality oil only is used for coating purposes. Deposits of palm and coconut oil have been found in odd corners ot tanks in perfect condition three or four months after discharge of the cargo; it has been stated authoritatively that good quality coconut oil will keep in perfect condition for at least three months if it is not exposed to strong sunlight.

Heated air and light accelerate rancidity due to oxidation whilst heat and moisture encourage the formation of rust and the growth of mould or mildew and it is advisable to provide reasonable ventilation in a tank once it has been coated. The object should be to provide just sufficient circulation of air to prevent the tank warming up unduly and the formation of dew on cold surfaces.

If a tank after cleaning appears to be forming rust rapidly it is probably better not to coat it with oil even though shipment is not to take place immediately. It is much easier to remove a coating of loose rust with inexperienced labour in a limited time than to remove a pasty mess of oil and rust. In such cases filling the tank with fresh water might prove the cheapest and easiest way of dealing with it; if the tank were pumped out and wiped down immediately before loading it would probably be in satisfactory condition.

Whilst coating is not obligatory prior to loading edible oils, it is absolutely necessary if latex is to be carried. The whole of the tank structure with which the latex may come in contact must be coated with paraffin wax or an approved protective paint. The paraffin wax should form a thin evenly distributed white film over the whole of the tank; it does not flow or spread like ordinary paint and it has to be applied to the steelwork at a temperature of about 150 deg. F. if it is to adhere properly. Waxing must be carried out by experienced workers, the surfaces to which the wax is being applied must be absolutely clean and free from humidity and every piece of equipment connected with the waxing should be perfectly clean. Each workman carries his supply of hot wax in a container and he applies the hot wax with a bristle brush in short sharp strokes; at first the wax is transparent but he continues brushing until the wax shows up white. The final result can be compared with an infinite number of wax scales forming an unbroken coat of wax and if it has been satisfactorily applied it will sound solid when tapped with the finger tips or beaten lightly with the flat of the hand. Another simple test is to make a cut in the wax with the point of a knife or scraper and then run the point of the tool along the edge of the cut; if the wax flakes off or tends to lift bodily or sounds slack when tapped it is not adhering properly and must be removed; if it chips off in pieces up to the size of a finger nail it can be considered satisfactory but well applied wax should show no tendency to lift. This perfect condition is not easy to obtain and if trouble is met it can usually be attributed either to the surface not being perfectly clean, or to the wax not being hot enough when first applied, or to undetected dampness due to humidity of the atmosphere. Cases have been known where it has been impossible to get the wax to bond properly and the reason has never been established.

An interesting case in this connexion occurred on a hold bulkhead where the waxing of the tank was entirely satisfactory except for a strip about eight feet deep right across one bulkhead; the wax on this area could be peeled off without effort. It was stripped off in the usual way and the bulkhead rubbed down again to ensure that it was clean and dry but still the wax would not stick. One worker eventually pointed out that the bulkhead plating was exceptionally cold and it was ascertained that the cargo on the other side of the bulkhead had been loaded in severe winter conditions and had obviously not yet heated up. It is probable that the cold steel was cooling off the wax before it had had sufficient time to bond and also that dew was forming rapidly on the cold surface. The difficulty was finally overcome by using hotter wax and coating the area in the cool of the night when the air temperature and humidity were appreciably lower. Wax which has been removed because of poor application should never be reheated and applied again; splashes and droppings should be removed and collected as the work proceeds but should not be reheated for further use. It has been found in practice that wax which has been used and reheated appears to be discoloured when compared with fresh wax.

Air pipes and ventilator trunks must be waxed as high as possible internally before the bottom end closing appliances are placed in position, the closing appliances themselves must be completely covered with wax, and the inside of rust traps must be coated as well. Remember always that coagulated latex is almost impossible to remove from bare metal in confined spaces such as the inside of pipes.

Transparent spots in the wax coating sometimes appear on engine room bulkheads and are generally due to hot spots formed by steam connexions on the other side of the bulkhead; the source of these hot spots must be dealt with either by removal or by local insulation if this can be done effectively. It is sometimes found that the sun beating on the ship's side

FIG. 12—*Wax coating of hatch coaming in progress*

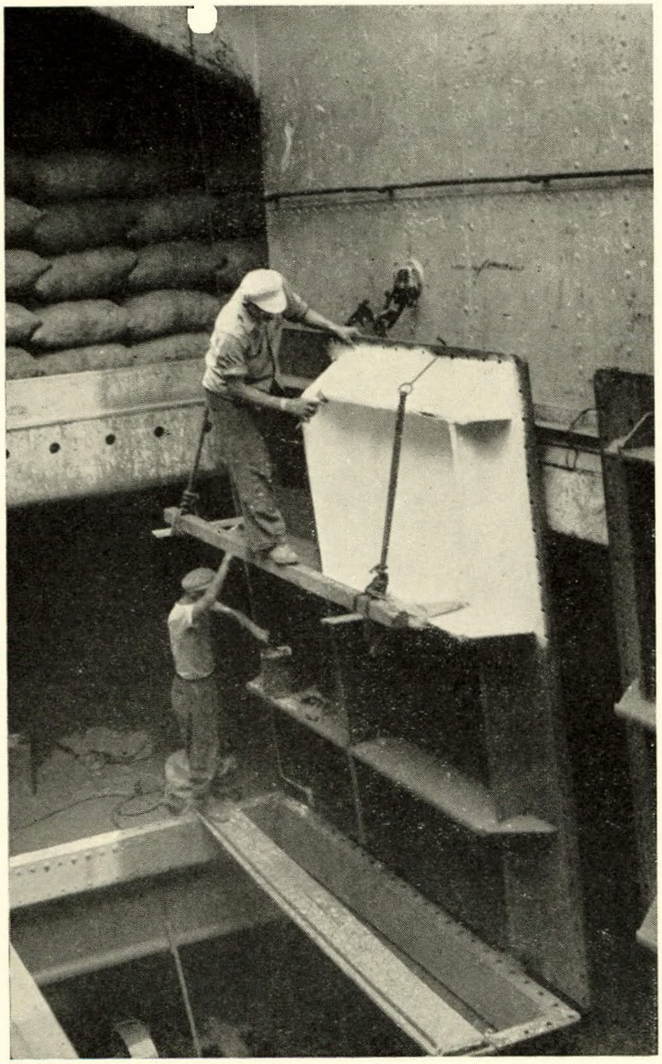


FIG. 13—*Wax coating of hatch cover in progress*

causes the wax to soften and become semi-transparent; if the wax has been properly applied in the first place it will hang on satisfactorily but if the midday sun is allowed to beat down on the tank top either before or after the latex has been loaded it is almost certain that the wax will drop off and complaints will be made. It is also inadvisable to bump heavy cargo on the tank top or 'tween deck plating, as this would undoubtedly loosen the wax and the whole of the tank top coating might fall away. Care must be taken to see that no bare patches are left as the staging is being removed; wax cannot be satisfactorily applied with a long handled brush.

Latex used to be, and still is, carried in steel drums which are coated internally with a bitumastic solution having alkali-resisting properties. Experiments have been carried out with bitumastic on deep tanks but up to the present they have not been entirely satisfactory. The coating must be thin and evenly distributed but in time it becomes porous and sweats; it is also easily damaged by general cargo and there is always the risk that an unsuitable bitumastic may be used if repairs are necessary. In every case met with so far, it has been found necessary to coat the bitumastic with paraffin wax as an additional precaution. As bitumastic cannot be accepted in edible oil tanks it does not appear to offer any advantages in a general purpose deep tank.

Permanent coatings for deep tanks have frequently been suggested but they all suffer from the disadvantages mentioned in connexion with bitumastic and the disadvantages appear to outweigh the advantages except in the case of small tanks which are used exclusively for the carriage of certain cargoes.

Metal spraying would not be suitable for latex tanks and it is probable that exception would be taken to the wholesale application of non-ferrous metals to the surface of edible oil tanks.

Attempts have been made to clean tanks completely immediately after the discharge of an edible oil cargo and then to coat them with a vegetable oil-based rust inhibitor. In those cases of which the author has had experience, the tank has had to be used for ballast on the outward voyage and, although every precaution was taken to ensure that the ballast water was uncontaminated, it was found that the chemical action to which reference has already been made had taken place and that the tank was generally covered with black slime and that there were several inches of thick black sludge in the bottom of the tank.

There is obvious scope for research into the problem of coating tanks and into the behaviour of steel subjected to the combined action of vegetable oils and sea water. Until some more satisfactory solution has been found, the best method of dealing with tanks would still appear to be to remove all

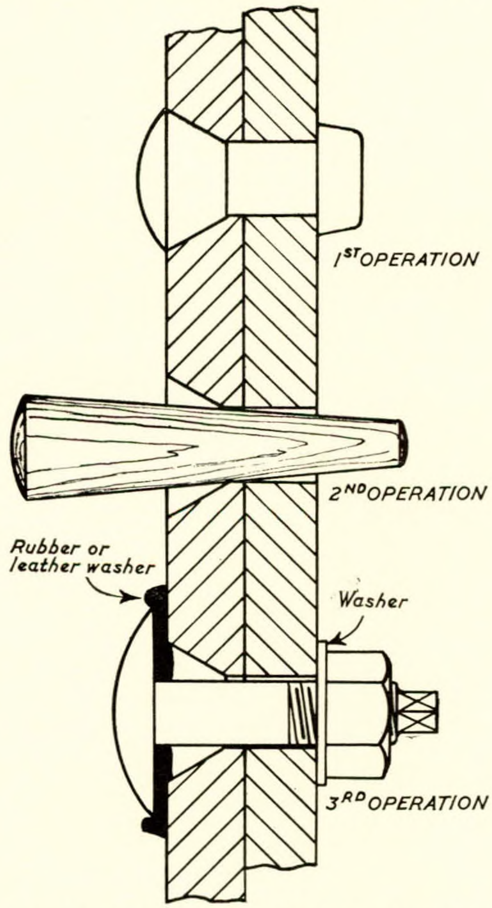


FIG. 14—*Replacement of defective shell rivets*

If experienced men are employed and the work is done methodically, very little water should enter the deep tank and there will be no interference with cleaning operations.

First operation: Burn or cut off all defective rivet heads.

Second operation: Diver drives in long tapered wood plugs as rivet shanks are punched out.

Third operation: Diver fits bolts and washers in place as wood plugs are punched out and workman inside fits, and tightens, nuts and washers.

Fourth operation: The affected area should be enclosed in a cement box.

residual oil, either by steaming or by any suitable tank cleaning process, as soon as possible after discharge and then to carry out the final cleaning by manual processes as near as possible to the loading port.

TEMPORARY REPAIRS AND OTHER EXPEDIENTS

No paper dealing with the practical aspects of cargo carrying would be complete without some reference to temporary repairs. Cases are bound to occur where satisfactory permanent repairs cannot be carried out but temporary repairs should only be adopted when no other solutions are available.

If it is found necessary to fit a cement box to a bulkhead or tank top, try to fit it outside the tank. If it has to be fitted inside the tank, make the box of light plating with welded connexions and close the top of the box with a welded plate. Leaking shell rivets should always be replaced by suitable bolts before a cement box is fitted. Suitable bands or clips may be fitted to air and sounding pipes if necessary but should never be fitted to defective steam heating coils. If it is found impracticable to remove a non-ferrous or galvanized fitting from a latex tank, the fitting should be well covered with bitumastic or cement and this seal coated with wax; wax alone cannot be considered reliable. Adhesive waterproof surgical tape has on occasions been found useful for covering such fittings and this again should be coated with wax.

The main thing to remember with regard to temporary repairs is that the effect of an unsatisfactory temporary repair cannot be localized and may result in damage or contamination to the whole contents of the tank.

CONCLUSION

Little remains to be said about the actual carriage of these cargoes; provided the shippers are satisfied that the tanks have been prepared in accordance with their requirements, the cargo will be loaded by them and they will supply the ship's personnel with all necessary data concerning coefficients of expansion, temperature at which the oil should be maintained and the temperature to which it should be raised in readiness for discharge. Instructions regarding temperature control should be rigidly observed.

When expansion trunks are not fitted, the ship's personnel must ensure that adequate allowance is made for expansion due to rises in temperature after loading. Solid fats will be heated when loaded but may require to be raised to a higher temperature prior to discharge; liquid fats may be cold when loaded and their temperature may rise very appreciably if the ship has to spend any length of time in tropical or warmer waters during the course of the voyage.

Considerable thought may also have to be given to the trimming of the ship if a number of half tanks, i.e. one side of the centre line only, have to be loaded separately at different ports.

Once the cargo or cargoes have been loaded, there is nothing to be done with the majority of them; the temperature of solid fats must be controlled but with a well designed system of heating coils the shipper's instructions should be easily carried out.

The author is fully aware that much has been omitted from this paper in order to keep it within reasonable limits but repeats his hope that others will add to it subsequently in whatsoever way they think best.

ACKNOWLEDGEMENTS

The author wishes to thank the Committee of Lloyd's Register of Shipping for allowing him to write and publish the paper, Mr. L. Baker, lately of Messrs. Alfred Holt and Company, for photographs of discharging operations, Mr. Loh Wing Kay of Singapore for photographs of cleaning operations, and all his colleagues who have helped, either directly or indirectly, in the preparation of this paper.

Discussion

MR. D. A. BRETT said that there were remarkably few cases of contamination of vegetable oils carried in bulk in deep tanks as a result of insufficient cleaning at the time of loading.

Mr. Wormald asked about powdered rust, and he himself had definite views about this. There was bound to be a small amount in all deep tanks, and it was always found in tankers. It was also found in the land tanks in which vegetable oil was stored after arrival. But as far as he was aware it did not have any appreciable ill effects.

What he had in mind was the hard powdered rust which was found on steel surfaces which had just been cleaned. If one wiped it with one's hand it did not come off loose, and it did not do any harm. On the other hand, there was also the heavy scale found in tankers in the petroleum trade. If the side plates of the ship were banged, there was a shower of very thick particles and scale. This was not at all desirable.

He could not recall a single case of trouble from rust, however, except in very refined lubricating oils which required very special preparation of the tank.

Anyone who was interested in the carriage of oils or liquids in bulk could look forward to great expansion of the trade.

Lubricating oil was now being loaded outwards from this country to the Far East—a return trip. It had its own special requirements, and tanks had frequently to be cleaned on this side for loading outwards.

Petroleum chemicals such as ethylene glycol and alkane, the basis of many detergents, were being carried in deep tanks and, incidentally, in tankers.

Trade in all these products could be expected to increase in the next ten years.

A coating for deep tanks was required which would be oil resistant and would prevent rust from forming, a coating that would always give a perfectly clean smooth surface that would not hold oil but would wipe down and drain down easily. Some deep tanks were coated with stainless steel, and this was very effective although rust did come through sometimes. It depended, of course, on the original application of the coating. Zinc and plastics had also been tried, and there were great possibilities in the latter. These coatings would no doubt solve a lot of the troubles with regard to cleaning tanks, although it was too early to say much about it yet.

It was debatable whether tanks should be wiped down with the oil they were going to carry. In his view, it was quite unnecessary and was waste of time and money. If the tanks were clean and dry and comparatively rust free, and contained no other matter, they would carry the oil all right.

Indeed, all one did was to put on a thin coating of vegetable oil which would stand for a number of hours, if not days, before loading. It would develop a very high acidity, becoming rancid. It could do as much harm as any good done by applying the coating. His company never thought of recommending this procedure in Europe when preparing deep tanks or tankers and they never had any trouble whatsoever. This was, of course, his personal view.

Chemical cleaning should also be considered. There were preparations on the market which cleaned tanks very well. There had been some very successful experiments, although there had also been failures and disappointments.

In this country and Europe, in particular, the cost of cleaning tanks was becoming extraordinarily high in both labour and delay in time to the ship.

Mechanical cleaning should also be considered, such as the use of pressure sprays, which were extremely effective in tankers and could he effective and efficient in deep tanks. The difference in construction between a tank of a tanker which carried 500 to 1,000 tons of oil and a deep tank was very small indeed. Obviously one must consider whether the ship could provide high pressure hot water, but the cost of cleaning in the Far East as well as in Europe meant that all concerned with the trade should look carefully into this method.

With regard to expansion tanks, he thoroughly agreed that the present coamings on deep tanks were dangerous. He would like to see well-placed expansion tanks with coamings about 3 feet high, of the type used in tankers. This might involve certain structural and cargo troubles, but a proper, well-designed expansion tank would help to prevent one of the greatest causes of leakage in deep-tank cargoes. This was overfilling on loading, heating up for discharge purposes and getting a pressure in the tank that resulted in leaking from the tank lids by blowing the packing or by oil coming out through the ventilators or sounding tubes.

In general, deep tanks seemed to have been regarded as the odd place to stow oil, and not enough consideration had been given to factors in design which would make for efficiency in cleaning and discharge.

The time had now come when oil in deep tanks was a first-class cargo possibility, and specific account should be taken, in design, for efficient discharge and cleaning.

It was odd that the heating coils were never placed low enough in a deep tank, or very seldom. With the hard oils—coconut oil and palm oil—there was no heating effect whatsoever underneath the coil. One inch below the coil the oil was hard. Consequently, if the oil was one foot off the bottom of the tank being discharged, possibly ten inches of the oil would be solid or semi-solid and the work was held up with extra cost and with vast delay. In his opinion the only place for heating coils was as low as possible, flat on the bottom of the tank, if possible, or with, say, two-inch clearance. This applied especially to bilges. There should be no insuperable engineering difficulties. The design of the internal construction was undoubtedly improving, with the avoidance of internal obstructions such as stringers, beams, stiffeners and so on. Some tanks had already been designed with most of these obstructions outside, so that there could be flat plate surfaces inside. This resulted in much quicker discharge and easier cleaning.

One result of smooth and good internal arrangements was a better out-turn in weight. One did not leave so much oil in the tank because there were fewer difficult places where hard oil would set, taking time to get out. Such arrangements gave clean discharge within reasonable time.

A subject not mentioned in the paper was the calibration of deep tanks. Possibly an engineer would not normally come across this, but the shipper, the buyer and the insurance company were vitally interested. Nearly all sales of oil were on the basis of c.i.f. delivered weight terms. The buyer paid for what he received in out-turn in his factory or at the ship. The shipper put on board the quantity he contracted for, and the weight was ascertained by bulk measurement or weighing as the oil went on board. At some ports, however, the facilities were extremely crude and the results were very inaccurate. The out-turn on this side, assuming everything had been properly handled here, might be from 0·25 to 5 per cent short in weight. 5 per cent on 500 tons was a lot of oil; 25 tons was missing. With 40 cu. ft. to the ton this was a huge space. One did not make mistakes like that, but yet such discrepancies occurred. When one measured the ship's tank capacity through the ullage port provided, one should be able to obtain a pretty accurate check of what was in the ship.

Many deep tanks were not calibrated to an accuracy better than 2 to 5 per cent, and that did not help. What he would like to see in the future—and he thought the demand would come from shippers and insurance companies—was tanks accurately calibrated to ¼ of 1 per cent. A proper measuring point was essential, but this was often completely neglected. There was a table showing so many cubic feet at such and such ullage but not where the ullage was to be taken. It was often taken at some odd corner in the tank top, and this was one of the main reasons for inaccuracy. If there was a proper measuring point in the deep tank top, as there should be in all normal designs, accurate results should be obtained, provided the volume of the tank had been accurately determined.

MR. L. FIRTH congratulated Mr. Wormald on his excellent paper. It was of special interest to himself as it covered a subject with which he was directly concerned. Such a paper, he felt sure, would be of great interest and guidance to all those who were concerned with the successful handling of bulk liquid cargoes.

The fact that little had been written in the past about bulk liquids made the paper even more welcome, and it was appreciated that such a valuable accumulation of many years of experience was available.

Before offering his own contribution, might he read that of Mr. A. B. Tytler?

MR. A. B. TYTLER thought Mr. Wormald had confused the loading and discharging arrangements as regards the pumping of the liquids. On page 68, and again on page 70, he referred to the obligation on the consignees to make the discharging arrangements. This, in his experience, applied only to latex. Pumps for the discharge of vegetable oil were comparatively simple and were readily obtainable at most of the main discharging ports. The auxiliary machinery of some vessels included a pump for cargo oils, but if a ship did not have such a pump it was quite easy for the shipowner to hire one; and shipowners in general preferred that any cargo operations in the ship itself should be entirely under their control. It was therefore made the responsibility of the ship to discharge bulk oil. The loading of the oil was, of course, quite different in that the only apparatus necessary on the ship itself was the pipe carrying the oil, and the pump, which was ashore, remained under the control of the shipper. Latex in bulk, however, was a comparatively new trade. It required a special type of pump, and it had therefore become the custom to stipulate that the consignee must supply the pump for the discharge of the vessel. This, of course, automatically gave him the right of access to the ship, which strictly was not held by the consignee of oil.

Mr. Wormald suggested that consideration should always be given to the provision of an accessible and well-ventilated cofferdam between deep tanks and cargo holds, and he pointed out several advantages which would result. In this connexion the economics of fitting cofferdams might be of interest. A ship having a beam of 60 feet, with a thwartship deep tank 20 feet deep and frame space of 3 feet would lose 3,600 cu. ft. with a single cofferdam, representing 90 freight tons. It would result in the loss of this earning space not only when liquids were being carried homeward (and there were few liquids carried in bulk outward from Europe) but also on the outward voyage and for every voyage of the ship. In the Far Eastern trade, with which Mr. Wormald was familiar, a ship would make three round voyages in the year, so that the total space lost to the ship would be 540 tons. Assuming average earnings to be in the region of £5 net per ton, the annual loss of earnings would be about £2,700 for each cofferdam. In addition, the loss in deadweight due to the weight of the material for the additional bulkhead would be approximately 25 tons for each cofferdam.

Mr. Wormald remarked that in practice the cover joint should not be under pressure other than that caused by surging of the liquid, which implied that loading should never be to a greater height than the top of the tank lid. However, it should be, and he thought was, possible to make a joint oil-tight and thus use expansion trunking which rose above the level of the tank lid in order to carry additional oil. Heated oils were loaded at different temperatures, and oils which were carried without heating, of course, varied in temperature according to climate. The expansion required depended upon three factors—loading temperature, highest temperature to be encountered during the voyage, and pumping temperature. To meet these different factors it might be necessary to supply a greater percentage for expansion than was required on any particular voyage for any particular oil, and there was no reason why the excess space should not be used for carrying more cargo. The aim, therefore, should be to fit jointing which would remain tight when there was some pressure from excess oil in expansion trunks. It was unlikely that the height above the tank lid would ever be very great until the temperature of a heated oil was raised for pumping, when the whole expansion trunk would be full. This involved the fitting of a Saunders valve, of course, for drawing off the excess oil.

Whilst one must agree, of course, with Mr. Wormald that latex should not be subjected to temperatures which would affect it adversely, careful investigation over a long period had shown that it was quite practicable to carry palm oil or coconut oil adjacent to latex without affecting the latex in any way. Air and sea temperatures at the latex loading ports in Malaya and at Colombo were comparatively high and, in fact, might approximate to the carrying temperature of palm oil and would exceed the carrying temperature of coconut oil. Shipments of latex had increased over the last few years, and it seemed likely would increase still further in the near future. If the very large number of ship tanks available in the Far Eastern trade were to be utilized satisfactorily, it must be conceded that latex could be carried adjacent to palm oil or coconut oil provided precautions in the matter of temperatures were taken. Obviously the latex must be discharged before any heat was applied to the oils to raise them to pumping temperatures.

MR. FIRTH, resuming his own contribution, said it should be stated here that there was need for improvement in the handling of vegetable oils in bulk, especially at the producing station.

The merchant, on receipt of his oil, was interested mainly in the amount of free fatty acid it contained and whether there was any discoloration. Either of these would mean extensive processing, which was a costly business. Discoloration was difficult and often impossible to remove, and when it was present in excess it was usually due to overheating.

F.F.A. was a chemical action brought about by enzymes which were present in the living fruit or seed and became more active when the fruit was removed from its parent tree. It was the breaking down of the composition of the oil; that was to say, the separation of the fatty acids from the glycerides.

Moisture, heat and bacterial action accelerated the separation. It would be noted that the greatest increase in the F.F.A. content took place from the time the fruit was picked to when it arrived at the ship for loading.

The more modern plantations produced the oil quickly with the aid of crushing machines and with the minimum of air content. The oil produced had a low F.F.A. content. At other plantations, however, the fruits were still crushed by native "pestle and mortar" methods. Here, of course, one had the maximum of air content and needless to say oils from such plantations were noted for their high F.F.A. content. The indications were that modernization was required to speed up the processing.

The increase in the F.F.A. during the carriage in the ship's deep tank was very slight and he felt sure that even this was mainly due to the fact that the "rot"—should he say?—was already present.

Mr. Wormald in his introduction referred to vegetable oil loaded into ships as being refined. He himself would prefer to look upon it as being in a crude state. Refining proper was usually carried out at its destination.

Again, he felt he must say a few words in defence of the by-products of vegetable oils. Surely they too were valuable. The following were some of the uses of vegetable oils: margarine, cooking fats, salad oil, salad cream, animal feedingstuffs, soap, cosmetics and toilet preparations, plastics, lubricating oils, paints and enamels, inks, linoleum and oilcloths, and fertilizers. The coir of the coconut palm was a valuable raw material for the making of ropes, mats, mattresses and a host of similar articles in daily use.

Recently a process had been developed for extracting some of the protein from the crushed cake of the groundnut and converting it into a synthetic fibre not unlike wool from which cloth could be made.

Mr. Wormald, in referring to latex, gave the melting point of wax as 130 deg. F. in the first instance. It had been stated to be 135-140 deg. F. This slightly higher figure could be a great influence when loading latex adjacent to hot oils.

Whilst he was in full agreement with the statement that latex was adversely affected by high temperature, it should be made quite clear that latex could be, and in fact had been for some considerable time carried successfully in tanks adjacent to palm and coconut oils. Any heat transfer through the divisional bulkhead would be by conduction and that would be minute.

Recently he had had the bitter experience of heating, or trying to heat, a 400-ton tank of oil by conduction with, he was afraid, little success. It later transpired that the water content of this oil was extremely high. In fact, approximately 50 tons of water had separated out to the bottom of the tank, where, of course, the steam coils were situated.

The temperature of that bottom layer of water reached 200 deg. with a miserably small increase in the oil temperature above it. Eventually, the 50 tons of water had to be drawn off before it was possible to heat up the oil to its desired pumping temperature. In view of this personal experience, he found it difficult to believe that any measureable heat transfer took place with palm oil adjacent to latex.

Fig. 3 showed a pressure relief valve for latex. Should not the adjusting pin be fitted with a lock nut?

Mr. Wormald stated that in practice the cover joint should not be under pressure. Providing a good joint was made there was no reason why it should not be under pressure. Indeed, it was known that at least one shipping company did in fact carry dissimilar oils in one tank above another when the joint of the cover separating the two withstood a considerable pressure at all times.

Finally, he wondered if Mr. Wormald had had any experience with tallow in bulk. He understood that the shippers demanded that the side heating coils should reach to the top of the tank. Having had no experience whatsoever with bulk tallow, he would greatly appreciate any information.

Mr. C. G. Hutton (Member) said that the paper would be of great interest to seagoing personnel, some of whom did not fully realize the exacting requirements necessary to the carriage of the various oils.

Mr. Wormald had given an arbitary figure of 2 sq. ft. per ton for the heating coils, but providing the coils were well placed, 1·5 sq. ft. should be sufficient. In many instances, the solidifying of palm oil, in particular, was not caused by lack of heating surface but was due to the fact that the heat was not applied soon enough. Ship's side and bilge coils, which should be positioned as close to the ship's side and as low in the bilge as possible, in his view should be on a separate circuit. Once oil had been allowed to solidify on the ship's side it was most difficult to liquefy it again in place, and, therefore, it was imperative that the ship's side coils should be used early in the passage.

Another difficulty experienced when the tanks were alternating between the carriage of bulk oils and dry cargoes was the positioning of the thermometer pockets. Temperatures taken in a tunnel side tank by means of a long pocket situated from the engine room bulkhead to the second bilge bay, had revealed a difference of 30 degrees from that taken from short pockets inserted from the tunnel sides. Too much reliance placed on temperatures taken at the tunnel side would almost certainly result in solid oil at the ship's side.

When the oil was being discharged, the operation should be continuous, otherwise if the tank was left in a half discharged condition and the steam coils left on, there was a very great danger of the oil, at the point where the side coils broke the surface, becoming scorched and discoloured.

It has been found beneficial to build tanks in the superstructure of the poop and forecastle decks. These tanks, with a capacity of approximately 100 tons, were very useful for small parcels. In the case of the carriage of latex, the deck could easily be insulated from heat of the sun, by 2-in. timber. These tanks could be arranged to be discharged by gravity by means of a small bottom sump at the bulkhead connected to a valve on the other side, which in turn was connected by a short pipe to the ship's side for discharge. These fittings could be removed easily for cleaning, and there was the added advantage that in the case of latex, æration was reduced to a minimum.

He asked whether Mr. Wormald had had any experience of corrosive action with the carriage of coconut acid oil. This cargo had often been carried to America but not so often to this country. In a recent instance he personally examined a tank after the carriage of this oil, and he found no active corrosion at that time.

Mr. H. P. Southwell (Member) said that he naturally viewed the subject of the paper from the same point of view as Mr. Wormald for he had had the same experience of cleaning tanks in tropical ports. It was a very unscientific job.

He had learned for the first time, on listening to the speakers in the discussion, what happened at the receiving end, and their views and comments were very interesting. Mr. Wormald and he knew very little about these things in those early days. Personally, he still thought that for many years to come the problem of cleaning tanks in the Far East would be the one they had faced for so long and there was still much to be said for cleaning these tanks by hand. Reference had been made to obstructions and how much better it would be if there were none. He thoroughly agreed, but ships could not be built without these essential features. Special linings and compositions inside the tanks had also been mentioned, and he had no doubt that the day would come when the cleaning of tanks would be simplified by the application of such compositions. But for the time being and for many years to come tanks would be cleaned as they were cleaned in Singapore and other ports. He could only confirm that it was a most difficult, tiring and unpleasant task and without the co-operation of first-class experts on the cleaning side, it would be impossible to do the job.

He could amplify Mr. Wormald's examples by describing one that had occurred in his own experience. For many years these tanks had been cleaned by the same contractor and he himself was able, as was Mr. Wormald in different circumstances, to go down once at the end of the time and pass the coils or the fittings and the whole tank as clean before the tank was coated. This was done in two or three hours, depending on the size of the ship and the number of tanks.

For reasons into which he need not go, one ship was handed to a completely new contractor. He realized the difficulties and co-opted the services of the master and officers to expedite the work, but after four or possibly five visits the tank was still unfit to be passed, and the vessel left without a certificate. That emphasized the difficulty of the job and bore out Mr. Wormald's remarks and advice.

MR. H. CLARKSON (Member) said it was pleasant to see Mr. Wormald when one might have thought the occupational hazards in the Far East would make his a limited life. It was clear that the two or three husky staging riggers walking the planks in front of him were there to test the factor of safety.

Many of those who had read the paper with interest were directly concerned with the operation of preparing the cargo but few had the training and experience to paint so clear an overall picture of the problems involved. More problems had come to light during the discussion.

Up to the present, very little had been written on this subject, and no doubt copies of the paper would be found in future in most shipyards, as well as in ship offices in the different ports.

He asked whether there was any compulsory control of the melting point of 130 deg. F. or whether it was a matter of supplying one's own or relying on the honesty of the contractor.

With ventilating trunks with a pass through the 'tween-deck, were the ventilators really required to be water-tight right up to deck level? There were advantages in putting a blank flange at low level where the ventilator proper was isolated and the space below could be cleaned thoroughly and coated with wax or whatever was necessary, thus reducing the contamination hazard. This was purely as a ventilator alone, not as an air pipe or sounding pipe.

With regard to steam heating coils, there would be general agreement as to the need for heavy-gauge piping from the carrier's point of view and for testing to maximum pressure. But on motor ships particularly, at the present time, high pressure steam had to be very carefully allocated. For one reason, the peak load for edible oils in cold weather was also the peak load for ship's heating and general purposes. A case could perhaps be made out for utilizing exhaust steam having done useful work being put through coils so that the latent heat was put to use.

Presumably there would be no objection to the use of reliable steam traps, provided that they could be bypassed to flush through, and also to prove that they were getting full bore steam and no chokage.

In connexion, too, with steam heating coils, the author's opinion would be welcome on whether or not a header tank was justified to keep the out-of-use coils full of water, more or less equalizing the pressure of the oil on one side and the water on the other to limit leakage. This might be a means of preventing oil from getting into some coils and perhaps solidifying and choking up the coils. Once they were choked, it was hopeless.

Many of the points that arose would be handled easily if only edible oils and latex were carried. But where general cargo was involved there was the abuse of landing edges on tank doors and lids which made the head of pressure question more difficult. Here again there was a safety factor which was well justified.

In the preparation of tanks for different ports, what would be the validity, in the author's opinion, of a test certificate, should normal dry-docking be carried out between the preparation of and testing of tanks and the loading of the commodity? This question occasionally cropped up.

He had met Mr. Wormald in the Far East and thought that he set a rare example for his successors to follow. He was a good ambassador.

MR. W. SEYMOUR ROQUES (Associate) said he had found the author's reference to the cleaning and coating of tanks of great interest. He was very pleased to see that in the written paper the author stressed the importance of the immediate cleaning of tanks after the cargo had been discharged. He knew from experience what a formidable job one was left with if it was not done at once.

The pictures of the scaffolding quickly made a point for the use of chemical cleaning. While this was probably quite a good way to do it out East, even there the price charged was causing attention to be turned to chemical cleaning which greatly reduced the time and cost. In this country, the scaffolding would cost a lot of money and take a long time to put up and take down.

Chemicals lent themselves to cleaning of edible oils due to the fact that all of them were saponifiable and, consequently, they could be removed by detergents built up on an alkaline chemical. A phosphate of sodium base chemical was best used if the oil on the tank sides had become heavily oxidized.

The system used was usually to lower a small air-driven duplex pump to the tank bottom and run in sufficient fresh or salt water to cover the heating coil or come up to the heating coil. The chemical was mixed with this water and the heat was put on the coils. The pump took its suction from the mixture and discharged through a hose and a long lance, usually made of copper for lightness. He had seen it working 25-30 feet long without any bother to the operator. It was usually given an angle of about 45 degrees at the end to facilitate getting behind beams and frames. The outlet at the end of the lance should be flattened to give a jet and not a spray.

One usually started by doing one half of the deckhead and then the other, before commencing on the sides. All the time one must try to arrange that the chemical would hit the plate surface at an angle of about 45 degrees so as to give a cutting action rather than a straight jet. The chemical ran back to the tank bottom where it was reheated and a circulating process maintained. This had been found an economical and fast way of cleaning tanks, and some ships had actually adopted a permanent fitting for this work. They had a pump in the engine room and the chemical was mixed and drawn by this pump in the engine room and discharged through a line on deck. Points were conveniently fitted so that the hose could be connected with the tank likely to carry edible oil. This gave a whole self-contained system and all that was necessary was to carry the chemical and mix it when required.

After the chemical cleaning, there was flushing or washing down with fresh water to make sure none of the chemical was left behind. This method had the advantage that the cleaning could be done at sea by the crew without holding up the ship.

It was interesting that the particular ships mentioned were now carrying lubricating oils out East and this chemical system was used to clean them, rendering them fit to carry edible oils back to this country. A complete chemical cleaning system was maintained on board the ship. He believed a crew of four was used to do this work.

He had seen a tank that had been coated with a cold applied plastic, and it was really good. It would stand up to boiling caustic and its appearance was very much like the operating theatre referred to by the author in the early part of his paper. It was particularly hard and durable. It could be hit quite hard without any impression being made on it.

It was particularly interesting for coating tanks which would inevitably have to carry general cargo at some time or other.

Mr. A. W. M. Collyer said that he represented Mr. H. E. Upton, O.B.E. (Member of Council) who wrote as follows:—

From the author's very interesting paper, it was apparent that the carriage of edible oils and similar bulk cargoes was a very difficult procedure, which was made more complicated by the variety of oils and fats which required transportation.

Two factors which seemed to apply with the majority of cargoes handled were (a) cleanliness, and (b) careful control of the cargo temperature.

With regard to cleanliness, it appeared that the preparation of the tank for receiving the oil required a considerable amount of labour time and labour well-skilled in the art.

Apart from the tank sides, any component inside the tanks also required the same attention to cleaning. Heating coils, which were required on tank bottoms and sides, fell into this category and reduction in the time required for cleaning could be achieved by utilizing an alternative method of heating.

Such a scheme could consist of a circulating pump and oil heater, the pump drawing oil from the tank and discharging back to the tank through the heater. Obviously the position of the suction and discharge connexions would require careful choice, so that circulation of the oil in the tank and along the sides adjacent to the sea was effective.

Reference had been made to the heating coils in the tanks, and these would appear to be of plain tube construction. The suggested steam pressure for heating was from 100-200lb. per sq. in., the equivalent saturation temperatures being 338 deg. F.-388 deg. F. Assuming an oil side partial heat transfer coefficient of 50 Btu. per sq. ft. hr. deg. F. for natural convection and a steam side partial heat transfer coefficient of 1,000 Btu. per sq. ft. hr. deg. F., the mean metal temperatures would be approximately 310 deg. F.-360 deg. F. As it was apparently just as important to avoid overheating the oil as to prevent solidification, the author's views would be appreciated on the great possibility of overheating the oil when using the steam pressures mentioned with plain tube tank heating coils.

These high metal temperatures and the associated danger of overheating could be reduced by utilizing a heating medium having lower terminal temperatures, and hot water would satisfy these requirements.

Alternatively, the use of secondary heating surface provided lower metal temperatures and taking the same conditions for heating as those assumed for plain tubing, the corresponding mean metal temperatures would be 250 deg. F.-280 deg. F. for a secondary to primary surface ratio of 10 to 1. Even metal temperatures of this order would seem high, and reductions in the heating steam pressure and corresponding saturation temperature or the use of lower temperature hot water would appear desirable.

If increases in the partial heat transfer coefficient on the oil side could be effected, further reductions in the mean metal temperature would result, but with natural convection the main characteristic affecting the heat transfer coefficient—namely, oil velocity—was beyond the control of the design engineer for all practical purposes.

Consequently, in order to increase and at the same time control the velocity of the oil, forced circulation through a separate heating unit seemed necessary.

Thus, the separate circulating pump and heater unit provided all the requirements, whilst at the same time giving scope in the design of the heating surface to ensure minimum metal temperatures.

However, two major factors required attention in the design of a suitable heater: (1) accessibility, and (2) choice of materials.

To ensure cleanliness and purity of the oil carried, it was essential that any heater fitted should be capable of being cleaned, preferably with the minimum amount of trouble. To satisfy such a requirement, the heating surface must be capable of easy withdrawal from the heater and constructed in such a manner as to allow manual cleaning, if necessary, and visual inspection.

The author's views on the choice of materials for construction of the heating surface would be appreciated, as it was believed that copper, copper-bearing alloys or tinned surfaces affected adversely a large percentage of the oils and fats carried as bulk cargo. Steel was known to be suitable and the only remaining common metal not already suspected as unsuitable appeared to be aluminium. Perhaps the author could advise on the suitability of this metal.

Mr. G. F. Wright said he had been associated with the development of metal spraying in its application to the shipping industry. Mr. Wormald's paper had been of inestimable help to his colleagues and himself. The frequent enquiries they had had, as a small firm, regarding the treatment of edible oil tanks had made them extremely interested in the subject, with the idea of endeavouring to help to reduce the excessive costs of cleaning with which shipowners were at present faced.

With all respect to Mr. Wormald, he disagreed with the statement that metal spraying was completely unsuitable for latex tanks. Exception might be taken to non-ferrous coating in edible oil tanks, but he regarded that as mere prejudice. He believed metal coatings would in due course be accepted, though perhaps they were not ready yet.

He would like to trace the use of metal spraying in tanks from the time when it first started just after the last war for treating ordinary cargo deep tanks carrying ballast water and general cargo.

He felt sure everybody knew about it, but the basic part of metal spraying was that the surface had to be shot-blasted to begin with. That, in his opinion, was the only known method of properly cleaning the steelwork, and unless it was done no subsequent coating had any hope of survival.

The experts stated that corrosion on shot-blasted steelwork started twenty minutes, roughly speaking, after shot-blasting. In normal practice, it was not possible to metal-spray so quickly and therefore there was a certain dampness on the shot-blasted surface. But the metal spray was applied through an oxy gas, usually propane flame. As the metal was sprayed, one saw a semicircle of dampness receding from the track of the gun. This ensured a completely clean and dry surface.

Sprayed metal coatings were porous. It was therefore as well to coat them, in their turn, in the case of ordinary cargo deep tanks, with paint. The increase in the life of paint was phenomenal, it would probably be agreed, as compared with the old days when deep tanks were scaled and painted with red lead. And he was also a paint manufacturer! It was then practically certain that by the time the ship got to the dock gates half the paint was floating about on top of the water in the tanks. This did not happen with metal sprayed and painted deep tanks.

Considerable success had been achieved. It was not perfect yet, but tanks thus treated had been coated with only one coat of paint during four-and-a-half years and then merely repainted and left for another four-and-a-half years.

A certain company had asked for a treatment for the carriage of lubricating oil cargoes. Experiments were made with accumulator jars and so on. Finally, with the approval of the owners, a ship was treated. The four 400-ton tanks were shot-blasted, metal-sprayed with 1/5,000 inch of zinc and then treated with two coats of a certain plastic. Two ships had been done now. The first had been in service for eighteen months and was now in New York. The marine superintendent had just viewed her, and had expressed himself as completely satisfied. He believed he was right in saying she had carried three separate cargoes of oil, and that the total tank cleaning costs for the job in America were in the neigh bourhood of £300. This compared favourably with certain figures with a lot of 0's which had been given to him by other owners. There was therefore something to work for with edible oil tanks.

Latex presented a formidable difficulty, but he had been in touch with the Rubber Producers Research Association who had informed him that latex with its ammonia content increased to 0·75 per cent (which was similar, he believed, to latex as carried in ships) was giving very little trouble with a certain aluminium alloy and the Association was considering adapting this for use in road transport tanks. Most of these alloys could be sprayed by wire or the powder processes. Tests would be carried out with metal spray and plastic coatings with this particular alloy.

While this was going on with latex—and it was admittedly very difficult to deal with—an interested shipowner was considering treating an edible oil tank which would not be used for latex with metal spray and plastic. Aluminium and not zinc would be used.

What one feared most was the possible contamination of a valuable cargo. Calculations for a 500-ton tank showed that if the whole coating, aluminium and plastic, were to fail, the total possible contamination of the cargo by weight would be 0·04 per cent aluminium and 0·004 per cent plastic resin. The plastic resin used by his company was colourless, odourless and non-toxic. He did not think there *would* be a complete failure but these were the figures, and it might be that such small figures were not liable to give rise to serious concern.

There was a chance of producing a coating which would satisfy the conditions and enable these tanks to be cleaned very easily, so that the use of some of the nasty little tools displayed on the table could be avoided!

MR. F. A. POWELL (Associate) said he did not think that the shipowner would be persuaded to install large cofferdams between adjacent cargo tanks and between cargo tanks and hold spaces, because the loss of cargo space and the additional cost of upkeep would outweigh the advantage of easier tank testing and the separation of tanks carrying different oils.

The author said "it was advisable to fit the coils with a view to their being easily removed". Heating coils were easily removed, but was there any method of refitting them easily? It would seem that in spite of pipe diagrams, adequate markings and storage racks, it was almost impossible to avoid getting them mixed up and when four or five sets of coils got mixed, it required considerable efforts to straighten them out. Would it not be better to make the coils a permanent fixture and arrange some form of portable covering when carrying dry cargo or latex? In the latter case presumably bolted and jointed plates would be required, but this simplified cleaning and waxing of the tank bottom.

Water testing of tanks was certainly more satisfactory than air testing and it gave correct pressure conditions, but there were occasions when large quantities of fresh water were not available and the owners did not wish to fill the tanks with dirty dock water because of the extra cleaning time required. Air testing in these cases was desirable. Did Mr. Wormald consider that releasing a quantity of ammonia into the tanks would make detection of leaks easier?

The author mentioned that a light powdery coating of rust over the tank was common and considered that this would fall to the bottom. Did he not consider that there was sufficient circulation of oil set up by the heat applied to keep this in solution?

MR. J. MCAFEE (Member) said that he would like to take the opportunity to emphasize one point regarding the duties of surveyors and already mentioned by the author of this comprehensive paper. Whilst a Classification Society might, if desired by owners, approve tanks for the carriage of oil cargoes, these would, in normal circumstances, only require to be examined and tested every four years as part of the periodical special surveys of the whole ship. The testing, cleaning and examination for a loading certificate was not a Classification matter, but was carried out in accordance with the wishes of shippers, owners and underwriters. It was the shippers, in particular, who laid down the standard of cleanness and the frequency of testing. It was thought well to reiterate these points since it was not uncommon for owners to complain that surveyors were over-zealous when they were, in fact, merely complying with the standards laid down by the shippers and possibly peculiar to a particular port and trade. As regards the high degree of cleanness so often necessary, he wondered why more use was not made of something comparable to the Butterworth system. He appreciated that where a ship had only one vegetable oil tank, the owners might not feel that the expense of the additional cleaning equipment was justified.

It would appear, however, that a service tender stationed at a loading port and suitably equipped with pressure pumps and heaters could be maintained in profitable employment.

Whilst Mr. Wormald had extensively quoted the Rules of Lloyd's Register concerning the classification of oil tanks, it was possible that the requirements might not be entirely clear to those without his extensive experience. Perhaps it would be helpful to give a broad summary of the four types of tanks which might be constructed as part of a ship's structure:—

(1) *Water ballast tanks* (which might, of course, also be used as dry cargo spaces). These called for the simplest form of construction, and a centre line bulkhead was not required.

(2) *Oil fuel bunkers for ships' use.* These required the strongest form of construction, since apart from the penetrating nature of fuel oils, the tanks in service might be in any condition from full to empty, so that the structure had to withstand the stresses set up by movement of the oil in a seaway. On this account extra stiffening was required on bulkheads and side framing, and more substantial connexions. A centre line bulkhead which might be intact or perforated was also fitted in tanks which extended from side to side; this acted as a wash plate.

(3) *Tanks for the carriage of oil fuel as cargo.* If these were likely to be only partially loaded the conditions would be as for (2) and similar structural requirements were therefore applicable. If, however, they were to carry oil only in the filled condition, some modification in the structural arrangements was permitted, and the centre line bulkhead might be omitted.

(4) *Tanks for vegetable and similar oils.* If the tanks were to be used in the filled condition only, then the minimum requirements were as for ballast tanks (1) with the addition of a centre line bulkhead in tanks which extended from side to side.
Tanks constructed as oil fuel bunkers (2) were structurally suitable for the carriage of vegetable oil. Tanks constructed for the carriage of oil fuel as cargo would also be suitable for the carriage of vegetable oils, and with the same limitations regarding part filling.

Vegetable oil tanks were, of course, frequently used also for the carriage of dry cargoes, so that if an owner wished to avoid the encumbrance of a centre line bulkhead, the tank must be constructed in accordance with the requirements for tanks carrying oil fuel as cargo, and they must not be used in the part-filled condition. This latter condition could not, as Mr. Wormald pointed out, always be observed, so the arrangements, at the design stage, would have to be decided on the probable trading requirements of the ship.

On reading Mr. Wormald's paper, he had felt that he could only disagree with the last sentence where the author alleged that much had been omitted. He felt that there was nothing left to say, but this impression was rapidly dispelled by the keen and interesting discussion which had taken place. Such a discussion was a worthy tribute to so excellent a paper.

Correspondence

MR. H. HOFFMANN, O.B.E., commented that one of the oils which Mr. Wormald had not dealt with and of which large tonnages passed were whale oil and sperm oil, and although he stated that these were now a specialized trade, in fact they linked up with the carriage of other types of edible oils. It would have been quite interesting to have heard his views on their carriage in connexion with bulk cargoes generally. Crude glycerine and indeed refined glycerine were now being carried in deep tanks of liner vessels with considerable success. Here again the paper could have given some views on the carriage of that commodity.

With regard to coil heating tanks conveying palm oil, Mr. Wormald might know of the recent developments whereby a system of preheating was used instead of coils. This type of heating was developing quite rapidly and the West African shipowners were vitally interested in the method.

In regard to cleaning of vessels' tanks, there was a new method at present being tried out and perhaps by the time Mr. Wormald repeated his paper in Liverpool on the 2nd April 1956, his Company would have had experience of it, and he might be able to report developments.

Author's Reply

Before the discussion was opened the author gave a short lecture, independent of the text of the written paper, in which he referred at greater length than had been possible in the written paper to many controversial matters. The text of the lecture follows.

" If it were possible to carry out in one continuous operation all the tests and inspections which are part of the preparation of a deep tank for the carriage of edible oil in bulk, it would probably take an experienced surveyor longer than the half hour which this talk is supposed to occupy. It will be assumed that all who are present at this meeting have had some experience of these cargoes and reference will only be made to points which may, with advantage, be discussed later.

According to information available, roughly 80 per cent of the raw material used in America in the manufacture of cooking fats in the year 1920 was cottonseed oil; most of this was produced, and subsequently manufactured, in the continent of America and did not depend in any way on transport by sea. By 1932, however, the cooking fat industry had extended considerably and other raw materials had either become available or had been developed to meet the increasing demands; approximately 70 per cent of the total amount of raw fat used in America in 1932 was coconut oil, whilst the proportion of cottonseed oil had fallen to about 10 per cent of the total.

By 1932 America was able to ship large quantities of coconut oil from the Philippines and, although the United Kingdom did at that time import and use coconut oil, it would appear that our manufacturers relied to a greater extent on supplies of whale oil and palm oil. The palm oil was obtained from Malaya, Indonesia, West Africa and South America and all of these sources of supply called for transport of the raw material by sea.

At the present time America still relies largely on coconut oil and the United Kingdom on palm oil, but coconut oil production is being stepped up in Malaya and Ceylon, and United Kingdom importers are now taking it in larger quantities. The indications are that demands for shipping space for these oils will continue to increase and that it will become more and more necessary to provide suitably separated compartments for the simultaneous carriage of a variety of oils which will require individual temperature control during the voyage as well as complete elimination of the risk of inter-tank leakage.

The normally constructed steel bulkhead provides adequate protection for most cargoes against inter-tank leakage and contamination, but more consideration will have to be given to the provision of suitable cofferdam separation where valuable cargoes which require individual treatment are to be carried regularly. This problem has already been met with in relation to the carriage of latex and edible oils in adjacent tanks; these cargoes have been carried in adjacent tanks, when alternative space has not been available, and in most cases the shipments have turned out satisfactorily but the carriage of latex in tanks adjacent to edible oil tanks cannot be recommended.

Advantages which cofferdams afford to the shipowner have been referred to in the written paper in connexion with the testing of tanks and also in connexion with pumping arrangements. Some other advantages from the shipowner's point of view are that, in the event of a bulkhead being found defective under test to such an extent that no repairs are possible on the spot, it may only be necessary to put one tank out of commission for liquid cargo and not two as would be the case with normal bulkhead separation. Again, if a bulkhead defect should develop during the course of the voyage, it is more likely that effective steps could be taken to deal with the defect if it were in an accessible cofferdam space.

Pipe tunnels which run fore and aft should be made the full depth of the deep tank so as to serve in every respect the same purpose as a cofferdam. Before leaving the subject of cofferdams and pipe tunnels, it is perhaps advisable to say that one of their main objects will be defeated if sufficient attention is not given to the structural layout and to the installation of all the necessary fittings. Accessibility and freedom to move and work should never be sacrificed and in no circumstances should engine room personnel be allowed to use these compartments as additional storage space.

More consideration ought to be given to the provision of expansion trunks; in addition to the normal purpose of providing for change of volume due to temperature variation, they would appear to offer other advantages. They could be made large enough, without interfering unduly with general cargo space, to form access trunks, and some of the problems connected with the utilization of cargo space on top of the deep tank might thereby be eliminated. They could be used for loading purposes as an alternative to the main hatch and if the access trunk were large enough to accommodate the shore-based discharge pump they could also facilitate discharging operations. Air pipes and ventilator trunks could be led from the top of the expansion trunk and the risk of cargo contamination arising from these fittings could be appreciably reduced. It has been mentioned in the written paper that heating coils should never be fitted in expansion trunks and precautions should always be taken to ensure that no solidified oil remains in the expansion trunk after the oil cargo has been discharged; residual oil is liable to liquefy if the vessel subsequently runs into hot weather and cases have occurred where general cargo stowed in the deep tank has suffered damage due to neglect of this precaution. When latex is carried in a deep tank provided with an expansion trunk, the whole of the trunk must be coated with wax although it is unlikely that the latex will come in contact with the steel under normal circumstances; the gas relief valve which is a necessity for this cargo should be fitted to the air pipe or ventilator which leads from the top of the expansion trunk.

Figs. 1 and 2 depict the conditions prevailing in a palm oil tank and in a latex tank immediately prior to discharge.

In the case of the palm oil tank, the oil is probably at the highest temperature it has attained since being shipped and its volume is therefore the greatest it has been—it will be seen that there is not much allowance for further expansion.

In the case of the latex tank, the latex is probably at the lowest temperature it has attained since shipment but this has little or no effect on the volume, the tank would be filled as full as practicable at the loading port in order to prevent turbulence during the voyage, it would almost certainly have been filled to within six inches of the top of the coaming and the apparent reduction in volume will probably have been caused by gradual dispersion of air trapped in the latex during loading operations. These two pictures should illustrate that the small coaming does not allow much in the way of a safety factor and it is hoped that they will emphasize the advisability of fitting either deep hatch coamings or expansion trunks.

The testing and inspection procedure usually adopted in the Malayan and Indonesian trades can be divided into three operations for each deep tank; however, cases rarely occur where a single tank has to be dealt with and a larger number of tanks call for greater organizing ability on the part of the ship's personnel. The first operation is the testing of the deep tank boundary bulkheads and connexions and the organization of this is generally the concern of the deck department. The second operation is much more of a combined operation and it calls for full co-operation between the deck and engine room departments, and the cleaning contractor. With proper co-operation it should be possible to test the double bottom tank or tanks in way of the deep tank; to test the heating coils in the deep tank; to test any suction well or suction pipes passing through the deep tank; to examine all air pipes, sounding pipes, ventilator trunks and their closing appliances; to check up on the blanking arrangements and to examine the deep tank itself for cleanness. None of the tests or examinations referred to in this operation can be carried out satisfactorily until the deep tank has been cleaned and the advantages of combining them into one composite inspection will be clear to everybody. The third operation is the examination of the finished tank after removal of all staging and the application of coating if this is required; a final check will also be made to see that all blanking arrangements and special fittings are in order and that the tank is in every respect in fit condition to receive the cargo. The organization of the final operation is generally the concern of the deck department.

There is no necessity to adhere rigidly to the above procedure; but two things should be remembered. Firstly, the double bottom tank, the steam heating coils, as well as the air and sounding pipes from the double bottom tanks, cannot be satisfactorily examined and tested until they have been properly cleaned. Secondly, steam heating coils should never be tested after they have been coated with edible oil—the oil in contact with them will be scorched and is almost certain to contaminate the cargo.

Attention ought to be drawn to the necessity of the special fittings (Figs. 3 and 6 to 11) being as simple, and therefore as easily replaceable, as possible. When they are not in regular use they are apt to be misplaced or lost and it invariably happens that the loss is not discovered until the last minute. Complicated systems of cross connexions and bypasses with permanent fittings may reduce the risk of loss but they also have their drawbacks; where plans or diagrams of such connexions were provided originally they are rarely to be found when required and it frequently happens that the ship's personnel have no knowledge of the purpose of the fittings or of how to connect them correctly for the various cargoes. Another point worthy of mention is that several ships came out new with permanently connected gunmetal relief valves which had been distinctly specified for the carriage of latex—not only is gunmetal unacceptable for this purpose but the valves were fitted in inaccessible positions and it was no easy matter to have them removed and replaced by suitable valves before a cargo of latex could be loaded.

And now for the question of blank flanges; the primary purpose of fitting blank flanges to suction lines is to prevent accidental discharge or contamination of the liquid cargo through permanent connexions to the tank but a consideration which is frequently overlooked is that oil may lodge inside open-ended pipes which are left in the tank and may cause endless trouble later—this applies particularly to solid fats, drying oils and latex. It is much easier to prevent these commodities getting into pipelines than to remove them once they have coagulated or congealed therein. The question of being able to pump the tanks out in an emergency has been briefly referred to in the written paper but one further comment may not be out of place here—if it were a question of jettisoning cargo in a hurry, it would probably be a simpler matter and very much cheaper to jettison general cargo than any of the solid fats which would require to be heated to a very high temperature to ensure that they did not solidify in the long exposed permanent pipelines and in the pump itself. Latex could not be discharged with the ship's pumps.

Cleaning has been dealt with fairly fully in the written paper but there is ample scope for further discussion regarding the standard of cleanness and the usual formula of "free from all old oil, deposit, loose rust and moisture". In the first place it is impossible to coin any phrase or suggest any test which can be applied to every case likely to be met with in practice. The best that can be done is to say that the condition of the tank must be in accordance with the above formula, that it must be appropriate to the quality of the oil to be shipped and that it should also bear some relation to the purpose for which the oil is to be used. It is reasonable to assume that shippers will not ask for a certificate of cleanness, knowing full well the amount of work and the cost involved, if they do not attach great importance to the condition of the tank and if a surveyor is asked for such a certificate he is bound to assume that the standard required is that which is normally accepted in the trade with which he is concerned. Nothing must be left in the tank which is liable to contaminate the cargo and the only way to ensure this is to clean the tank to bare metal. It is not practicable to issue certificates for differing degrees of cleanness and if the cargo is such that adulteration is of no importance then it should be shipped and carried without a certificate of cleanness for the tank. Cleaning methods which depend wholly on the use of a spray or nozzle are totally inadequate for final cleaning—they may remove the bulk of the residue but there is always the risk of deposits remaining on the innumerable horizontal surfaces in the upper part of the tank. The only satisfactory method at the present time is to do the final cleaning manually from staging which provides access to every part of the structure and no surveyor is justified in issuing a certificate of cleanness unless he is able to examine every part of the tank by means of staging or some suitable alternative.

Twenty-five years ago, palm oil was shipped to Marseilles from West Africa for soap making in tanks which were never used for general cargo or ballast water and which were never cleaned out after an oil cargo had been discharged. The oil was carried to the ship in all sorts of containers, the commonest of which was made of plaited fibre, and it was poured or scraped into the tank with plenty of solid matter in suspension. There was never any question of a certificate of cleanness being required for these tanks but obviously something different is required when highly refined oil is to be shipped.

It is worth mentioning here that oil is brought to the bulking stations in Singapore in railway tank wagons and in small seagoing or coasting tankers and it is then bulked in shore-based cylindrical steel tanks. Neither the tank wagons nor the tankers are used for any other purpose than the carriage of the one specified oil and they are not cleaned after each shipment but the condition of the oil as shipped in the tank wagons or tankers is such that no question has ever arisen of mould or mildew developing nor of rancidity due to oxidation causing trouble. Similarly the tanks in the bulking stations are frequently only part filled for long periods and no trouble from either of these sources has been experienced. These facts are quoted to illustrate, and to give emphasis to, the statement made in the written paper that when troubles of this kind are encountered after coating of deep tanks they can generally be attributed to the quality of the oil used for coating.

To return to the previously quoted formula for cleanness —when a certificate of cleanness is required there should be no difficulty in connexion with the removal of old oil and deposit if the residue of the last oil cargo was removed before the tank was used for ballast water. Several references to the action which takes place when this is not done have been made in the written paper and it would be interesting to know whether this action is a combination of corrosion as we know it and of what is sometimes referred to as "bacterial corrosion". It is understood that this form of corrosion is produced in oil tanks by sulphate-reducing bacteria and that the product is black iron sulphide.

If normal precautions are taken when the tanks are not being used for the carriage of these cargoes and if experienced contractors are employed for the final cleaning it should be a perfectly straightforward task to deal with everything except loose rust and moisture; these are old enemies—and an entirely satisfactory solution has not yet been found to the problem which they present. Final cleaning generally takes the form of scraping and wirebrushing to remove the more solid deposits, then washing down with caustic soda or some other detergent to remove any grease there may be and finally washing down with fresh water.

Final cleaning of the tanks generally takes place in tropical climates where humidity is high and this condition is aggravated by the washing processes; the use of blower or extractor fans during cleaning operations helps considerably but is not the full answer. Whenever there is unprotected steel and atmospheric moisture there will be rust and the rate of rust production will depend on many factors. It would be most helpful if an authoritative opinion on the effect of comparatively small quantities of powdered rust on oil which must be processed later could be obtained and it would be greatly appreciated by all connected with the carriage of these cargoes. If it is established that such rust is undesirable, is the solution to be found in the use of rust removers and if so what is the subsequent treatment of the steelwork to be? Obviously, the rust remover must be washed off with fresh water and what treatment would have to be applied to prevent rust formation subsequent to this washing down? It has been found that vegetable oil, used as a coating, does not act effectively as a rust inhibitor. Would health authorities or edible oil technicians consider the use of chemical rust removers unsuitable for edible oil tanks, bearing in mind that caustic and other detergents have been used regularly without complaint? It is hoped that some enlightenment on these questions will be forthcoming from sources qualified to give an authoritative opinion.

The formation of dew and rust in cargo spaces has exercised the minds of shipping people for many years but some of the phenomena which take place in deep tanks have to be seen to be believed.

One amazing example of unexplained rust formation has been quoted in the written section of the paper and two examples of dew formation other than the one quoted in the written paper are perhaps worthy of mention here. The first case concerns a tank which was being prepared for the carriage of coconut oil; it was cleaned satisfactorily and subsequent rust formation was negligible but when the time came to coat the tank with coconut oil the humidity and dew formation were so severe that the oil almost emulsified as it was being applied —there was nothing one could do about it and a suitably worded certificate was issued. The tank was examined by the shippers several days later and after all superfluous oil and water had been mopped up it was accepted by shippers without further question. Another case concerns a tank which had been coated with wax for the carriage of latex and dew formation on the ship's side subsequent to coating was so heavy that when the final examination before loading was carried out there were two or three inches of water—dew—in the bilges and water was just streaming down the ship's side and to a lesser extent down the bulkheads. The surplus moisture was mopped up, the wax tested and found to be adhering perfectly, and the latex shipped but it would have been impossible to apply the wax if similar atmospheric conditions had existed when the waxing had to be carried out.

It is admitted that the cases quoted are extremes but there are many variations on these which are intermediate to the cases quoted and to the perfect tank—if such a thing exists.

You, gentlemen, have your problems at this end but it is hoped that this brief summary will help you to an appreciation of the problems which superintendents and ships' officers have to face at the other end of the world and that all those who have opinions or suggestions to offer will not hesitate to do so now. If I may make a purely personal observation at this point it is that we must remember that we are dealing with deep tanks on ships as well as with edible oil and that a sense of proportion should be observed by all parties."

Replying to the discussion, the author hoped that Mr. Brett's opening remarks on contamination were intended as a tribute to the work which was being done at the cleaning and loading ports and that they did not imply that most of this work was unnecessary. He was also very pleased to have

Mr. Brett's confirmation of his own views, expressed tentatively in the written paper (page 74, column 1), that small quantities of powdered rust are not appreciably harmful although heavy scale undoubtedly is. The author agreed that wiping down with oil similar to that to be carried was, in the majority of cases, a waste of time and money and it was hoped that shippers would take note of these views.

The carriage of lubricating oil was outside the scope of the paper but there was no doubt that a cargo of lubricating oil would remove anything likely to contaminate edible oils and reference to the beneficial effects of carrying a cargo of light mineral oil was made in the written part of the paper (page 74, column 2). Unfortunately, shipowners rarely found suitable cargoes for the outward voyages and this was at the bottom of many cleaning problems.

Mr. Brett's remarks on permanent coatings were fully appreciated but it must never be forgotten that the type of deep tank with which they were dealing must be suitable for carrying almost any kind of liquid cargo, as well as dry cargo and water ballast. The problem of finding a permanent coating which would satisfy all the usual requirements and still stand up to the wear and tear of the normal trading conditions was not insuperable but was it going to be an economical proposition?

Any process which would reduce the time and labour necessary for cleaning deep tanks would be welcome but the author still thought that chemical and mechanical means which had proved adequate for petroleum trade tanker cleaning were not suitable for the final cleaning of edible oil tanks. It was absolutely essential that all residue be removed from the structure of edible oil tanks and the author felt that chemical or mechanical processes could not be relied upon to remove such deposits from the innumerable horizontal surfaces and crevices which existed in the present day deep tank. In the opinion of the author, petroleum trade tankers were quite a different proposition in that all cargoes were derived from the same base, viz., crude oil, whereas edible oil was carried in what Mr. Brett described as "the odd place" where it was quite conceivable that some poisonous or highly deleterious chemical was carried on the outward voyage.

The advantages of fitting expansion trunks were discussed in the author's introductory lecture and the precautions necessary to allow for changes of temperature and volume were referred to in the written paper (page 78, column 2). The author found it hard to understand why expansion or access trunks were not fitted more often nowadays and was pleased to have Mr. Brett's confirmation of his views on deep hatch coamings when expansion trunks were not fitted.

Mr. Brett's remarks on the design of tanks for efficient discharge and cleaning and on the layout of heating coils emphasized points which the author tried to make and they were greatly appreciated.

The question of calibration was one with which the author had not been directly concerned and his remarks in the written paper were confined to recommending the fitting of suitable ullage plugs. Any improvement, such as the provision of proper tank calibration charts, would undoubtedly be beneficial to the trade as a whole and it was hoped that shipowners would ensure that deep tanks of the future were reliably calibrated.

Whilst on the subject of calibration and allowance for expansion it might be helpful to seagoing personnel to know that a rough and ready rule was to allow 1 per cent increase in volume for every 25 deg. F. rise in temperature likely to take place, for any reason whatsoever, after the oil had been shipped.

The author thanked Mr. Tytler for correcting him with regarding to the responsibility for discharging arrangements for edible oils and he agreed that it was the responsibility of the "carrier" or shipowner. The point which the author was trying to stress was that discharge by the ship's own pumps and pipelines was not recommended and that it was usual to use shore based equipment for the purpose. The pumps required for latex discharge were, as stated by Mr. Tytler, supplied by the consignee and it might be interesting to those concerned to know that, to the best of the author's knowledge, there was no pump available at loading ports in the Far East which would be capable of pumping out a shipment of latex if the necessity for doing this should arise.

The economic aspect of fitting cofferdams had been dealt with at length by Mr. Tytler and this was a subject upon which every shipowner was entitled to have his own views. In the running of a large fleet of ships, a shipowner could not hope to meet every demand and compromises must be made but there was no doubt that many new ships were being fitted with cofferdam separation from dry cargo spaces and with similar inter-tank separation. The practical advantages of these arrangements could not be disputed but the economic problems would have to be left to the individual shipowners, with a reminder that shippers and underwriters might be influenced in their future outlook in this rapidly developing trade by the additional security afforded by cofferdam separation.

Reference to the fitting of expansion trunks had been made in the reply to Mr. Brett and the author repeated his view that they were not yet becoming as usual a feature as cofferdams. It was admitted that a sustained pressure might come on the joints of tank lids when properly constructed expansion trunks were fitted but the author could not refrain from quoting two extracts from Mr. Tytler's remarks: "—— which implied that loading should never be to a greater height than the top of the tank lid"; and "—— until the temperature of a heated oil was raised for pumping, when the whole expansion trunk would be full". These remarks had been taken from their context but did Mr. Tytler mean that the expansion trunk should be treated as an integral part of the tank when loading was being carried out and that the ship's personnel should estimate the expansion due to heating for pumping with such a degree of accuracy that the expansion trunk would be completely full at the discharge temperature of the oil? This interpretation would saddle the ship's personnel with very great responsibility and would completely defeat the object of the expansion trunk in the interests of utilizing every available cubic foot of space. It was stated in the paper that the tank lid joints must be oil and gas tight and thanks are due to Mr. Tytler for pointing out that a sustained pressure could come on the joint when expansion trunks were fitted and without the abnormal conditions referred to by Mr. Brett having become operative.

Mr. Tytler's reference to a Saunders valve might be misleading; in the author's opinion, any type of control valve suitable for drawing off the oil in the expansion trunk through an aperture in the tank lid would serve the required purpose.

It was admitted that the temperature conditions at latex loading ports did approximate to the carrying temperature of palm oil but the temperature to which this oil must be heated prior to discharge was the major complication. Latex had been carried satisfactorily, on many occasions, in tanks adjacent to palm oil tanks but special consideration must be given to the loading and discharging sequences. The discharge of palm oil should be delayed, due to the imposition of temperature control, until the latex has been discharged and this could result in delay to the ship itself. It might be advantageous to deal here with Mr. Clarkson's comments on the melting point of the wax used for coating latex tanks; this wax was usually purchased in slab form and in cartons from the oil companies who manufacture it. The certified melting point was generally printed on the carton, or on the invoice, and this was the only check exercised by the surveyors. The use of a wax with a higher melting point would offer advantages in cases similar to those mentioned by Mr. Tytler but the difficulties of applying the wax successfully would be much greater. It was a difficult and very unpleasant job applying wax with a melting point of 130 deg. F. and the use of wax with an appreciably higher melting point would, in so far as the workmen were concerned, probably make all the difference between an unpleasant sting and a nasty burn —all this in addition to the problems of keeping the wax hot enough to apply satisfactorily.

It was admitted, as stated by Mr. Firth, that the risk of damage to latex by the conduction of heat was almost negligible but it would be appreciated from what had already been written that the difficulties arose during the loading and discharging operations and, although everything possible was done to prevent intertank leakage, it must also be remembered that the risk of contamination was increased when the bulk, or the density, of two cargoes in adjacent deep tanks varied to any great extent, as when one tank was only part full.

The suggestions made by Mr. Firth about improvement of conditions at producing stations were valuable but were really outside the scope of this paper and the author was sure that there was little to complain about with oils shipped in Malaya and the Philippines. This subject was dealt with briefly on the first two pages of the paper and the author still considered he was right in referring to oils shipped in Malaya and the Philippines. The oils were pure and free from adulteration and could be used for edible purposes in the condition in which they were shipped. However, when the purposes for which they were to be used required that the odour, taste and colour be removed, these features were dealt with by the manufacturers at separate factories. The author understood the establishments to be known officially as "processing plants" and not as "refineries" but he had no wish to be pedantic on this point.

Mr. Firth also referred at length to oil production methods, F.F.A. content, "rot" and similar characteristics; the information given by Mr. Firth was valuable corroboration of the author's brief remarks on oil made from poor quality raw material and the importance of proper temperature control during carriage. The author had no desire to disparage the by-products of vegetable oil manufacture and readily admitted their value commercially; this again was a case where the economics of carriage by sea had to be considered and the author would suggest that, generally speaking, it was not an economical proposition to carry the residue of the fruits and nuts after the oil had been extracted.

It would be clear from replies to previous contributors that the cover joints should be capable of withstanding sustained pressure and the author had frequently dealt with the superposed tanks to which Mr. Firth referred. It might be interesting to know that he could recall cases where shipments of edible oil and of latex had been been satisfactorily carried in superposed tanks. It was also confirmed that the adjusting pin for the latex valve would, in theory, be better with a lock nut; in practice, there was no risk of a properly fitted pin slackening back without human assistance.

The author regretted that he had had no experience with tallow in bulk but he suggested that tallow was probably more difficult to keep fluid than palm oil. In this case, the fitting of side heating coils to the top of the tank would be advantageous but the risk of scorching the tallow if any of the coils were not permanently covered should not be overlooked; mention had been made of this risk in the written paper. No definite figure could be given for the solidifying point of tallow; it varied considerably and depended on the animal fat used in its manufacture.

Mr. Hutton's views on the heating surface necessary and on the disposition of heating coils were largely in agreement with those of the author but it was again suggested that it was preferable not to arrange ships' side and bilge coils on separate circuits and to supply a little too much heating surface rather than too little. It was admitted that 1·5 sq. ft. should be sufficient but the author felt that this figure allowed no margin for safety in extreme weather conditions. If possible, the solid fats should not be allowed to solidify, even at the ship's sides, and in order to ensure this the ship's side coils should never be completely shut off; this should only be done after discharge had started, when precautions must be taken to prevent scorching of the oil. These points had been dealt with in the paper and in replies to other speakers but the author felt that they were important enough to justify repetition.

The importance of fitting adequate means for obtaining reliable temperature readings was barely touched on in the paper and the author was grateful to Mr. Hutton for stressing the importance of careful consideration being given to the provision of adequate facilities. The author was also grateful to Mr. Hutton for the additional information on small tanks in superstructure spaces and he confirmed the advantages of being able, in many cases, to discharge them by gravity and the comparatively greater accessibility of the pipe lines and fittings for cleaning.

The author regretted that he had had no experience of coconut acid oil beyond having had to recommend temporary repairs to a bulkhead, incidentally adjacent to a dry cargo space, which had developed a leak on passage. It would appear that this oil had little or no serious corrosive effect on sound plating but that it would "search" out latent weaknesses. Where the oil had run down the unprotected surface of the bulkhead, the plating had the appearance of having been very lightly galvanized; the oil had in fact removed all surface deposits and left the plating perfectly clean.

"Prevention is better than cure" and, although the surveyor was only required by the shipowner to certify that the tank was fit as regards tightness and cleanness, it was obviously to the advantage of everybody concerned that the surveyor should be able to look for latent defects and advise that they be dealt with. The surveyor could not do this effectively when insulation, lining or sparring was fitted to the bulkhead; he might, in such a case, be able to state unreservedly that there was no leakage at the time the tank was tested if the bottom tier of planks was removed, as was suggested by one contributor to the discussion, but was this enough?

The author was very grateful to Mr. Southwell, a colleague with experience of these cargoes in another part of the world, for confirming so much of what had been said by him about cleaning. Brief reference was made to deep tanks which were as clear of obstruction as an empty box on page 68, column 2, of the paper and the author could vouch for their many advantages but he was not prepared to say whether, from a shipowner's point of view, they were economically justified; it should perhaps be added that the tanks to which reference was made had, probably, a capacity of 600/700 tons and were not small non-structural tanks. Neither were they to be found in British ships!

Mr. Clarkson's question regarding the melting point of the wax used in coating latex tanks had been dealt with in the author's reply to Mr. Tytler.

Ventilator trunks which passed through 'tween deck spaces and which were in communication with the deep tank whilst liquid cargoes were being carried must be watertight and gastight right up to deck level. There was always the risk, particularly when expansion trunks were not fitted, that liquid would rise into the ventilator trunk and cases had been known, as mentioned by Mr. Brett, where oil had actually overflowed on to the deck. In the opinion of the author, the best method of dealing with ventilators was to blank them off efficiently as near to the top of the tank as possible but there might be other considerations which prevented this plan being adopted in all cases. In some ships, deep tanks were loaded through the ventilator trunk.

It was stated in the paper that there was little to be gained from the use of high pressure steam during shipment and the author intended "shipment" to cover the whole of the time the oil was in the tank. The author felt that heavy gauge piping was far more important than high steam pressure but suggested that it should always be possible to apply the full steam pressure, and not an appreciably reduced pressure, to the coils for testing and, if necessary, for blowing out obstructions. There was no reason why exhaust steam and steam traps should not be employed but the author considered that they introduced complications and that the simplest systems proved the best in practice.

Header tanks for topping up out-of-use coils were, at one time, a regular fitting but they were now more or less obsolete. One could never guarantee a balance of pressure between the water in the coils and the oil in the tank; if there happened to be a defect in the coil and the oil was prevented from getting into the coil one could be reasonably certain that some water got into the oil before the defect was discovered. It was admitted that the latter alternative was preferable but the best solution was to fit robust coils with adequate clips to prevent vibration and well designed flanges, also to supply plenty of the proper tools for tightening the joints. With these there was no necessity to fit headers and all the additional piping.

The question of the validity of a "Test Certificate" when normal drydocking took place before loading was, as explained on page 70, column 2, of the paper, really one for the shipper but the author's own opinion was that the certificate would be considered invalid and he would advise any shipowner to retest the tank for his own satisfaction and protection. It was hoped, however, that this view would not be interpreted as indicating that the author expected a well designed ship, or its deep tanks, to be affected in any way by the drydocking.

The author was very pleased to have confirmation of his views on the importance of cleaning tanks immediately after discharge and was grateful to Mr. Seymour Roques for the description of a method of chemical cleaning which had proved suitable for the preparation of tanks for the carriage of lubricating oil. The author's views on the necessity of manual cleaning had already been expressed, and confirmed by Mr. Southwell in his contribution to the discussion. Before the 1939 war, ships on the "round-the-world" run regularly carried lubricating or light mineral oil in their deep tanks from the United States to the Far East and these tanks never presented any problem as far as cleaning was concerned. However, it was always found necessary to rig staging for the final cleaning and inspection. The problems which arose from the alternate carriage of light mineral oils and edible oils in those days were connected with shell and tank top riveting and it was quite usual to have to replace thirty or forty badly leaking shell rivets by the method described in the written paper (Fig. 14).

The type of scaffolding described and pictured in the paper was perfectly reliable and there was no need to employ three husky riggers as "guinea pigs", as was suggested by Mr. Clarkson: the question of erecting and dismantling time was dealt with in the written part of the paper (page 72, column 2).

It would be interesting to know whether the plastic coating referred to by Mr. Seymour Roques had been applied to one of the deep tanks which were really the subject of this paper; the author, prior to writing the paper, asked his colleagues at all known loading ports for information on their experience of plastic coatings and none admitted having seen them except in small non-structural tanks such as those referred to by Mr. Hutton in his contribution.

Mr. Upton's suggestions for improving the facilities for heating the oils were worth further consideration but again it was suggested that the question of economy entered. The author favoured simplicity but was not averse to improvements where they could be justified from the shipowner's point of view. To install a circulating system such as the one suggested, with the necessary heaters, would cost an appreciable sum of money and it would not be in regular use in the ships which the author had in mind. The author recently read of an experimental installation on the lines suggested but he was of the opinion that the tank(s) in question were intended solely for the carriage of palm oil and that there was reasonable certainty of their being constantly used for the carriage of this commodity. There was no doubt that very careful thought would have to be given to the design in order to make the circulation effective and it would appear that additional cleaning of pumps and pipe lines, as well as of heaters, would be necessary when different cargoes had to be dealt with by the same system; it would also be necessary to install independent circulating systems and pumps for individual tanks if packages of different cargoes had to be carried simultaneously.

The heating coils in common use were of plain tube construction and in many cases the number of flange connexions had been reduced to a minimum by the use of all-welded grids. They were not difficult to clean and the internal application of high temperature steam helped appreciably in the process; the question of steam pressure had been dealt with in the reply to Mr. Clarkson and it was agreed that there was a grave risk of scorching the oil if the full steam pressure was applied to the coils. In practice, however, the flow of steam was, or should be, controlled by adjustment of the steam and exhaust valves on each individual coil and, in some cases, by introducing a reducing valve into the system. The result was, in effect, that for the greater part of the time there was little more than hot water circulating through the coils. The importance of gradual heating was stressed in the written paper and to return to Mr. Hutton's contribution it was quite an easy matter to scorch oil adjacent to the double bottom tank top coils if it was allowed to cool down to the point where the circulation set up by convection currents was eliminated.

Steel was the material in commonest use for heating coils and was the only one with which the author had had experience. Copper, copper-bearing alloys, tinned or galvanized surfaces were not in favour with health and similar authorities and, in the opinion of the author, they offered no specific advantages. There was apparently no reason why aluminium should not be used, other than that of initial cost, and the greatly increased risk of "accidental" loss when coils were removed for any reason whatsoever.

Mr. Wright's contribution to the discussion dealt largely with the shape, or surface, of things to come and must give rise to a good deal of thought. The author could not agree that the objections to non-ferrous coatings were mere prejudice in the case of latex tanks and he would have welcomed the views of rubber technicians on this point. It was a known fact that responsible authorities had questioned the indiscriminate use of non-ferrous fittings in edible oil tanks but they had not yet felt it necessary to prohibit their use.

It was very pleasing to see that considerable success had been achieved with the coating of ordinary cargo deep tanks with paint after metal spraying but were shippers willing to accept tanks which had been thus treated for the carriage of edible oils? Cases could be quoted where shippers had insisted on wax being applied over plastic coatings when latex was to be carried and it must be made clear that this was the shipper's prerogative and not the surveyor's prejudice.

The carriage of lubricating oil had already had several references and nothing further need be added at this point. Mr. Wright's references to the experimental work on the use of aluminium spray treatment for both latex and edible oil tanks were a valuable addition to the paper and they perhaps confirmed the reply given to Mr. Seymour Roques about aluminium heating coils.

The author was pleased to make use of Mr. Wright's estimates of possible contamination in a way which he probably had not intended. When considering a cargo of edible oil in a deep tank it must always be remembered that any contamination would be evenly distributed throughout the whole of the cargo and it would not be concentrated in one particular area, as would be the case with dry cargo. It was, therefore, all the more important that no method of cleaning tanks which could not be relied upon to remove all possible sources of contamination should be adopted for deep tanks intended for the carriage of these very valuable commodities. Chemical and mechanical means might approach this state and be acceptable for mineral, and lubricating, oils but were shippers justified in waiving their right to proved methods of cleaning the structure and fittings of tanks which were intended for the carriage of edible oils?

Mr. Wright and many others had referred to the time taken to clean deep tanks and the cost of doing this but the author must point out that these two factors ought to be considered in relation to the additional time which would be taken in loading and discharging an equivalent tonnage of dry cargo; secondly, that the work of cleaning generally goes on simultaneously with loading of general cargo into the main cargo spaces and, finally, that the total cost of handling an equivalent tonnage of dry cargo—no small item either—was eliminated.

The author had dealt with Mr. Powell's remarks on cofferdams in his reply to Mr. Tytler but he could not appreciate the reference to the additional cost of upkeep; well designed and well ventilated cofferdams required a negligible amount of upkeep.

The author, in his reference to making heating coils easy to remove, had in mind many recently built ships in which it was impossible to remove the coils because they were not flanged but were welded into continuous lengths and, in some cases, were welded to the bulkhead connexion pieces. It was agreed that the individual lengths of flanged coils were easy to remove but more difficult to refit but with proper organization and plenty of proper spanners there should be no difficulty; the author had, on numerous occasions, seen the coils in three or four deep tanks on the same ship refitted and satisfactorily tested in less than twenty-four hours. Portable covering was quite suitable for the protection of permanent coils when dry cargo was carried but the author could not think of any similar arrangement which would be suitable for use when latex was to be carried—there would be far too many joints in the covering which would have to be made pressure tight and tested to ensure that they were tight.

Mr. Powell referred to air testing and the use of fresh water for testing purposes. It would appear that there had been an error in reporting Mr. Powell's comments on air pressure; it was water testing that gave the correct pressure conditions and, under normal circumstances, sea water was used for testing purposes. The author had tested thousands of deep tanks with sea water and probably less than a dozen with fresh water; the tanks should, whenever possible, be filled for testing before the vessel entered port and, in the trades with which the author was concerned, there was never any question of using fresh water in preference to dirty dock water. The effects of dirty dock water were more easily dealt with than the residue of previous oil cargoes which had been mixed with clean sea water used for ballast purposes. It was not thought that releasing a quantity of ammonia into the deep tanks would simplify testing by air pressure; there were generally far too many other strong smells to contend with when testing was in progress.

The question of rust had been dealt with from the point of view of contamination in the reply to Mr. Brett and the author still thought that this rust would settle to the bottom of the tank in spite of the circulation set up by the heating coils.

The author was very grateful to Mr. McAfee for stressing that loading and similar certificates were not a Classification matter and it was hoped that this would be brought to the notice of ships' personnel, most of whom thought that the surveyor was responsible for all the various requirements connected with the carriage of these cargoes. They were the men with whom the surveyor had to deal.

Mr. McAfee's suggestion regarding something comparable to the Butterworth system for cleaning deep tanks had been dealt with in the replies to Mr. Seymour Roques and to Mr. Brett. Mechanical or chemical processes might be satisfactory for preliminary cleaning or for removing the residue of a previous cargo but the author felt that the final cleaning must be done by hand and this view was confirmed by Mr. Southwell, who had had experience of these cargoes in ports and trades different from those of the author.

The author was also grateful to Mr. McAfee for the additional information on the subject of the Classification Society's interests in the construction of deep tanks for the carriage of these cargoes and he was sure that shipowners and shipbuilders would appreciate Mr. McAfee's lucid summary of the various types of tanks, their structural features, their suitability for carriage of part cargoes and all those features which required special consideration at the design stage of the ship.

The author, unlike Mr. McAfee, felt that there was still plenty to be said on the subject matter of this paper and he was very grateful to all of the contributors to the discussion for their very valuable additions to the paper; he was sorry, however, that there had been no contributions from shippers and importers or from technicians connected with the edible oil and latex industries. It would be unreasonable to assume that they were entirely satisfied with the present arrangements and that they were prepared to leave the improvements, which the author thought could still be made, to those who were only concerned with the carriage by sea of these cargoes.

Mr. Hoffman's comments on the absence of views on the carriage of whale oil and sperm oil were appreciated. It was understood that the solidifying temperature of these oils was about 32 deg. F. and the author suggested briefly that their carriage would not present any problems greater than those connected with the carriage of palm oil. The author had had no experience of the carriage of glycerine but, since it was a colourless viscous fluid with a definite taste, he suggested that it was similar to the semi-drying oils and that special attention ought to be given to the cleaning of the tanks in which it was carried.

The author assumed that the system of "preheating" referred to by Mr. Hoffman was similar to the system suggested by Mr. Upton and he considered that this system was only suitable for installation in deep tanks which were to be used exclusively for the carriage of palm or similar oils. The author's experience of West African oils was that less attention need be given to the cleanness of the tanks and fittings and some of the cleaning problems quoted in the reply to Mr. Upton might, therefore, never occur. The author hoped to hear more about this method of heating and also about the method of cleaning now being tried out when he visits Liverpool, and he repeated what he said in his reply to Mr. McAfee, that improvements could still be made in the arrangements for the carriage of edible oil and similar bulk cargoes.

Annual Dinner

The Fifty-Third Annual Dinner of the Institute was held at Grosvenor House, Park Lane, London, on Friday, 9th March 1956, and was attended by about 1,000 members and guests.

The President, MR. H. A. J. SILLEY, was in the Chair.

The guests included: His Excellency Hr.Per Prebensen, G.C.V.O., C.B.E., The Norwegian Ambassador; His Excellency Dr. D. U. Stikker, G.B.E., The Netherlands Ambassador; His Excellency Senhor Pedro Theotónio Pereira, The Portuguese Ambassador; The Right Honourable the Viscount Cilcennin, First Lord of the Admiralty; Sir John Lang, G.C.B., Secretary of the Admiralty; Sir Gilmour Jenkins, K.C.B., K.B.E., M.C., Permanent Secretary, Ministry of Transport and Civil Aviation, and Past President; Kenneth R. Pelly, Esq., M.C., President, the Chamber of Shipping; Admiral Sir Ralph Edwards, K.C.B., C.B.E., Third Sea Lord and Controller; The Rt. Hon. The Lord Winster, P.C., K.C.M.G., President, Navigators and Engineer Officers Union; Sir Donald F. Anderson, President-elect; Vice-Admiral Sir Frank Mason, K.C.B., Engineer-in-Chief of the Fleet; Sir George Nelson, Bart., President, Institution of Electrical Engineers; Sir Ronald Garrett, Chairman, Lloyd's Register of Shipping; Sir Victor Shepheard, K.C.B., Director of Naval Construction; W. J. Ferguson, Esq., M.Eng., Chairman of Council; P. D. Proctor, Esq., C.B., Deputy Secretary, Ministry of Transport and Civil Aviation; Eng. Capt. W. A. Graham, O.B.E., R.N.R., Honorary Member; Sir Charles Connell, Chairman, British Shipbuilding Research Association; R. Gillespie, Esq., C.B.E., Managing Director, British Tanker Co., Ltd.; R. B. Shepheard, Esq., C.B.E., B.Sc., Director, Shipbuilding Conference; W. Donald, Esq., C.B.E., Chairman, Port Line, Ltd.; Brigadier L. F. E. Wieler, C.B., C.B.E., Major and Resident Governor, Tower of London; the Hon. J. K. Weir, C.B.E., A. F. Hull, Esq., Chairman and Managing Director, Ellerman Lines, Ltd.; W. F. Wackrill, Esq., Director, Esso Petroleum Co., Ltd.; Basil Sanderson, Esq., M.C., Chairman and Managing Director, Shaw Savill and Albion Co., Ltd.; W. MacGillivray, Esq., Director, Prince Line, Ltd.; F. Charlton, Esq., Deputy Chairman, Furness, Withy and Co., Ltd.; G. Ewart Thomson, Esq., Deputy Chairman, Corporation of Lloyd's; A. Belch, Esq., C.B.E., Controller, Shipbuilding Conference; Instr. Rear-Admiral Sir Arthur Hall, K.B.E., C.B., Treasurer, Institution of Naval Architects; Commodore G. C. Oldham, D.S.C., R.A.N.; Lieut. Cdr. T. L. Taylor, R.N.Z.N.; Commodore J. V. Brock, D.S.O., D.S.C., C.D., R.C.N.; J. H. Burgoyne, Esq., D.Sc., Ph.D., Institute Silver Medallist, 1955; H. O. Kohl, Esq., Director, John I. Jacobs and Co., Ltd.; Professor D. M. Newitt, M.C., D.Sc., F.R.S., Institute Silver Medallist, 1955; Commodore R. L. F. Hubbard, R.D., R.N.R.(ret.), Warden, Trinity House; P. Faulkner, Esq., C.B., Under Secretary, Ministry of Transport and Civil Aviation; Commander S. B. Salimi, R.P.N.; P. L. Jones, Esq., M.C., B.Sc., Wh.Ex., President, Institution of Mechanical Engineers and North East Coast Institution of Engineers and Shipbuilders; Commander B. V. Hegarty, D.S.C., South African Navy; J. E. Church, Esq., President, Society of Consulting Marine Engineers and Ship Surveyors; W. K. Wallace, Esq., C.B.E., President, Institution of Civil Engineers; Captain G. C. Steele, V.C., R.N.R., Captain Superintendent, the *Worcester;* R. H. Gummer, Esq., President, Institute of Fuel; D. S. Tennant, Esq., C.B.E., General Secretary, Navigators and Engineer Officers Union; Captain W. H. Coombs, C.B.E., President, Officers (Merchant Navy) Federation, Ltd.; Miss M. B. A. Churchard, O.B.E., Assistant Secretary, Ministry of Transport and Civil Aviation; Captain F. G. Spriddell, C.B.E., R.D., R.N.R., Senior Warden, Honourable Company of Master Mariners; Victor Wilkins, Esq., F.R.I.B.A.; A. W. Wood, Esq., Assistant Secretary, Ministry of Transport and Civil Aviation; Ronald Ward, Esq., F.R.I.B.A.; S. E. Tomkins, Esq., Secretary, Salvage Association; J. D. C. Stone, Esq., F.C.A.

The Loyal Toasts, proposed by the Chairman, having been honoured, HIS EXCELLENCY SENHOR PEDRO THEOTÓNIO PEREIRA The Portuguese Ambassador) proposed the toast of "The Royal and Merchant Navies of the British Commonwealth". His Excellency said: I really wonder if all of you realize that I belong to the most backward, reactionary and primitive extraction of seafaring people—the sail amateurs. Is my guess correct if I assume that more than one marine engineer in his leisure hours feels like I do? I really do not see anything against it. Nor do I see anything against letting you know that I had no objection to installing a small but very reliable Diesel engine aboard my tiny ship.

Recently I read in *Shipbuilding and Shipping Record* an old quotation from a Chinese philosopher which applies to we Portuguese—a most helpful quotation at this stage as you are seeing me for the first time and I have not been introduced, and so it is good to have a Chinese philosopher to introduce me. He said that we were like fishes—"Remove them from the water and they straightaway die". Portugal was too small for all of us to live in, but in spite of the views of that very clever Chinese philosopher, we could not find a solution to our problem merely by deciding to jump into the water of the Atlantic. We had to negotiate the wild and dark ocean of the Middle Ages confronting us. And certainly we did. This resulted in the discovery of the World and in our doing a lot of things on the Seven Seas. A destiny in many points similar to the glorious seafaring history of this country. May I say now how pleased I feel to see with us tonight my very distinguished colleagues representing the two magnificent maritime nations, Norway and the Netherlands. (*Applause.*)

Side by side with our love of the sea, we Portuguese could not avoid producing at the same time an inexhaustible supply of landlubbers. (*Laughter.*) You have certainly quite a few too. I must admit, though, that some of our landlubbers were rather remarkable ones. For example, one of my predecessors at the Court of St. James in the eighteenth century, the Marquis de Pombal, who later became Secretary of State, Prime Minister, everything, used to say: "You can find people for any job, even to go down to the sea in ships". (*Laughter.*) You will tell me very reasonably that he came to England aboard a man-o'-war or took a berth in the Falmouth Sailing Packet. Undoubtedly he was quite unable to fly B.E.A., but there is no historical evidence to prove that he did not have to be pushed from behind to go on board. (*Laughter.*)

To speak now, very briefly, about marine engineers, I think that the first attempt in this country to put an engine in a ship occurred about 1800. I read that a memorandum on the subject was submitted to the Lords of the Admiralty. It seems that their reply was more or less this: "After careful consideration, their Lordships were of the opinion that such a proposition would be of no value in transmarine navigation". (*Laughter.*) It seems that there was one opposing voice, that of a young Admiral called Nelson.

In order not to leave Lord Nelson's countless admirers—among whom I include myself—too proud about this judgement, I move to the field of the landlubbers and am glad to recall that the Duke of Wellington, in spite of his early reasons for disliking the adoption of steam in ships, changed his views suddenly and told the Government in about the 1840's that a new and serious state of things had come about; in short, that the seas around these islands seemed to be infested with alien, smoky and fast-going vessels ignoring the old rules of winds and tides. That is why the Duke of Wellington came to such a strong conclusion that for this country there was no defence or hope of defence except in her Fleet.

No greater tribute has ever been paid to the role of the Royal and Merchant Navies. I feel very honoured at having been asked to say a word to-night about the Royal and Merchant Navies, and I wish very sincerely to thank our Chairman for this great privilege. Might I add, too, how delighted I was to realize when reading this wonderful programme to-night that this very unimportant and dull speech of mine would be responded to by my great friend, Lord Cilcennin, the First Lord of the Admiralty. (*Applause.*)

I think it most appropriate to look at the two Navies together. We in Portugal have been associated with them since their earliest steps. I must not fail to-night to refer to our old association with this country. Indeed, I am pleased to recall at this stage that our first treaty on shipping and fisheries was dated 1353, which means that it preceded by some twenty years the original Treaty of Alliance, and, as you know, our Alliance is the oldest in the world. (*Prolonged applause.*)

In the mid-fourteenth century, and in spite of the great risks of the ocean, there was a very active trade between the two countries. Soon after was to come what is called by the Portuguese, sometimes very nostalgically, their Golden Age on the Seven Seas. Its twilight came just when the Royal and Merchant Navies were growing up during the seventeenth century.

Everybody knows of their further and brilliant development, the geographical and scientific expeditions completing and enlarging the findings of the early pioneers of the sea, the new overseas enterprises flourishing in many parts of the world, the shipshape and Bristol fashioned Merchant Navy of the East and West Indies, and, finally, the wonderful and supreme machine that would play such a great role at the crucial moment of the Napoleonic Wars—the Royal Navy. All through the nineteenth century the Royal and Merchant Navies wrote some of the best pages of the history of this country, both in peace and in war. They were the symbols and the instruments of what can be called the halcyon days of the modern era, which had Kipling as its great interpreter.

Portuguese waters—and I recall this with deep pleasure—in the various parts of the world from Europe to the Far East have never ceased to be friendly havens to the Navies of this country in good and bad days. (*Applause.*) I am happy to say that no people in the world among your many old friends has ever felt more sympathetic towards the ships flying the Red and White Ensigns than have the Portuguese people.

As though even more supreme tests had to be asked of your two Navies, both World Wars demanded of them what in the memory of man had never before been realized. After the courageous and valiant exploits of the 1914 War, in which the operations at sea still had a flavour of a classic style in many ways recalling the days of Lord Nelson, the Second World War called forth the last extremes of effort and sacrifice on the part of the two Navies.

When some weeks ago I looked at the memorial to the glory of your Merchant Navy down in the heart of the City and facing the river by the walls of the Tower, I recalled the epic of the convoys with the grey ships of the Royal Navy mounting guard. I think that there is no better symbol of the role of both Navies gallantly doing their duty.

As Ambassador of your most ancient Ally, I am pleased and honoured to join in your feelings by paying tribute here to the glory of the Royal and Merchant Navies of the British Commonwealth. (*Applause.*)

The Rt. Hon. The Viscount Cilcennin (First Lord of the Admiralty), who responded, said: I am accustomed to replying to the toast of "The Royal Navy". I am mounting my seventh year as a member of the Board of Admiralty, first as a junior Minister and then as First Lord. So I suppose the Royal Navy expects me to speak for it in reply to the toast; in fact, I imagine that it has got rather accustomed to it by now. However, perhaps those of the Royal Navy who are here to-night, accustomed as they may be to my replying on behalf of the Royal Navy, will allow me to say what an honour it is to be entrusted on this occasion with the task of replying also for the Merchant Navy. (*Applause.*) It is a great task, and I trust that Sir Gilmour Jenkins will convey my pleasure in being asked to perform it to the Minister of Transport.

The two Navies, not merely of this country but of the Commonwealth, are not so very different. They have a great affection for, and great trust in, each other, both in times of war and in times of peace. (*Applause.*)

I must say, Mr. Chairman, that I am particularly delighted that this toast was proposed by that seafaring amateur (as he called himself)—not so amateurish as you may think, as I shall tell you in a moment—His Excellency the Portuguese Ambassador. He said—I was so glad he said it, because it cannot be repeated too often—that he represents in this country at the Court of St. James our oldest Ally, that great seafaring race, the Portuguese. (*Applause.*)

What a man to represent his country! If anyone loves the sea, it is His Excellency the Portuguese Ambassador. He sails his own yacht on every possible occasion. He never misses a launching. Even when I changed Houses—in the Parliamentary sense—the other day, there he was at my new slipway for the launching of my new boat, and I much appreciated his presence.

I must confess that he very frequently extends to me a kind invitation to sail me in his yacht from Portsmouth to Lisbon through the Bay of Biscay. He always chooses either the month of December or the month of January, and, good sailor though I am, and though I have never broken down though many Admirals around me have done so—(*Laughter.*)—I am not quite sure what risks I can really take. However, if he repeats his invitation for May, June, July, August and possibly September, I might reconsider my decision. (*Laughter.*)

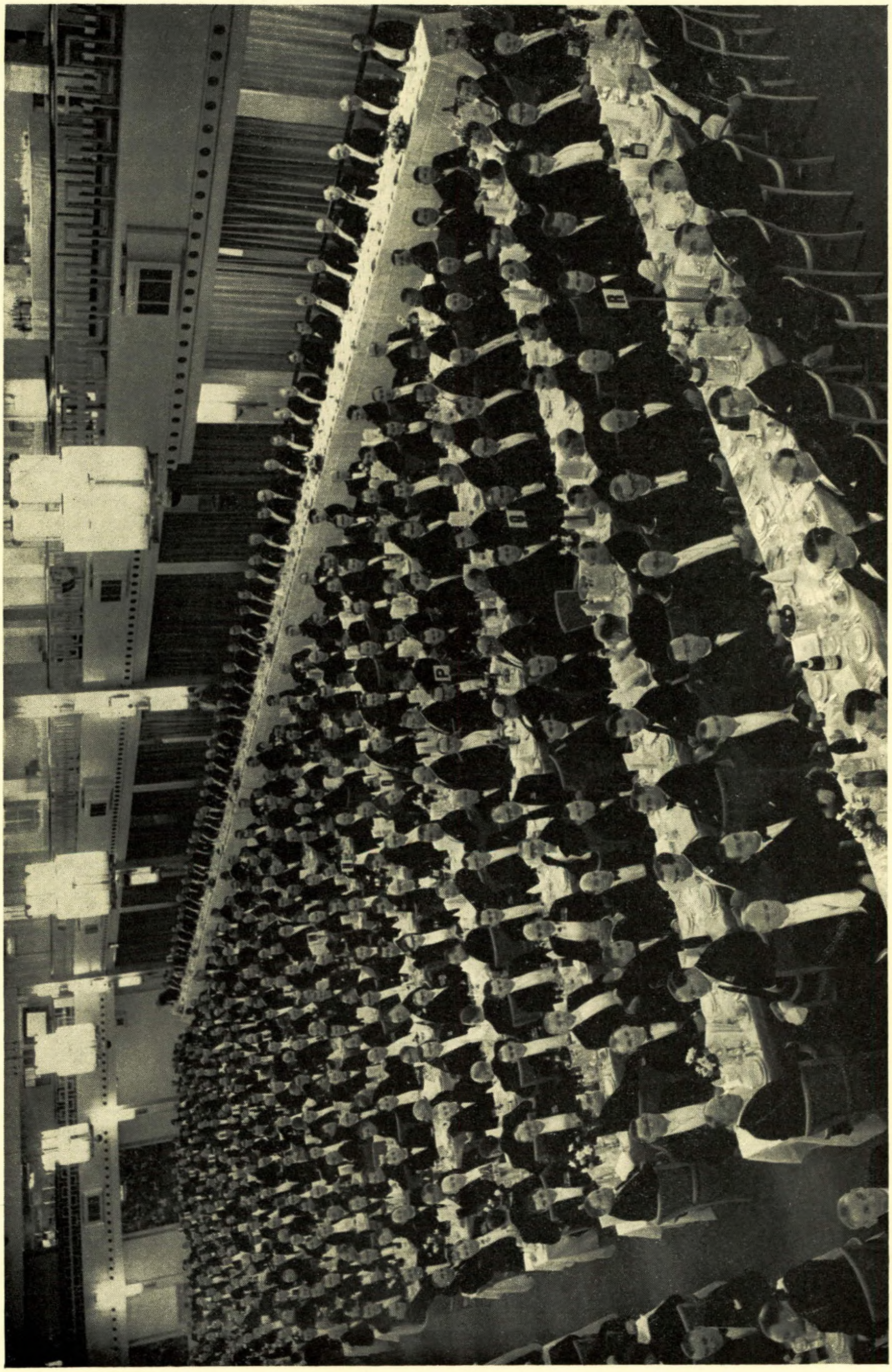
The Ambassador also takes some extremely good films which I have had the privilege of seeing on several occasions. There is one delightful one taken during a squall in the middle of the Bay of Biscay. The Ambassador left the helm—is that the right word to use?—because he is an equally good cook. Almost all his passengers, let alone his crew, were hanging over the side expecting the worst. The Ambassador is seen coming smiling from the galley carrying a frying pan containing a delicious looking but oily fish, which he probably ate himself. I think it must have finished the people who were already hanging over the rail. (*Laughter.*)

There is, of course, another link between the Portuguese Navy and the British Navy, and, I might also say, the American Navy. Rather, there was a link; I am sorry about the

The Right Honourable The Viscount Cilcennin (First Lord of the Admiralty), His Excellency Hr. Per Prebensen, G.C.V.O., C.B.E. (The Norwegian Ambassador) and His Excellency Dr. D. U. Stikker, G.B.E. (The Netherlands Ambassador)

Vice-Admiral Sir Frank Mason, K.C.B. (Engineer-in-Chief of the Fleet), Sir George Nelson, Bart. (President, Institution of Electrical Engineers), His Excellency Dr. D. U. Stikker, G.B.E., and His Excellency Senhor Pedro Theotónio Pereira (The Portuguese Ambassador)

Annual Dinner, 1956



Fifty-third Annual Dinner at Grosvenor House way in which it has been broken. For three or four years the Portuguese Minister of Marine, the American Secretary of the Navy and the First Lord of the Admiralty here had the same name of "Thomas". I sometimes thought it would be a good thing if we changed places, for I thought it would give us much wider experience, and I personally much looked forward to presiding for a short time over the Navy of our oldest Ally. Unfortunately, it never came about. In a most disloyal way I left the Thomas clan and took a new name, for which I do not think the Portuguese Ambassador has quite forgiven me!

To return to the Royal and Merchant Navies of the British Commonwealth, I would say at once that the Royal Navy runs a very fair sized Mercantile Fleet, the Royal Fleet Auxiliary Service, of which we are very proud. The Mercantile Fleet keeps closely in touch with the problems of the Royal Navy in an emergency.

Modern wars—we hope another war will never come—are not quite like eighteenth century warfare. In those days the enemy always very kindly gave us warning of trouble to come. In fact, the opposing commanders very frequently begged their rivals to fire first. Nowadays they seem to have lost that old world courtesy which our oldest Ally and we ourselves used to have. Now wars come unheralded, leaving no time for converting commercial vessels to Fleet Auxiliaries. Therefore, we run the Fleet Auxiliaries. They are attached to the Navy and they exercise with the Fleet in peace time and know exactly where they fit in. They are with us at the beginning of an emergency, and the Merchant Fleet, upon which we rely so much, then joins us and comes to our aid.

I do not propose to-night to say anything about marine engineering, partly because there is a later toast to your Institute which will be dealt with by people with far more technical knowledge than I have. However, no one who is First Lord of the Admiralty would wish to lose this opportunity on behalf of the Board of Admiralty and the Admiralty itself of praising you and all those connected with marine engineering and thanking you for all that you have done.

At the same time, one might perhaps wonder how pleased you are with the messages which you get from the Admiralty urging you to cut down the space and weight taken by your machinery for the Royal Navy. The Admiralty idea is that the machinery should be small and easily installed. That is because we are increasingly worried about, to use a most appalling word, the habitability—I suppose it means "the accommodation"—of our ships.

We have done our best with pay and pensions, but pay and pensions are not everything, and one of the first priorities on which the Board of Admiralty has to insist is the accommodation of our sailors afloat. I feel that the lack of decent accommodation is one of the main causes of the trouble from which we have been suffering, which is the failure to re-engage in the Fleet. I very often think that the Merchant Navy, judging by some of the ships that I have seen, is better off in this respect than we are, but we are doing our very best. Those in the Royal Navy know that the accommodation has to be fitted into a very small space, and they know that ships these days are smaller and that the space occupied by machinery is greater and the space for accommodation grows less. We have to put that right, and we are putting it right. Those of you who look at our new frigates or the destroyers that we have converted into anti-submarine frigates will have a good idea what the Controller of the Navy is doing in getting better accommodation for our people afloat, which I am certain is one of the most vital things for the Royal Navy and the Merchant Navy at the present time.

There is another bond in common between the Royal Navy and the Merchant Navy. Everything that we want costs far too much. This is affecting every nation. It is affecting the American nation, as I saw when I went to America a few months ago. It is affecting the nations of the Commonwealth. I think they are learning from us, but I must say that I learned a great deal from the great American Navy when I went to its Bureau of Ships—BU/Ships, as they call it—about the original planning for cutting costs.

I think that the relationship between the Royal Navy and the Merchant Navy of the Commonwealth is best summed up by saying that in war time the understanding between us is so close that we are really two arms of a single service. (*Applause.*)

We have to establish equally close contact in peace time. We have the officers and men of the Royal Naval Reserve who have done service and training in the Royal Navy. They are a tremendous link between us and the Merchant Navy. We have also the scheme with the Council of British Shipping under which young naval officers serve part of their time in merchant ships and often take passage home from foreign stations as supplementary officers in cargo ships and tankers instead of travelling as passengers in liners. We have the cadets at Dartmouth and also the sub-lieutenants from Greenwich, who have short voyages in your coasters for their holidays. We even send captains of the Royal Navy to the head offices of the shipping lines to study and learn at first hand the methods of husbandry in docks.

We try to help the Merchant Navy in return. We run courses for it to bring it up to date in convoy organization, and we teach defence against atomic attack and so on. Two thousand officers and men a year go on those two-week courses. I hope, therefore, that the Royal Navy is doing something to repay all that the Merchant Navy does for us.

So you see that both we and the Merchant Navy are doing our best to establish in peace time the tremendous link of friendship and comradeship that we have learned in war time. It is not only training and experience that the Royal Navy and the Merchant Navy share. There is, after all, the greatest bond of all, which is love of the sea. Love of the sea ran through every sentence of the speech of His Excellency when he proposed the toast. We have a common standard between us in the great ideals of the two great Services. We have learned so much from each other, and we can learn so much in the future.

That is why, Your Excellency, in thanking you for the charming way in which you proposed the toast, I should like to say that I am so grateful—because we have so much in common—that the Royal Navy and the Merchant Navy are coupled together in that toast.

Thank you, Mr. President, very much indeed on behalf of the Royal Navy and on behalf of the Merchant Navy for your hospitality, and thank you, Your Excellency, for your most excellent speech which thrilled us in coming from you as such a great lover of the sea. (*Applause.*)

Sir Ronald Garrett (Chairman, Lloyd's Register of Shipping) proposed the toast of "The Institute of Marine Engineers". He said: It is a great privilege for me to-night to propose the toast of your Institute. If speech making could ever be a pleasure to me, I would add that it is a pleasure too. (*Laughter.*)

I welcome this opportunity of paying my tribute to a body of men with whom I have been more or less in contact during all my working life and in particularly close contact in the last twelve or thirteen years when I have been directing the affairs of Lloyd's Register. In fact, one of my colleagues said to me that marine engineers might be regarded as an occupational risk attaching to the position of Chairmanship of the Register. (*Laughter.*) If that is a fair description, I am glad to say that in my case the risk has turned out extremely happily. It has brought me many friends and a great many extremely pleasant contacts with the members of your profession. (*Applause.*)

In the course of the journeys which I make round the country from time to time I have been very much struck by the diversity of jobs in which one finds marine engineers engaged. They are to be found in steelworks, power stations, hospitals, bakeries and breweries—(*Laughter.*)—and, of course, in every major engineering undertaking in the country. When I ask myself why this should be, I think the answer is that the Ministry of Transport certificate or membership of your Institute implies not merely a degree of technical knowledge, but also a degree of practical working experience in the operation of machinery. (*Applause.*) Whatever the reason, there is no doubt, I think, that the Ministry of Transport certificate is a first-class passport to any job in which a knowledge of mechanical engineering is required. (*Applause.*)

One would imagine that that would be an inducement to the young men who are adopting engineering as a career. It is surprising and disturbing to find that, in spite of it, there is a shortage of young men of the right quality entering the sea service. I wonder whether the value of the Ministry of Transport certificate is realized as fully as it might be. It is not, of course, I know, your responsibility, but I suggest that this problem of the shortage of the right type of young men for the sea is a matter to which your Institute might well devote some thought, because, after all, however diverse may be the opportunities offered to the marine engineer, fundamentally the welfare of the profession depends on British shipping and British shipbuilding.

If we look at those two industries for a moment, I do not think we have any reason at all to be complacent. If you have read the report of the Chamber of Shipping which was published only a week or two ago you will have noticed that the British Mercantile Fleet is not holding its own in the world; that is to say, the proportion which it represents of the world fleet is steadily diminishing. The reasons given for this are British taxation, foreign economic nationalism, flags of convenience, flag discrimination, and so on—all problems outside the control of the British shipowner, who has to cope with them as best he can. All we can do is to sympathize with him and wish him luck, but it is a situation which all of us whose interests are bound up with the sea must watch with concern.

As regards shipbuilding, there are also, I think, some disturbing features, and we must not allow the fact that British shipbuilding boasts of an order book which is full to bursting point to delude us into an attitude of false complacency. We have recently had, and, in fact, still have, the deplorable spectacle of a great shipyard to a large extent immobilized by a squabble between three unions as to which shall have the exclusive right to bore holes, a simple job which anyone, any competent workman, no matter to what union he belongs, and no matter whether he belongs to a union, could perform perfectly well. (*Applause.*)

Contrast that with what I have seen not long ago when going round a large continental yard. I was told that once the ship was on the fitting out berth there, only one union was involved, and the members of that union were allowed to do any job which came along provided that they were competent to do it.

Is it to be wondered at that in the face of facts like these the time from the commencement of build to the completion of a ship takes twice as long in this country as it is in Germany or Japan or Sweden and substantially longer than it is in Denmark or Holland or Italy or America?

There seems to be an alarmingly widespread attitude of mind in this country which thinks that full employment means employing the maximum number of men per job. That, of course, leads to overfull employment. Surely full employment ought to mean the minimum number of men for a job combined with the maximum number of jobs. (*Applause.*)

These are weighty matters which we must leave to those who have the misfortune to have to deal with them—(*Laughter.*)—but I make no apology for mentioning them here because they are all of very great concern to us, and whether they are solved and how they are solved is going to have a great effect on the future prosperity of your profession.

Looking at the future for a moment, it seems to me, as a layman, that there never was a time which offered greater promise of scope for the marine engineer. (*Applause.*) You have to keep abreast of multifarious advances and developments in well-established systems of propulsion, you have the problems of the gas turbine well on the way to solution, and just over the horizon you have nuclear energy. I am glad to see that your Institute, in common with other Institutes, is taking steps to keep itself informed of the development of atomic power.

To keep all your widespread membership fully informed on all these matters is going to put a very great strain on your Institute in the years to come. You have played a great and essential part in the welfare of your profession, and I hope very much that when you enter into possession of your new headquarters, as you will shortly do, that will mark the beginning of a new era of even increased prosperity and usefulness. (*Applause.*)

I have much pleasure in giving you the toast of the Institute. (*Applause.*)

The CHAIRMAN, who responded, said: I should like to thank Sir Ronald Garrett for the manner in which he has proposed the toast of the Institute, and, indeed, for a most interesting speech. (*Applause.*) It is a great pity that we did not ask the members of the T.U.C. to come here to-night and listen to it. (*Laughter.*)

There has always been a very close link between Lloyd's Register and the Institute. Many of the staff of that great society have also rendered valuable service as members and officials of our Institute. The link is further cemented in that this year Mr. Ferguson, the Chief Executive of Lloyd's Register, is Chairman of our Council. (*Applause.*)

The aim of our Institute is to promote the advance of the science of marine engineering for the benefit of our country and, in particular, our country's most important industry, shipping. We believe—surely we may do so after all that we have been told to-night—that we are contributing towards the efficiency of that industry, and we feel that what we have heard from the First Lord of the Admiralty and the presence of the President of the Chamber of Shipping and many of our leading shipowners represent an endorsement of this belief.

In the year that has elapsed since we last entertained our guests in this room the Institute has continued to grow in membership and, we believe, in stature. Our membership now approaches 10,000. (*Applause.*) This growth has taken place not only at our headquarters in London but also to a great extent at the outport sections which were started only three years ago. In the Commonwealth, too, sections are springing up. We believe that in time our name will be known and respected wherever ships call. (*Applause.*)

During the year awards have been made to members of the Institute for the best papers read during the Session. I should like to congratulate three gentlemen who are here to-night, the winner of the Denny gold medal, Mr. T. W. Bunyan; the Institute's silver medallists, Dr. J. H. Burgoyne and Professor D. M. Newitt. (*Applause.*)

On a recent trip to India I received a very friendly welcome from the members in Bombay and Calcutta. In both of those cities the newly-formed sections are working in close harmony with the engineering colleges that are sponsored by the Government of India. Together, the Institute and the Colleges are training engineer apprentices most of whom will in due course join either the Indian Navy or the Merchant Service as competent seagoing engineers.

This has been an important year in our Institute's affairs. In the early part of November we were honoured by His Royal Highness the Duke of Edinburgh who laid the foundation stone of our new headquarters in the City. (*Applause.*)

The year also brought a great loss. Our Honorary Treasurer, Alfred Robertson, who was the driving force behind the project for the memorial building, died during the year and was thus deprived of the opportunity of witnessing the fulfilment of his dreams.

The building, which is to be our memorial to the marine engineers, some 4,000 in number, who gave their lives in the last war, is now under construction, and we have every hope that we shall see it completed by the autumn of 1957. (*Applause.*)

We are fortunate in having among our distinguished guests tonight His Excellency The Norwegian Ambassador and His Excellency The Netherlands Ambassador. (*Applause.*) We are always delighted to have Their Excellencies with us, not merely because the great maritime nations which they represent were our staunch Allies during the war but because we have come to regard them as friends of our Institute. (*Applause.*)

I should particularly like to thank His Excellency The Portuguese Ambassador for honouring us with his presence and for proposing so charmingly the toast of the Royal and Merchant Navies of the British Commonwealth. (*Applause.*)

We are indebted also to the First Lord of the Admiralty for joining us and for replying to the toast proposed by His Excellency. (*Applause.*)

I retire in a few weeks' time after serving two years as President. I should like to take this opportunity of offering my thanks to the Chairman of Council, the members and the Secretary for their courtesy and kindness to me during this interesting period. (*Applause.*)

Might I say to all you gentlemen that we, the Institute, are delighted to have you with us tonight as our guests, and we hope that you have enjoyed your evening. (*Applause.*)

The proceedings then terminated.

INSTITUTE ACTIVITIES

Minutes of Proceedings of the Ordinary Meeting Held at the Institute on Tuesday, 13th December 1955

An Ordinary Meeting was held at the Institute on Tuesday, 13th December 1955, at 5.30 p.m., when a paper by J. Wormald, B.Sc.(Eng.), M.I.N.A. (Member), entitled "The Carriage of Edible Oil and Similar Bulk Cargoes" was presented and discussed. Mr. W. J. Ferguson, M.Eng. (Chairman of Council) was in the Chair. Seventy members and visitors were present and ten speakers took part in the discussion.

A vote of thanks to the author was proposed by the Chairman and awarded by acclamation. The meeting ended at 7.50 p.m.

Section Meetings

Kingston upon Hull and East Midlands

A meeting of the Kingston upon Hull Section was held on Thursday, 22nd March 1956, at 7.30 p.m., at the Metropole Hotel, Leeds, when Mr. R. K. Craig re-presented his paper entitled "Passenger Liner with Engines Aft". Forty-one members and friends attended and a very full discussion followed the lecture. Mr. W. J. L. Foreman (Member) proposed a vote of thanks to the author which was seconded by Mr. C. Breckon (Member) and accorded by acclamation.

Northern Ireland Panel

The inaugural meeting of the Northern Ireland Panel was held on Monday, 13th February 1956, at 7.30 p.m., at the College of Technology, Belfast. Mr. C. C. Pounder (Vice-President) was in the Chair and there were about 250 members and others present.

Mr. A. G. Arnold (Member) presented his paper entitled "Some Experiences in Vessels Equipped with Two-stroke Cycle Harland and Wolff Opposed Piston Diesel Engines Using Boiler Oil" and an interesting discussion followed. A vote of thanks to the author was proposed by Mr. W. McAdam, seconded by Mr. J. W. Bell and accorded by acclamation.

Scottish

Second Annual Dinner

The second annual dinner was held at the Central Hotel, Glasgow, on Tuesday, 31st January 1956. Regrettably, the President, Mr. H. A. J. Silley, was unavoidably absent, but he was represented by Mr. W. J. Ferguson, M.Eng. (Chairman of Council). Mr. J. Stuart Robinson (Secretary) was also present.

There were 292 members and guests present and Mr. D. W. Low, O.B.E. (Chairman of the Section) presided. After the Royal Toast, Sir A. Murray Stephen, M.C., B.A. (Past President) proposed the toast to the Institute of Marine Engineers and the Scottish Section, which was replied to by Sir William Wallace, C.B.E., Vice-President for Leith. The toast to the City of Glasgow was proposed by Mr. Ferguson and replied to by The Lord Provost of Glasgow, Andrew Hood, Esq., F.E.I.S., J.P. Mr. Ewen H. Smith (Vice-President for Glasgow) proposed the toast to "Our Guests", among whom were many prominent representatives of activities connected with marine engineering. The reply was given by Professor A. S. T. Thomson, D.Sc., Ph.D., of the Royal Technical College.

This first formal occasion was thoroughly enjoyed by all.

Annual General Meeting

The Annual General Meeting was held on Wednesday, 8th February 1956, at the Institution of Engineers and Shipbuilders, Glasgow. Mr. D. W. Low, O.B.E. (Chairman) presided and eighty members were present.

When the formal business was concluded, visitors were admitted to the meeting, bringing the attendance up to 104.

A lecture on "Some Experiences in Vessels Equipped with Two-stroke Harland and Wolff Opposed Piston Diesel Engines Using Boiler Oil", was given by Mr. A. G. Arnold (Member) and enthusiastically received. The discussion was limited to five speakers and the appreciation of all was aptly expressed by Mr. G. J. Thomas who proposed the vote of thanks.

This lecture was repeated at Queen's College, Dundee on the following evening at a joint meeting with the Dundee Institute of Engineers and about thirty-three members and guests were present. The Scottish Section was welcomed by Dr. Hall, President of the Dundee Institute, and the meeting was conducted by Mr. D. W. Low. Appreciation to Mr. Arnold for his excellent paper was heartily accorded on a vote of thanks proposed by Dr. Hall.

February Meeting

A joint meeting with the Aberdeen Mechanical Society was held at Robert Gordon's Technical College, Aberdeen, on Friday, 24th February 1956.

This occasion marked the extension of the Section's activities to northern districts and members of the Institute were welcomed by Mr. Whittaker, President of the local Society. Capt. N. J. H. D'Arcy, R.N.(ret.) (Chairman of the Scottish Section) presided and Mr. C. Timms delivered an interesting lecture on "Control of the Accuracy of Marine Gears" to the forty-five members and guests present.

Twelve members took part in the discussion and a vote of thanks was heartily accorded to Mr. Timms on the proposal of Dr. A. C. West, Local Vice-President of the Institute for Aberdeen. The meeting closed with a word of appreciation to the Scottish Section by Mr. Whittaker.

Annual Meeting in Edinburgh

The Annual Meeting of the Section held in Edinburgh took place at the Grosvenor Hotel on Wednesday, 14th March 1956. Mr. W. Young (Member of Committee) presided in the absence on business of the Chairman, Capt. N. J. H. D'Arcy, R.N.(ret.).

Mr. H. G. Findlay gave a very instructive lecture on marine electrical installations, illustrated by slides, to an audience of about eighty-five, and this was well received. A vote of thanks was accorded to Mr. Findlay on the proposal of Mr. A. W. Oxford. An informal dinner preceded the meeting and was attended by fifty-one members and guests.

In the afternoon a visit to Portobello Power Station was made by some eighty members and friends and this was greatly appreciated.

South Wales

Visit to the Auris

Some forty members visited this vessel on Wednesday, 15th February 1956, at Barry where she was carrying out fuel tests on the gas turbine installed in place of one of the Diesel sets with which she was originally provided.

The visit was arranged by Mr. R. H. Rees, O.B.E. (Member) and permission for the visit was given by Mr. John Lamb, O.B.E. (Member). The Section was most grateful to Mr. Lamb for making this visit possible and to Mr. Rees for carrying out all the arrangements.

The visiting party was augmented by visitors from Bristol Aero Engines, Ltd., in the persons of Mr. B. G. Marcham, Mr. R. Hunter and Mr. P. W. Griffin, and these distinguished engineers were very welcome.

The party was met on board by Messrs. R. M. Duggan, B.Sc., B.A. (Associate Member) and M. P. Holdsworth, M.Eng. (Associate Member), the two staff chief engineers in charge of the machinery, and was indebted to these gentlemen for the most concise explanatory talk with which they preceded the conducted tour around the engine room, where the turbine set was working throughout the visit.

Visit to the Auris

At the conclusion of the visit, the party was entertained to tea at the Barry Hotel by Mr. Rees on behalf of the owners of the *Auris,* and a most enjoyable and instructive session was rounded off in a very pleasant and friendly manner. Mr. J. Wormald (Section Vice-Chairman) suitably expressed the Section's gratitude to the owners and acknowledgement was made by Mr. Rees.

Junior Section

Falmouth

In connexion with the Junior Lecture programme, a film evening was arranged by Mr. C. Moffatt (Local Vice-President) at the Falmouth Technical Institute on 21st March 1956 for an appreciative audience of about one hundred students and members. An interesting and instructive series of sound films was shown, ranging from "The A.B.C. of Oil" to "Diesel Engines and Tanker Building".

Thanks were expressed to the Principal and Governors of the College as well as to the Petroleum Films Bureau and to Mr. Moffatt; a senior student proposed a vote of thanks to the Council of the Institute of Marine Engineers and this was carried with acclamation.

Election of Members

Elected on 6th February 1956

MEMBERS

William Atkinson Adam
John W. Atwell, M.Sc.
Robert Wilkie Cundale Bainbridge
Robert Fredrick Charlton Baldrey
Robert William Brown
Richard Chard, M.B.E.
George Henry Davis
John Charles Dua
Robert Grey, Lieut., R.N.
Helge Elof Eugen Hagelin
David C. Hagen
Henry George Isaacs, Lieut., R.N.
Frederic Clarence Jenks
Harold Craig Kelly, Instr. Captain, B.Sc. (Hons.), R.N. (ret.)
Thomas Lewis
George William Lochead
Frans Loos
Noel John Bray McDougall
John William McGuire
Colin Donald McLachlan, B.Sc. (Glasgow)
Archibald McLean
Edward Keith McQuarrie
Peter Marsh
Norman Alastair Matheson
Frederick Charles Pollard
Louis Proost
Frederick Charles Salter
Edward William Sexton, Lieut., R.N.
George Almond Short
Robert Sinnott
Thomas William Spurr
Richard John Sutton, Cdr., R.N.
John George Thornton
Francis Robert Topping, B.Sc.(Eng.) (Glasgow)
Edward Rupert Tyndale-Biscoe, Cdr.(E), R.N.(ret.)
Charles Ernest Wall
John Deick Wallace
Leslie Vernon Wilson
Adrian Albert Wynands

ASSOCIATE MEMBERS

Patrick Raymond Aldridge, B.Sc.
Andrew Bell, B.Sc. (Mech. Eng.) (Glasgow)
Henry Gordon Bell
John Vincent Bigg, M.A. (Cantab.)
Oswald Bogaert
John Wilson Brown
Ernest Samuel Richard Burker
James Thomas Carmichael
Hugh Paterson Cockburn
Dennis Henry Corder Coward
Colin Stewart Curtis
Peter Michael Fitzpatrick
Jack Arnold Green
Guy Griffiths
Dennis Reginald Hall
Marlyn Paley Hammet
Henry Heckford Hellam
Henry Hickland
John Hockaday
Patrick Joseph Marie Hopkins
Philip Frederic Caron Horne, B.Sc.
Albert Edward Kendall
Francis McAlees
Donald Maiden
William Albert Mason
Ronald William Melvin
Clifford Ernest Morley
Arthur Ross Morton
Peter Malcolm Newman
Gerald Leonard Nicolich
Denis Antony Outlaw
Ponodath Cherian Paulose, Lieut.(E), I.N.
Eric William Ralph

Marshall Robinson
Edmund Whitby Rodrigues
Peter Geoffrey Sarll, B.Sc.(Eng.) (London)
Gerald Scott
Bernard Frank Simms
Roy Charles Sunderland
Alexander Peter Vacca, M.A. (Cantab.)
Edward Hugh Ward
David Warren
John Frederick Weld
Leslie William George Wigg
Peter James Ternouth Woods, Lt.-Cdr., R.N.
Robert Yarr

COMPANION
Ronald Michael Thwaites, M.A.

ASSOCIATES
Sidney Rushforth Bew
Edgar Ventura Guimaraes
Charles Norman Ingram
Satish Chandra Majumder
Antony Stuart Melville-Ross, D.S.C.
U. Kyi Nyun
Eric Joseph Ostle
George Drysdale Paterson
Leslie James Woods

GRADUATES
Edward Douglas Arnot
William Anderson Barclay
Victor James Bentall
Ronald Blundell
Charles Borg
James William Bryden
Joseph Whitfield Collins
Gordon Fisher
William Alfred Froom
Brian James Goodman
Alfred Humble
Syed Sayeed Hyder Husain
Ian James McKelvie
Kenneth William MacLean
Surendra Mohan Misra, Sub. Lieut.(E), I.N.
Frank Henry Muller
Richard Pepperell Pitt
Cecil Scott
Gordon Bruce Scutcher
Edward Wilson Smith
David Gordon Hamilton Strahan
Robert Tatz
James Nelson Yardley

STUDENTS
Martin Redfern Hankey
James Andrew McCann
Norbert Joseph Masson
Maneck Pirojshaw Motawara
Michael John Payne

PROBATIONER STUDENTS
David Thomas Bindoff
George Ernest Craggs
Terence James Gooding
Robert Horner
Michael Anthony Mitchell
Arthur Terence Tuffee
David William Woodcraft

TRANSFER FROM ASSOCIATE MEMBER TO MEMBER
Joseph Francis Tucker, B.Sc. (Glasgow)

TRANSFER FROM ASSOCIATE TO MEMBER
Ernest Samuel Clews
James Henry Fownes Edmiston
John Alfred Lightburn
Archibald Dick Little

TRANSFER FROM ASSOCIATE TO ASSOCIATE MEMBER
Harry Alexander Andrews
John Beck
Donald Cameron
Sib Prasad Chakraverty
John Dennis Christopher
Robert Climie Cree
Maurice Stanley James
Robert Christopher Lapping
Andrew Burt Robb
John Wilson Young

TRANSFER FROM GRADUATE TO ASSOCIATE MEMBER
Neil Welbourn Jephcott
Stanley Cooper Machin
Gian Chand Sahni

TRANSFER FROM STUDENT TO ASSOCIATE MEMBER
Michael Curtis Eames, B.Sc.

TRANSFER FROM STUDENT TO GRADUATE
Mahendra Arora
Roy Sheppard

TRANSFER FROM PROBATIONER STUDENT TO STUDENT
Gerald David Ashley
Derek Franklyn Betts
Brian Sidney Brown
Keith Ledingham Collins
Leonard Elves
John Harrison
Gerrard Allan Hart
James Wilson John Hewitt
Ian Herbert Livingstone
Geoffrey Frank Mills
Richard George Tyrer

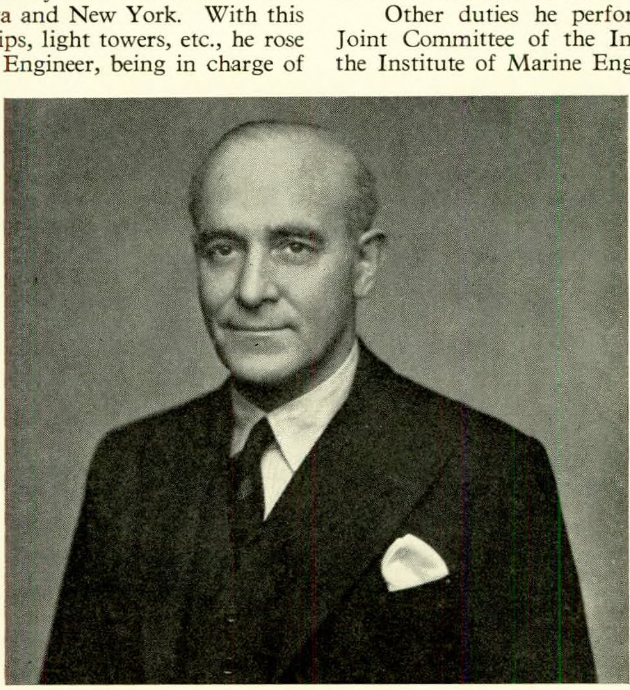
OBITUARY

Robert Rainie, M.C.

Appreciation by a Colleague

Robert Rainie was born at Newtown-on-Ayr in 1884, the son of the Minister of that Parish. Educated at Ayr Academy and the Royal Technical College, Glasgow, in 1901 he commenced his apprenticeship in the engine works and drawing office of Sir William Arrol and Co., Ltd., Glasgow, and was afterwards employed by them as draughtsman and assistant engineer.

From 1908 until 1914, apart from commercial training with John Carlisle and Co., Ltd., shipbrokers and underwriters of St. Mary Axe, he was mainly overseas, gaining experience in India, Egypt, the Sudan, and latterly with The International Marine Signal Company of Ottawa and New York. With this firm, which specialized in light ships, light towers, etc., he rose to the position of Assistant Chief Engineer, being in charge of contracts in Bermuda, the West Indies and Brazil. In 1914 he became London Representative of the Glengarnock Iron and Steel Company, but very shortly afterwards, on the outbreak of war, joined the Army.



He was commissioned in the Royal Scots Fusiliers, and served in the field with that regiment and as a staff officer, being wounded, mentioned in despatches and awarded the Military Cross.

On the establishment by Harland and Wolff, Limited, of their London Works Organization in 1921, he was appointed Assistant Manager, and became Manager in 1925, which position he held until his retirement at the end of 1953. During that period, in addition to the shiprepairing and dock maintenance work of this branch of the firm, he was responsible for developing its various other activities in London, including general and structural engineering, small craft building, foundry work and electrical installations.

In 1924 Robert Rainie was elected a Member of the Institute, and after service on the Council was appointed Chairman of Council for the two consecutive years 1937 and 1938, afterwards becoming a Vice-President. He will be long remembered for his work in promoting the status of the marine engineer as Institute representative from 1938-43 on the Engineering Joint Council, and in connexion with the granting of the Royal Charter. He served for periods with the Finance, House and Social Events Committees between 1933 and his resignation as a Vice-President in 1943. He was also elected a Member of the Institution of Mechanical Engineers in 1925.

He represented his firm on the River Thames Drydock Proprietors' and Shiprepairers' Association from 1926 until shortly before his retirement, serving as Vice-Chairman for eleven years and as Chairman for over five years. He served on the Conference and Works Board and the Central Board of the Shipbuilding Employers' Federation and on the Committee of the Dry Dock Owners' and Repairers' Central Council of the Shiprepairing Industry. He also represented that industry on the London and South-Eastern Regional Council of the Federation of British Industries.

Other duties he performed included membership of the Joint Committee of the Institution of Naval Architects and the Institute of Marine Engineers, and the Engineering Public Relations Committee, while during the last war he served as Liaison Officer for the Thames Area to the Admiralty and Director for Merchant Ship Repair, and Chairman of the Naval Architecture and Marine Engineering Committee of the Central Register, Ministry of Labour.

An early member of the L.D.V., he was appointed Second-in-Command of the 6th City of London (Silvertown) Battalion of the Home Guard with the rank of Major, and later commanded the 6th C.O.L. (Silvertown) Garrison Battalion until the Home Guard stood down.

In his early days Robert Rainie was a keen Rugby player and was selected to play in the Scottish Trials, and he maintained his interest in the game, belonging to several clubs; in his own words he also enjoyed "playing at golf". He was a Past President of the London Ayrshire Society, a Vice-President of the London Ayr Academy Club and a Member of the London Society of Sons of the Scottish Manse.

Robert Rainie died at Hove on 19th February 1956.

Such are some details of a very full life. But what of the man, Robert Rainie himself, of whose personality all these activities were but the outward and visible signs? In a few words, he possessed unusual powers of leadership, a strong sense of loyalty, together with a genius for friendship and the understanding of his fellow men.

As a leader he was a man of his word, forthright and on occasions plain spoken, but prepared to listen to other points of view and to give reasons for his decisions. For these decisions he took full responsibility, as well as for those of his subordinates, who rewarded him with a full measure of loyalty and respect and felt that they belonged to "a happy ship". In discussion or negotiation, whether with representatives of clients or of workpeople, his keen and logical outlook, which outlined both the problem and the solution, was often tempered by a kindly humour or a witty aside which carried his hearers with him, persuading the doubtful or disarming the difficult; many an awkward situation was overcome by this characteristic.

In this respect the very words which he himself wrote for the Institute's TRANSACTIONS on the death of his lifelong friend, Arthur Crighton, some eighteen months before his own are equally applicable to Robert Rainie: —

"Eminently able to look at both sides of a question, but seldom in doubt as to where the right lay—with a gift of leading those who differed from him to his own point of view—he fitted easily into his position and carried out his duties adroitly and wisely, developing cordial relationships with those with whom he had to deal".

Both in the business and social sphere he leaves a host of friends who mourn his passing and regret the short time allowed him to enjoy a well-earned retirement. They will remember him not only for his pleasant companionship, his happy home life, his rarely surpassed powers as an after-dinner speaker, or, in smaller circles, as a raconteur, but chiefly, with affection, for his sterling qualities as a man.

JAMES ANDREW RHYNAS

Appreciation by Mr. G. R. CHAPPEL, Wh.Ex. (Member of Council)

It is with great regret that we record the death of Mr. J. A. Rhynas on the 26th February 1956, at the age of sixty-six.

Mr. Rhynas spent the whole of his working career in marine engineering, serving his apprenticeship with John Readhead and Sons, Ltd., South Shields, and subsequently serving at sea where he attained the rank of chief engineer at an early age, before coming ashore as a Surveyor to Lloyd's Register of Shipping in the United States.

He took up employment with the Furness Prince Line on the inauguration of their Bermuda Service in 1916, and was eventually appointed as a Superintendent Engineer with the Prince Line in London, which appointment he held until his retirement at the end of 1953.

During the second World War his services were seconded to the Ministry of Transport; he was in charge of the repairing, staffing and storing of all vessels engaged in the Normandy operations sailing from the Royal Docks in London during the major part of 1944.

Mr. Rhynas was a very active member of the Institute, having served on the Council for several periods from 1939, being Chairman of Council in 1947. Until his death he also served on the Advisory Committee of Superintendent Engineers, the Marine Engineers' National War Memorial and the Social Events Committee.

In his younger days, he was a keen tennis player; in recent years much of his leisure time was devoted to golf and he participated regularly in the Golfing Meetings organized by the Institute.

He leaves a widow to whom our sincere sympathy is extended.

THOMAS WILLIAM BENSON (Member 6148), who had been senior assistant superintendent engineer at Southampton of the Cunard Steamship Company since 1948, died recently at the age of fifty-eight. He served an apprenticeship from 1914/18 with F. W. Rowlands and Company, Wallasey, and then went to sea. He joined the Cunard Company as a junior engineer in 1924; after serving in various ships of the fleet, including the *Aquitania,* he was inspecting engineer for the building of the *Queen Mary* and the present *Mauretania* and served in both ships. In 1941 he went to Sydney as assistant superintendent engineer, returning later to Liverpool, and in 1946 transferred to Southampton in the same capacity.

He had been a Member of the Institute since 1929.

MACKENZIE DRYSDALE (Member 8330) was born in 1892. He served an apprenticeship with J. W. Drysdale and Company of Gravesend from 1908-13 and continued with the firm until 1915 when he was sent to France on war service and was engaged on bridge building and engineering in general until 1919. On his return home he was appointed manager of the company, continuing in this work until his death after a short illness on 12th December 1955. He had been elected an Associate of the Institute in 1936, being transferred to full Membership in 1937.

IAN MUNRO FRASER (Member 9077) was born in 1903. He was educated at Grangemouth High School and Allan Glen's School, Glasgow, and then served an apprenticeship with the Grangemouth Dockyard Company from 1921/26. For the next eight years he gained experience as a seagoing engineer in both steam and motor ships, obtaining a First Class Steam Certificate with Motor Endorsement. From 1935/38 he was in charge of machinery repairs on steam and Diesel merchant ships and tankers with the Grangemouth Dockyard Company and in 1939 joined the engineering staff of the Singapore Cold Storage Co., Ltd., where his duties included the supervision of ice factories, meat and fish stores, milk and ice cream factories and maintenance of the various buildings and houses owned by the company. Mr. Fraser was interned by the Japanese during the occupation of Singapore, from

1942/45, but returned to Malaya in 1946 as Area Engineer for a district covering about half of the Malayan Peninsula. He returned to Scotland in 1951 as estimator with the Miller Insulation and Engineering Company, Glasgow, in connexion with heat and cold insulation for land installations. In October 1955 he joined Richard Thomas and Baldwins, Ltd., Ebbw Vale, as inspector of cranes and slings, safety engineering section, but died on 27th February 1956.

Mr. Fraser had been a Member of the Institute since 1940.

James Henderson Grieve (Member 7840) died in the Northern Hospital, Dunfermline, on 24th November 1955, aged seventy-five. He served an apprenticeship from 1894-99 with Hay and Robertson, Ltd., textile manufacturers, and then worked for the Fairfield Engineering Company, Glasgow, where he gained marine engineering experience. During his years at sea from 1900/14 he obtained a First Class Board of Trade Certificate and, as chief engineer with Messrs. Jones and Company of Cardiff, voyaged several times round the world. From 1915/21 he was employed as chief engineer by a jute manufacturing company in Calcutta and returned to Dunfermline in 1922 to serve as consulting engineer to Hay and Robertson, Ltd. In 1933 Mr. Grieve took over the long-established engineering business of Robert Hutchison, of 136, Chalmers Street, Dunfermline, which was founded in 1869, and served a number of firms as consulting engineer.

He had been a Member of the Institute since 1935.

Edmund Hugh Hair (Member 12461) was born in 1895. His apprenticeship was served with D. and W. Henderson, Ltd., Glasgow; from 1919-46 he was a seagoing engineer with Messrs. Alfred Holt and Company (for ten years as chief engineer). He obtained a First Class Board of Trade Steam Certificate in 1925 and a Motor Endorsement in 1934. In 1946 he was appointed assistant resident engineer for the Tyne area but after three years he returned to sea as chief engineer with John I. Jacobs and Co., Ltd., sailing regularly for them until 1954 when illness obliged him to retire. Mr. Hair was awarded the O.B.E. He was elected a Member of the Institute in 1949.

Herbert Saunderson Jones (Member 10616) was born in 1901. He served an apprenticeship with Cammell Laird and Co., Ltd., Birkenhead, from 1917/22 and then spent a year in the same firm as junior draughtsman. From 1923/32 he was a seagoing engineer with the Blue Funnel Line, obtaining a First Class Board of Trade Certificate in 1930. He came ashore in 1934 and for the next five years was wayleave officer in the estate department of the North Wales Power Company. On the outbreak of war he volunteered for the Merchant Navy Officers' Reserve and was appointed second engineer of the *Wendover,* a ship owned by Watts, Watts and Co., Ltd.; in July 1940 the ship was torpedoed and there was a heavy loss of life. Mr. Jones was severely wounded and spent the remainder of the war in German prisoner-of-war camps. He was discharged from the Merchant Navy in 1945 and was appointed land drainage and water supplies officer of Denbigh A.E.C. in the Ruthin area, being transferred later to Llangollen and finally to Wrexham. He died on 29th August 1955.

For many years Mr. Jones represented Wales in the Institution of Professional Civil Servants. He had been a Member of the Institute since 1946.

Brian Macdermott Lillie (Member 5333) served an apprenticeship with the Taikoo Dockyard and Engineering Company of Hongkong from 1913-18 and then spent six years at sea in the service of John Swire and Son, the Canadian Pacific Ocean Services, the Canadian Government Merchant Marine, and the Anglo-Saxon Petroleum Co., Ltd., obtaining a First Class Board of Trade Certificate. From 1925/40 he sailed with the White Empress Lines. In 1940 he was commissioned as engineer officer in the Royal Canadian Navy and served in this capacity until 1947, when he was promoted lieutenant commander and transferred to the R.C.N. Reserve. During this period he was for a time in charge of construction of new R.C.N. frigates, being responsible for machinery, trials and records. From 1947/51 he was a marine engineer with the Canadian Pacific Railway, serving in British Columbia coast steamships. In 1951 he was recalled to the Royal Canadian Navy and appointed project officer to the manager of the engineering department of H.M.C. Dockyard, Esquimalt, B.C.

Lieut.-Cdr. Lillie was in his sixtieth year at the time of his death on 1st December 1955; he had completed his normal duties on that day but felt unwell during the evening and died of a heart attack on the way to hospital. He was buried with full military honours at Royal Oak Burial Ground, Victoria, B.C.

Lieut.-Cdr. Lillie had been a Member of the Institute since 1925 and during his period of service with the H.M.C. Dockyard at Esquimalt he had taken an active part in the Institute work, being the means of introducing a considerable number of new members.

Alexander Clark Macneill (Associate Member 7707) was born in Glasgow in 1890. He served an apprenticeship with Barclay, Curle and Co., Ltd., from 1906-11, and then continued to work as a draughtsman for the same company, being promoted leading marine engine draughtsman in 1919 and chief draughtsman in 1934. He occupied this position until 1949 when he became assistant engineering manager, the appointment he held at the time of his death, 4th January 1956, only a few months before he would have completed fifty years continuous service with Barclay, Curle and Co., Ltd. From 1915/34 Mr. Macneill taught engineering drawing in Paisley Technical College to evening class students.

He was elected an Associate of the Institute in 1934 and transferred to the grade of Associate Member in 1935.

Charles Edward Roffey (Member 1637) served an apprenticeship with Cochran and Company and Laird Brothers of Birkenhead and then went to sea for four years, obtaining a Board of Trade Certificate of Competency, serving with the Blue Funnel Line and in vessels trading between South America and the Gulf of Mexico. In 1897 he came ashore as a consultant, settling in Dublin, where he started a business as ship and cargo surveyor on his own account. He served many of the foreign classification societies and underwriters through the Salvage Association of London. He died on 6th January 1956, aged eighty-five years.

Mr. Roffey was a Fellow and founder member of the Society of Consulting Marine Engineers and Ship Surveyors and a Member of the Institution of Naval Architects. He was elected to Membership of the Institute in 1902.

James Ernest Steele (Member 3648) served an apprenticeship with J. S. Hume and Company, Glasgow, and the Fairfield Shipbuilding and Engineering Co., Ltd., Govan. For seven years he sailed with the Den Line and the United Fruit Company, obtaining a First Class Board of Trade Certificate of Competency. In 1919 he was engaged as an engineer surveyor by the British Corporation Registry, continuing this service later with Lloyd's Register of Shipping. He retired in June 1953 and died on 14th January 1956, aged seventy-two years. Mr. Steele was elected to Membership of the Institute in 1919.

William Tennant (Companion 7948) died on 20th January 1956, aged sixty-six, after a long illness. He joined Wailes Dove Bitumastic, Ltd., in a junior position, in 1903, was transferred to their London office from Newcastle on Tyne in 1910 and from 1919/34 he was their assistant manager, being promoted manager in 1935. In 1944 he was appointed to a seat on the board of the company. Mr. Tennant had been a Companion of the Institute since 1935; he was also an Associate of the Institution of Naval Architects.