A CONSIDERATION OF TWO FOUR-MASTED BARQUES.

The two sailing ships under consideration in this paper are the four-masted barques HERZOGIN CECILIE and POMMERN. Both were built after the turn of the century, the former by Rickmers Act Ges in Geestemunde in 1902, and the latter by John Reid & Co., in Glasgow in 1903. The HERZOGIN CECILIE as one of the Fleet Cargo-cum-Cadet ships of the Nord Deutscher Lloyd Co. of Bremen, and the POMMERN as the MNEME(named for Mnemosene the Muse of Memory) for B. Wencke Sohne of Hamburg. In 1906 Wencke's sold the MNEME to the Herr Ferdinand Laeisz' 'Flying P' Line also of Hamburg. Laeisz renamed his new acquisition POMMERN(from Mecklemburg Vor. Pommern in the north of Germany). So the two ships had something in common as the CECILIE was named for the Herzogin Cecilie von Mecklenburg. "Herzogin' is German for 'Duchess'. The young Duchess was 18 years old when she officiated at the launching of the ship named for her. She later married Kronprinz Wilhelm and thus became Kronprinzessan Cecilie. Later still two N.D.L. trans-Atlantic liners bore both their names.

Both ships served with distinction until the Great War. The CECILIE in general trade and the POMMERN in the West Coast of South America nitrate trade. The beginning of that war found them both arriving in South American West Coast ports. There they stayed for six long years. During all those six years there were 89 German vessels laid up in the South American nitrate ports.

After the war all these German ships were loaded and sailed home. All German tonnage over 1600 tons was allotted under the Versailles Treaty to the Allies. The POMMERN discharged in Delfzil and was allotted to the Greek Government and the HERZOGIN CECILIE discharged in Ostend and was allotted to the French. From this point both ships were finally bought by Captain Gustaf Erikson of Mariehamn in the Aaland Islands. (the Aaland Islands comprise the Finnish Archipelago and although Finnish the language is Swedish and the Aalanders have autonomous government).

Both ships were finally employed by Erikson in the South Australian grain trade. The HERZOGIN CECILIE being tragically wrecked under Bolt Head, Devon, in 1936. On the other hand the POMMERN loaded grain in Port Victoria, Spencer Gulf in 1939, which cargo she discharged in Hull then sailed

home to Mariehamn to lay up and refit before once more sailing out to South Australia. Before she reached her home port the Second World War had begun. Now in 1994 she is still there.

Captain Gustaf Erikson died in 1947 directorship of the company being then in the hands of his son Edgar Erikson and his daughter Mrs. Eva Hohenthal. In 1953 the brother and sister handed the ownership of the POMMERN to the town of Mariehamn to be preserved as a museum ship. In this capacity the POMMERN is part of the Aaland Maritime Museum as the Museifartyget Pommern. The barque's present Intendant is Mr. Jyrki Abrahamsson.

In the closing stages of the commercial deep-water square-rigged sailing vessel as a profitable enterprise, the four-masted barque was most predominant. Vessels with a cargo capacity ranging between 4000 and 5000 tons were the most popular with owners.

All in all there was a total of 446 four masted square-riggers built between the years 1877 and 1926. The greatest proportion of these were built in British shipyards with a total of 362, which is 81%. The French shipyards built 31, the German 19, American 14 and the Italian 7. Other nations were Holland 2, Canada 2, Japan 3, and Denmark 1. The three Japanese barques were straight out training ships and carried no cargo. Three of the American and two of the Canadian built four-masters were entirely wood built. The largest of these, the ROANOKE could lift a cargo in excess of 5000 tons. The other two American ships were the SHENNANDOAH and the SUSQUEHANA, like the ROANOKE they were all built by Arthur Sewall & Co., of Bath, Maine. The two Canadian built barques were the KINGS COUNTY and the JOHN M. BLAIKIE.[1]

British ship owners began disposing of their sailing ship tonnage just after the turn of the century. The last four-masted barque built in Britain for British owners was launched from the Greenock yard of Scott Shipbuilding & Engineering in 1905 for the Glasgow firm of J. Hardie & Co. This was the ARCHIBALD RUSSELL. She was built from the same scrieve board as the NIVELLE and HOUGOMONT which had been built eight years previously also for Hardies. This firm began disposing of their sailing ship tonnage just after the First World War. Both the HOUGOMONT and ARCHIBALD RUSSELL were snapped up by Gustaf Erikson. Hardies then ceased to operate, being the last Glasgow firm to operate deep-water square-riggers.

The Erikson firm obtained all of its fleet in this manner and by the 1930's their house flag was flying from the main truck of twenty or so deep-water men. Their main source of income was in the South Australian Grain Trade out of Spencer Gulf and the Gulf of St. Vincent.

The author's first interest in these ships came in 1932 when the Erikson barque HOUGOMONT, under the command of Captain Ragnar Lindholm, arrived in Semaphore Anchorage, Largs Bay, after being badly dismasted in the Great Southern Ocean. Captain Lindholm had brought his disabled barque 700 miles under a very meagre jury rig unaided, a magnificent piece of seamanship. The barque came to anchor approximately 600 yards WNW of the seaward end of the Largs Bay jetty. There she remained for seven months.

In December of that year she was joined by the Flag Ship of the Erikson Line, the four-masted barque HERZOGIN CECILIE. The two ships lay lashed together in the anchorage for over a month while useful equipment from the HOUGOMONT was stripped from her and loaded aboard the CECILIE. The HOUGOMONT was then towed to Stenhouse Bay, a small gypsum loading port on the southern tip of Yorke Peninsula, and there sunk on the western side and parallel to the jetty to form a breakwater.

The CECILIE was a magnificent vessel indeed with a cellular double bottom with a capacity for 650 tons of water ballast. Another rare feature for a sailing ship was her holds were subdivided by seven transverse bulkheads. Two of these bulkheads, just eight feet apart(four frame spaces) separated Nos. 2 and 3 holds. Between the tank top and the tween deck this space was divided by two longitudinal bulkheads forming three compartments. These were for the barque's fresh water requirements having a total capacity of 168 tons and provided not only the domestic water but also the feed water for the donkey boiler which was situated on the main deck just forward of the main mast.

In 1968 the author wrote to the builders of the CECILIE with a request for a copy of the Lines Plan of the barque if still available. Unfortunately they were not as the plans of the firm had been completely destroyed during Hitler's War.

However, all was not lost. Prior to the War an Englishman, W.L.A.Derby, had written a book entitled "The Tall Ships

Pass", sub-titled "Embodying therein the history and description of the Finnish 4-masted steel barque Herzogin Cecilie".[2]

Derby had managed to obtain from Rickmers a copy of the Sail Plan, this in the profile of the hull showed the position of the poop and foc'sle head, main and tween decks at side and the frame spacing in the double bottom, the General Arrangement in plan view with the outline of the three decks, and two transverse construction plans. One of these transverse plans was situated in the forward well deck in the way of No. 2 hatch and embodied a deep web frame and could only be located at the after end of that hatch at frame No. 96. The other transverse plan was located in the long poop, clear of all hatchways and bulkheads. An assumption was necessary, the location being sighted forward of the mizzen mast at frame No. 53. See Fig.1, the Sail Plan. Fig. 2, the General Arrangement in plan view, and Fig. 3. The Transverse Construction Plan.

Having located the position of these two frames and having four points on the shape of the fore and after end frames a re-constructed Lines Plan was possible. See Fig. 4.

From this Lines Plan the Hydrostatic Curves and the Cross Curves of Stability were constructed. Reproduced in Figs. 5 and 6.

Stability.

The elements of the stability of the HERZOGIN CECILIE when in service are now no longer available. If any of this information is still extant it has remained hidden, so in this regard some assumptions have had to be made. As the transverse centre of gravity varies in position from cargo to cargo, and even with grain from year to year, this centre was required for the barque in the light condition. In this regard some meagre information is available. The following quotation from "Mother Sea" by Elis Karlsson, Chief Officer, 1933-36 provides some evidence.[3] "The ballast was dumped off Boston Island, and some of us took down the royal yards. HERZOGIN CECILIE carried 650 tons of water ballast.....but to make sure of her having sufficient stability for the short sail into the harbour Captain de Cloux struck the royals". Beside the 650 tons of water ballast she had a further 800 tons of sand ballast loaded on the tank top for long ocean voyages. "On the third day the Captain called. 'You might congratulate me on still being the captain of the HERZOGIN CECILIE after yesterday's events.

And he told me of how he was preparing to go ashore three days back. The Second and Third were busy in the holds supervising the scraping together the last of the ballast and cleaning the bilges. He had just come on deck when the squall struck the ship broadside on. She heeled on her side, and while the Captain raced toward the foc'slehead the anchor chain carried away. After a critical moment, the ship righted herself, and the Captain let go the other anchor.....the two following days were spent dragging for the lost anchor chain, and eventually it was found and picked up'.[3]

These two quotations would indicate, that, with the double bottom ballast tanks pressed up, and with a clean swept hold the barque's G.M. was not very high.

There is a further smattering on the barque's stability to be gleaned from Derby's work. In 1931 the barque had come up from Wallaroo with grain in the smart time of 95 days. She had discharged her cargo in Barry and then cleared for Mariehamn up in the Baltic Sea. On June 2nd she was standing up toward the Skagens Rev Light on the Northern tip of Denmark(The Skaw). She passed this light abeam at exactly 5 p.m. At 6.15 p.m. she passed abeam of the Laeso Trindal Light. These two lights on the chart are exactly 26 nautical miles apart. This gives an average speed over the ground of 20¾ knots. Of passing interest in ballast trim the barque was 308 feet on the waterline and this gave her a speed/length ration of 1.18. To attain the maximum speed/length ratio of 1.34 she would have had to reach 23.5 knots. To average 20¾ knots for 1¼ hours at some time during that period she must have almost reached the maximum? Further on Derby records that the greatest angle to which the barque lay over was a list to port of 32°.[2]

The assumtions derived from these points were:-

1. That for the voyage from Barry to Mariehamn in 1931 the barque was in light ballast only with the double bottom tanks pressed up and say 700 tons of sand ballast instead of the normal 800 tons required for an ocean voyage(this was the practice with the Erikson ships as ballast was much dearer in Britain than in Aaland).
2. That all plain sail was set and that the maximum wind speed reached was Force 7',[4] which at the top end of the

scale is approximately 33 knots generating a force of 3.6 pounds per square foot.(It was considered that the wind in gusts reached this velocity)

3. That with her ballast water only, that is with a clean swept hold, she had a G.M. of 1.20 feet, which increased to 1.27 feet with the royal yards on deck.

Throughout this paper the imperial system of measurement and weight has been used as all the plans of the ships considered are in those units. It is the author's opinion that the mathematics of Naval Architecture have far more beauty in the Imperial system than the Metric system will ever have. Metric conversion of results however are given.

So considering the effects of 2. a wind heeling moment curve was constructed and plotted against a curve of righting levers crossing at 32^{o}. The curve of righting levers was based on the assumption that the C.G. of the 700 tons of sand ballast was 8 feet above USK and the barque's G.M. when she stormed up the Kattegat was 2.93 feet. Conditions based on the above data are included in the Appendix.

A copy of the Lines Plan and all the attendant Hydrostatic Data was forwarded to the Aaland Maritime Museum(Aalands Sjofarts-museum) in Mariehamn.

This Museum kindly forwarded to the author a copy of the Lines Plan of the four-masted barque POMMERN. This barque is still afloat in Mariehamn as part of the Museum and is the only square-rigger preserved in original condition in the world today.

From this Lines Plan the Hydrostatic Curves were prepared a copy of which was duly sent to the Mariehamn Museum.

However all was not well. This data sent to the Museum eventually found its way into the hands of the barque's Intendant, Mr. Jyrki Abrahamsson, who on raising a query as to the origin of this data, pointed out that this Lines Plan was far from accurate. (This Lines Plan had been drawn up by the English author Harold Underhill)[5]. Albeit the Museum intended to have the Lines lifted from the hull in 1997 when the barque was due for drydocking in Stockholm.

About this time a book entitled "The Captains Watson of the Empire Line" by David P.H.Watson came into the Author's hands.[6] David Watson's grandfather had been master of the bald-headed barque INDIAN EMPIRE when he was sent by the Company to stand by

the building of a new four-masted barque being built in J. Reid's yard in Glasgow. This was the COLONIAL EMPIRE and she was launched in 1902. Eight years prior to this in 1894 Reids had built from the same scrieve board the four-masted barque LOCH NEVIS, which was to be the last ship to be built for the famous 'Loch Line' of Aitken Lilburn & Co. of Glasgow.

Immediately after the launch of the COLONIAL EMPIRE Reids laid the keel of another four-masted barque from the same scrieve board. This was the SCHURBEK for the Hamburg firm of Knohr & Burchard. This was followed by the MNEME also from this same scrieve board, which of course became the POMMERN.

Somehow David Watson had managed to locate all of Reid's plans of the COLONIAL EMPIRE and had published the sail Plan and some of the General Arrangement plans in his book. He had then donated all the plans to the Glasgow Museum of Transport.

From these people a copy of the Lines and Sail Plans was obtained. It would appear that the only way that the POMMERN differs from her three sisters is that Reids gave her slightly longer yards. From Mr. Abrahamsson the author received the correct measurements. Mr. Abrahamsson had sent one or two of his volunteers aloft to measure all the yards. This enabled a Sail Plan of the barque to be made. See Figs. 7 & 8. There were other differences; the POMMERN was given a slightly raised foc'sle head while the foc'sle head of the other three ships was flush with the t'gallant rail. Other differences include variation in hatchway positions, a larger chart house on the poop, the deck house containing the carpenter's shop and half-deck was situated further aft, and the halyard winches were arranged in different locations on deck. These were all amended on the redrawn Sail Plan.

The Lines Plans.

The profile of the bow of the POMMERN graced with an effigy of Mnemosyne, curves down, never becomes perpendicular, before it sweeps into the very soft curved forefoot. The water lines forward are not as full as one would expect in ships of this period. Fuller of course than the HERZOGIN CECILIE but finer than the HOUGOMONT(The Lines and Sail Plan

of this barque are also included in the Appendix). Significantly the POMMERN is some 10 feet longer than the HOUGOMONT but their deadweight at 3950 tons is the same. The lines flow aft easily into a hard turn of the bilge with a rise of floor of 6°. Aft the lines are much finer than one would expect. The parallel middle body occupies just over one third of the water line length.

The Lines Plan of the HERZOGIN CECILIE reveals a hull form as fine as the very much smaller ships of the 1880-90 era, and which were classified as medium clippers. Although some thirty or so feet longer than the POMMERN her deadweight capacity was only 4250 tons whereas the four-masted barque PARMA, also registered in Mariehamn and approximately the same length, beam, and depth as the CECILIE had a deadweight tonnage of over 5100 tons. Inspite of this the PARMA recorded the fastest passage between the Wars from Australia to the United Kingdom of 83 days.[7] Forward the CECILIE'S bow lines are softly curved, merging gently into the parallel middle body in a gentle sweep up into the counter, which is a moderate overhang. The counter above the water line is quite full, affording considerable reserve buoyancy.

In comparison with the HERZOGIN CECILIE and the POMMERN the lines of the HOUGOMONT are quite full. In spite of this she and her sister barque, the ARCHIBALD RUSSELL produced some creditable performances. The HOUGOMONT, loaded with grain, came from Melbourne to Queenstown(County Cork) in the excellent time of 85 days in 1907, and the ARCHIBALD RUSSELL 'won' the Grain Race in 1929 with a passage of 93 days also loaded with grain from Melbourne to Queenstown.

The POMMERN and the HERZOGIN CECILIE both had a rise of floor of 6° while in the HOUGOMONT the rise of floor was 5°. This slight rise of floor made for much better steering. As it was these big sailing ships were sometimes difficult to steer but this could be because of the rudder design. In most the fore edge of the rudder was set back some 12" or so from the after side of the stern post and of consequence when deep loaded and hard on the wind there would be a gap of some 20 square feet or so through the water under pressure would be gushing through from the lee side. One would have thought that a properly

designed double plated rudder with the fore edge housed into a hollow stern post would have improved the steering capabilities of these ships immensely.

The above paragraph leaves one to wonder why the modern cargo carriers are designed with no rise of floor at all, making steering that much more difficult particularly when proceeding into a port or up a river estuary with very little water under the keel.

When running free 'broaching to' was always a danger. This occurred to the four-masted barque PARMA in the Great Southern Ocean homeward bound from South Australia in 1932. This episode is recorded in "The Voyage of the PARMA" by A.J.Villiers, (pp. 71 et cet.), and in a paper "The Following Sea, Broaching and Surging".[8 & 9]

The Erikson barque KILLORAN deep-loaded with coal from Newcastle, N.S.W. toward Callao in 1926 'broached to' while running her easting down in the Great Southern Ocean. During the height of a westerly gale the barque was pooped by a huge sea which smashed the wheel and took both helmsmen into the sea. In the event the cargo shifted and the barque was flung on her beam ends. Luckily the hatches held, but it took the crew three days to re-trim the cargo and get the ship back under way again.[10]

Stability of the POMMERN.

The original or any subsequent Inclining Experiment Data is not now available or its whereabouts is elusive. The 850 tons of sand ballast she loaded in Hull in August 1939 is still in her hold, although it is now secured in strongly built wooden bins shored from the ship's side.

Fortunately, with some research Mr. Abrahamsson, located in the Mariehamn Museum a copy of the barque's load Line Certificate(Freibord-Zertifikat) issued by the Germanischer Lloyd in Hamburg on December 1st 1905. See Appendix. Her freeboard to the Summer Load Line is 5.41 feet(1.65 metres). The Fresh Water Load Line 5 inches(0.13 metres) above the Summer Load Line.

Some meagre information of the barque's stability is available in the Aaland Nautical Club publication POMMERN, Mariehamn, by Bjorn O. Svensson....."Only the ballast was discharged at Port Victoria, and 520 tons of grain for stiffening was loaded.

the nitrate cargo 34 cubic feet to the ton. It was considered that the nitrate cargo was all stowed in the lower hold, while in the case of the grain cargo there was 800 tons stowed in the tween deck compartments.

Only toward the end of the sailing ship era was any attempt made by shipbuilders to design and build sailing ships with internal water ballast. For the most part ballast consisted of sand, rocks or rubble. Between the wars ships working the grain ports of Spencer Gulf would anchor in the ballast grounds first and discharge a quantity of the ballast leaving just sufficient to stand right into the port under minimum sail and begin loading. After taking in enough cargo for stiffening the ship would then return to the ballast ground and discharge the rest of the ballast. A very costly exercise. Ballast was costly to buy and costly to load and discharge. On the West Coast of North America the use of ballast logs was prevalent. These were huge pine logs suspended by chains from the bulwarks, port and starboard. They were some 100 feet long and from 3 to 4 feet in diameter, weighing some 10 to 12 tons apiece, and supported so that with the ship upright each log was not quite afloat. The theory of these logs being that, should the ship list slightly, she would immediately immerse the log on the low side which which would then float, the weight of the log on the high side, which had now emerged, tending to bring the ship back upright again. In a normal sized four-masted barque, with the logs the size suggested above, the force applied by the log on the high side tending to bring the ship upright, would be approximately 240-260 tons foot. When the log emerges from the water the virtual weight weight of 10-12 tons is at the outboard edge of the bulwark, the lever arm approximating 20-21 feet. The use of these ballast logs has brought two of these ships to grief. The British four-masted barque ANDELANA capsized and sank in Tacoma Harbour, Oregon, in 1898. She had a clean swept hold and her hatches were open. With her went her Master and nineteen hands. She is still on her side at the bottom of Tacoma Harbour. The French four-masted barque AISIE capsized on to the wharf in Portland, Oregon in 1902. The theory with her ballast logs did not work either; she did considerable damage to herself aloft, but she was refitted and went to sea again.

Initially the water ballasted sailing ships had some problems. Mainly caused by inexperience of the personel con-

cerned. The Danish four-masted barque VIKING capsized on to the fitting out wharf while still in the hands of the builders, Burmeister & Wain of Kobenhavn. It would appear that nobody of authority in the yard would listen to the naval architect responsible for the design of the barque. He evidently tried to impress on all concerned that it was necessary to have her double bottom ballast tanks pressed right up. The VIKING finally saw service in the Erikson Line and was last in South Australia in 1947. She is still afloat as a floating hostel in Gothenburg.

In 1933 the Erikson barque PENANG outward bound toward South Australia went aground in Kobenhavn Sound. The PENANG had also been built by Rickmers and was completely water ballasted, with 1100 tons in double bottom and deep tanks. The Mate, who was Officer of the Watch, immediately braced all the yards aback, but it was no avail the ship was stuck fast. It was then decided to empty No. 1 double bottom tanks. The ship then floated free and it was decided to refill the tanks. This task was far from complete when the company's four-masted barque PONAPE hove in sight also outward bound. It was then that the Master of the PENANG, against the advice of the Mate, decided to get under way. Immediately the wind filled the sails the ship fell over on her side to such an extent that the water came in through the wash ports in the bulwarks. It was touch and go until the ship was brought up into the wind and the ship righted herself.

The same ship had nearly come to grief in England when in dry dock. The dock was being filled in order to float the ship and as soon as there was sufficient water around the ship, well before she was afloat, the crew had commenced to refill the ballast tanks. It appears that the dock was being filled too quickly and suddenly the barque began to take on a dangerous list. One of the Officers had the presence of mind to order the yards braced around hard on the backstays on the high side and the ship fortunately righted herself. [3]

The above near disasters could only be caused by lack of experience in such matters.

Construction.

The exact scantlings of the HERZOGIN CECILIE are not now available. However those of the POMMERN are. Although the CECILIE was a much bigger ship she could only lift 300 tons more than the POMMERN. The POMMERN was a single bottom ship

the collision bulkhead being the only bulkhead in her. The main deck was steel plated sheathed in pine 3½ inches thick. The tween deck is pine laid over the beams with a stringer plate port and starboard and two tie plates fore and aft adjacent to the hatch coamings. Amazingly the deck beams are on four feet centres(both main and tween deck) i.e. on every other frame head. This seems to have been common practice. The author has copies of the construction plans of the four-masted barques LAWHILL and HOUGOMONT and both are similarly constructed. This possibly accounts for the fact that when the POMMERN was inclined it was found that the Light Ship displacement was 1350 tons. On the other hand the HERZOGIN CECILIE with her double bottom and long poop deck(it was 201 feet long), frames on 2 foot 1½ inch centres and deck beams on every frame head on all decks, together with deep web frames at the end of each hatch, and her seven transverse bulkheads, her Light Ship displacement was 1950 tons.

Sail Plans.

The sail plan of the POMMERN shows that she was rigged with double t'gallant sails and no royals and was classified as being 'bald-headed'. However her designer gave her very deep upper t'gallant sails, which when under sail gave her rather a smart appearance in spite of the absence of royals. The three upper t'gallant yards were on parrals around the t'gallant masts and were the only yards fitted to those mosts, the lower t'gallant yards being slung on cranes attached to the top-mast cap forgings. Her upper t'gallant yards were wood as were her t'gallant masts and spanker boom and gaff. In 1938, before leaving outward bound for South Australia, it was found that the fore-t'gallant mast was affected with dry rot in way of the steel fittings. It was found impossible to obtain a suitable spar to replace it in wood so Harland & Wolfe's made one in steel, which cost £38. This spar is still in her. Longitudinally the Centre of Effort has a lead over the Centre of Lateral Resistance of 16.5 feet (5.65% of the Load Waterline length) when under all plain sail. The Sail Plan appears to be well balanced for she was steered from right aft on the poop by a single wheel and as far as is known there are no recorded instances where she has been difficult to handle. At the moment the volunteer crew under the direction of Mr. Abrahamsson have almost completed work on the making a full set of new sails. This from Standard No. 4 canvas gratiously

donated by Francis Webster & Sons, Ltd. of Arbroath, Scotland. Websters had supplied the Erikson Line with all its canvas requirements from the time that Gustaf Erikson had bought his first ship.

Aloft, with one or two minor exceptions, HERZOGIN CECILIE was basically much the same as any other four-masted barque, crossing royals over double t'gallants. She was rigged with double spanker gaffs and compared with other ships so rigged her gaffs stood parallel with one another. In the 'Flying P' ships the gaffs were rigged splayed at different angles which gave them a "Chinese junk" appearance.

As the CECILIE was designed and built as the Fleet School Ship for the Nord Deutscher Lloyd Company and was thus manned by a large number of cadets she was not fitted with any labour saving devices as brace and halyard winches. Beside the capstan on the foc'sle head there were two capstans port and starboard on the well deck and four port and starboard on the poop deck. When taken over by Erikson she was manned by a maximum of thirty three hands. This usually consisted of the Master, Three Mates, Bosun, Donkeyman, Carpenter, Steward, Cook, Sailmaker, eight Able Bodied Seamen, and the remaining fifteen classified as Ordinary Seamen or Apprentices. On her maiden voyage for the N.D.L. she had eightyfour cadets beside the Master, Mates, Petty Officers, Instructors, and A.B's. She also had a Doctor.

Under all plain sail her Centre of Effort was 19.4 feet ahead of the Centre of Lateral Resistance in the designed loaded condition. This is 6.3% of the water line length but would increase when trimmed one foot by the stern.

The POMMERN'S complement was usually twenty eight hands all told. of the two ships the POMMERN was undoubtedly the more economic, but with her long open main deck opposed to the long poop of the CECILIE she was more vulnerable to damage on deck during heavy weather. Fortunately the POMMERN did not suffer from this to any great extent.

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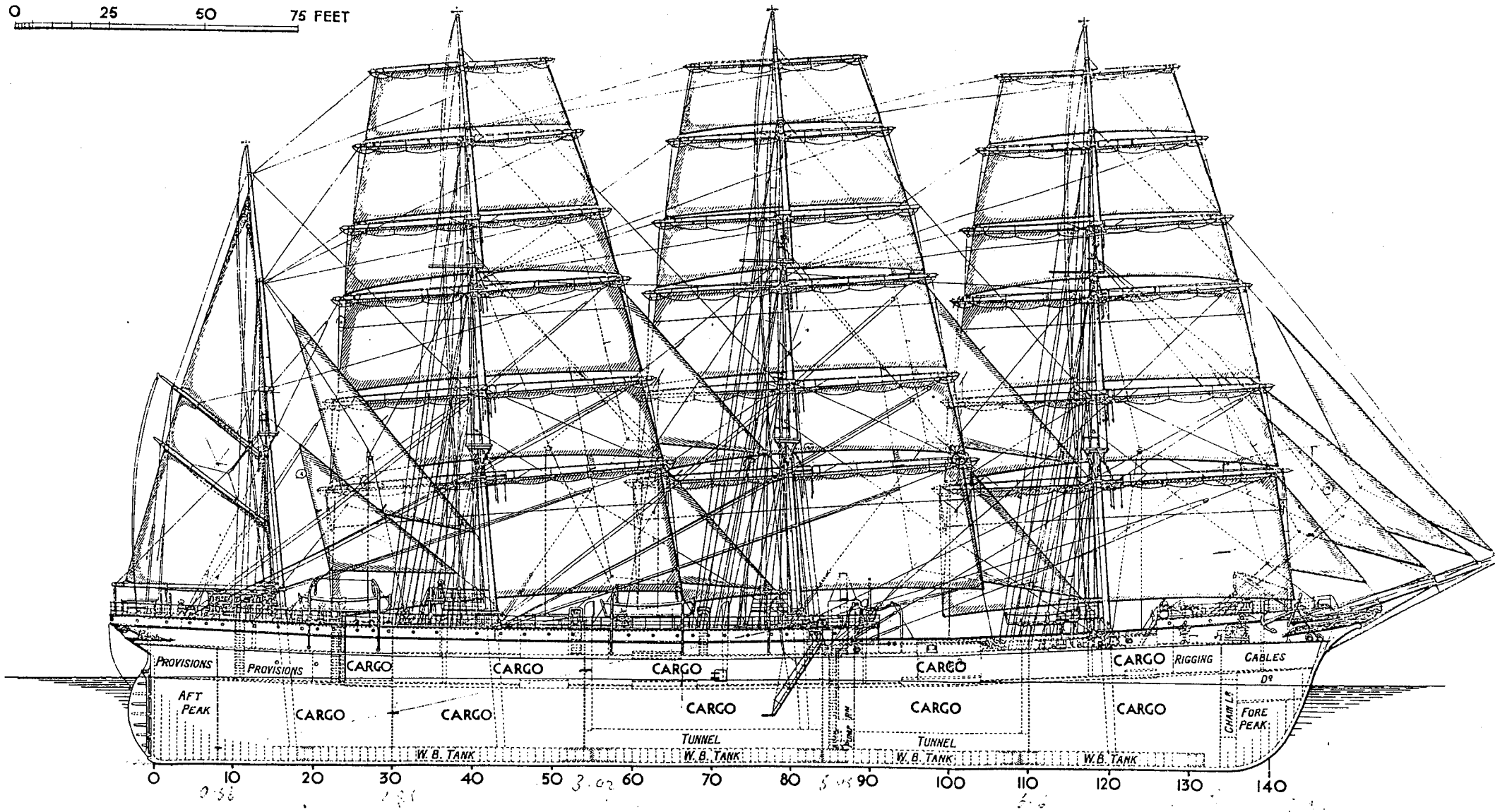
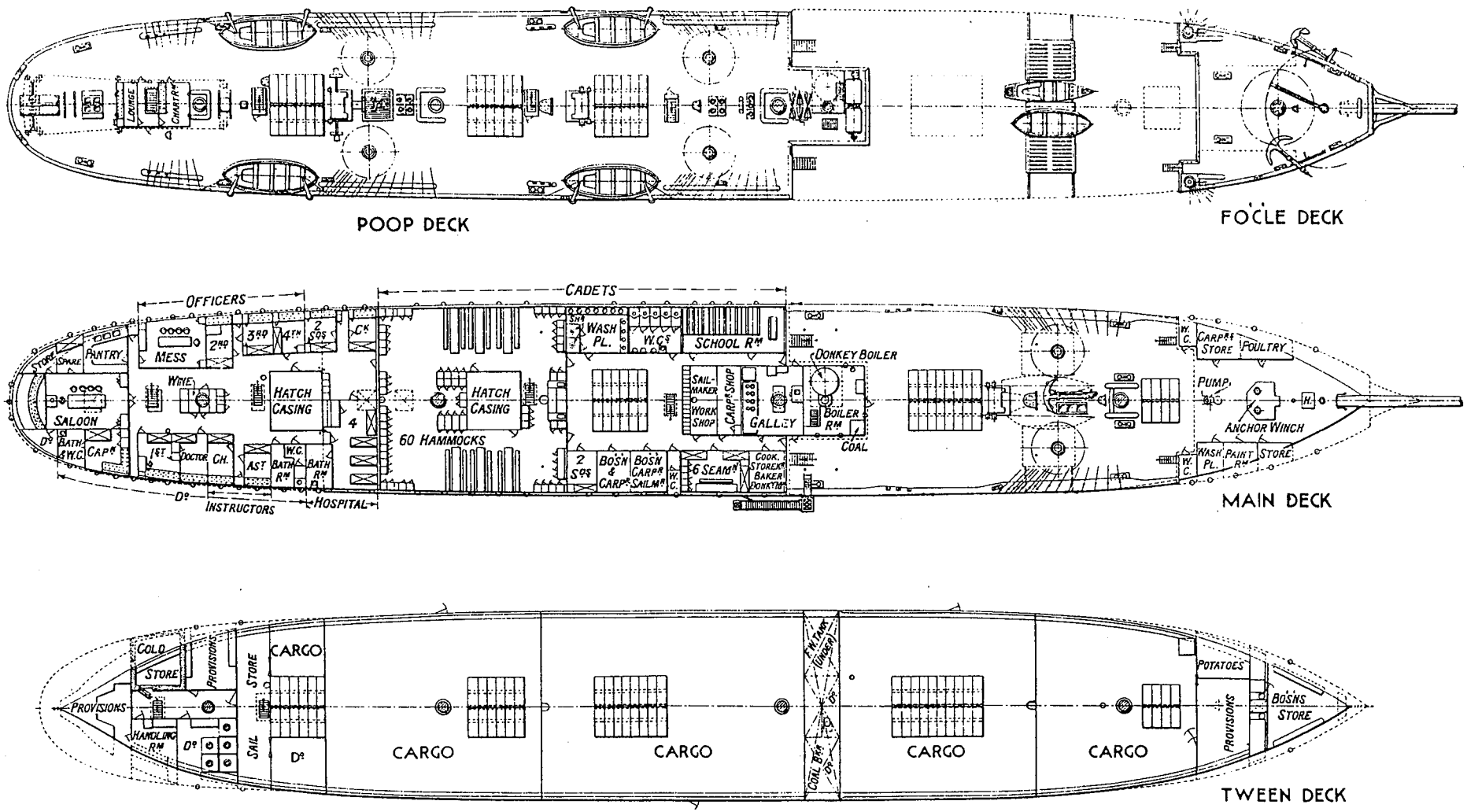


"HERZOGIN CECILIE" IN 1902

THE PROFILE OF THE HULL AND THE PLAN OF RIGGING AND SAILS

Fig. 1



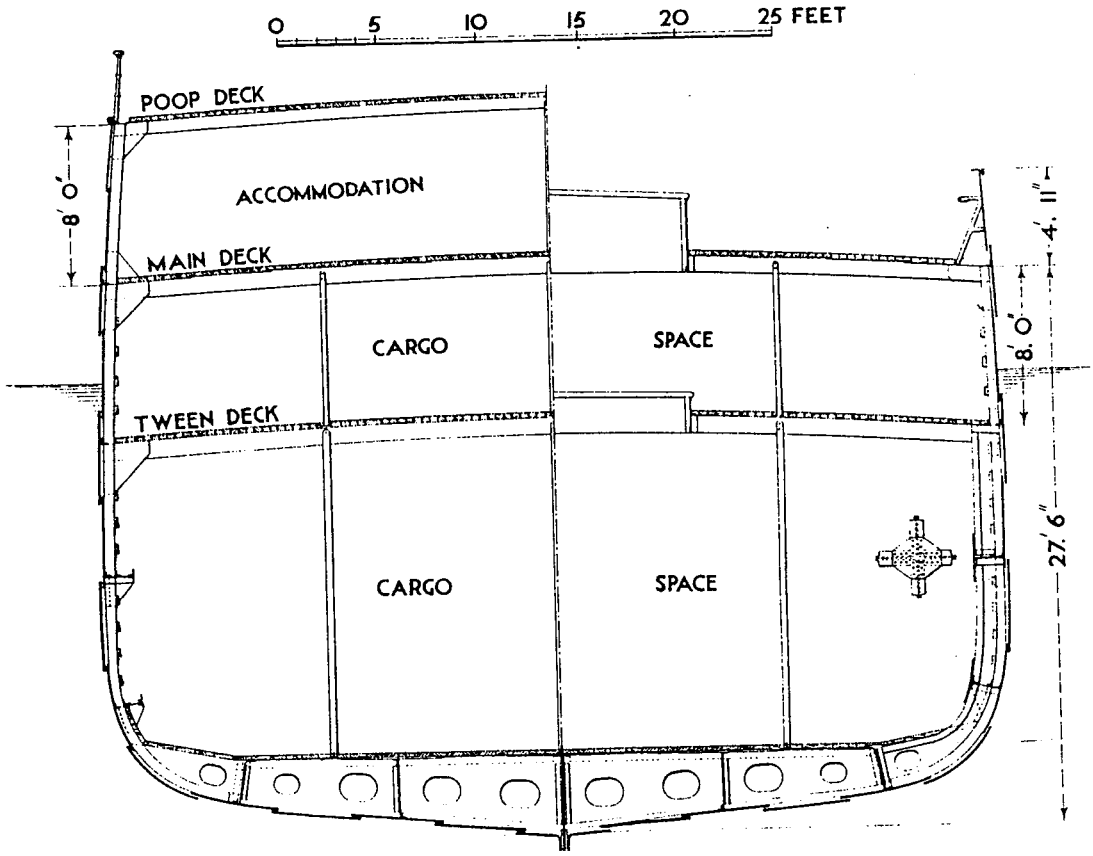
"HERZOGIN CECILIE" IN 1902

THE DECKS

Fig. 2

PRINCIPAL DIMENSIONS

LENGTH OVERALL	310'. 0"
LENGTH BETWEEN PERPENDICULARS	308'. 2"
BREADTH	46'. 0"
HEIGHT TO MAIN DECK	27'. 6"



MIDSHIP SECTION

"HERZOGIN CECILIE" IN 1902

Fig.3

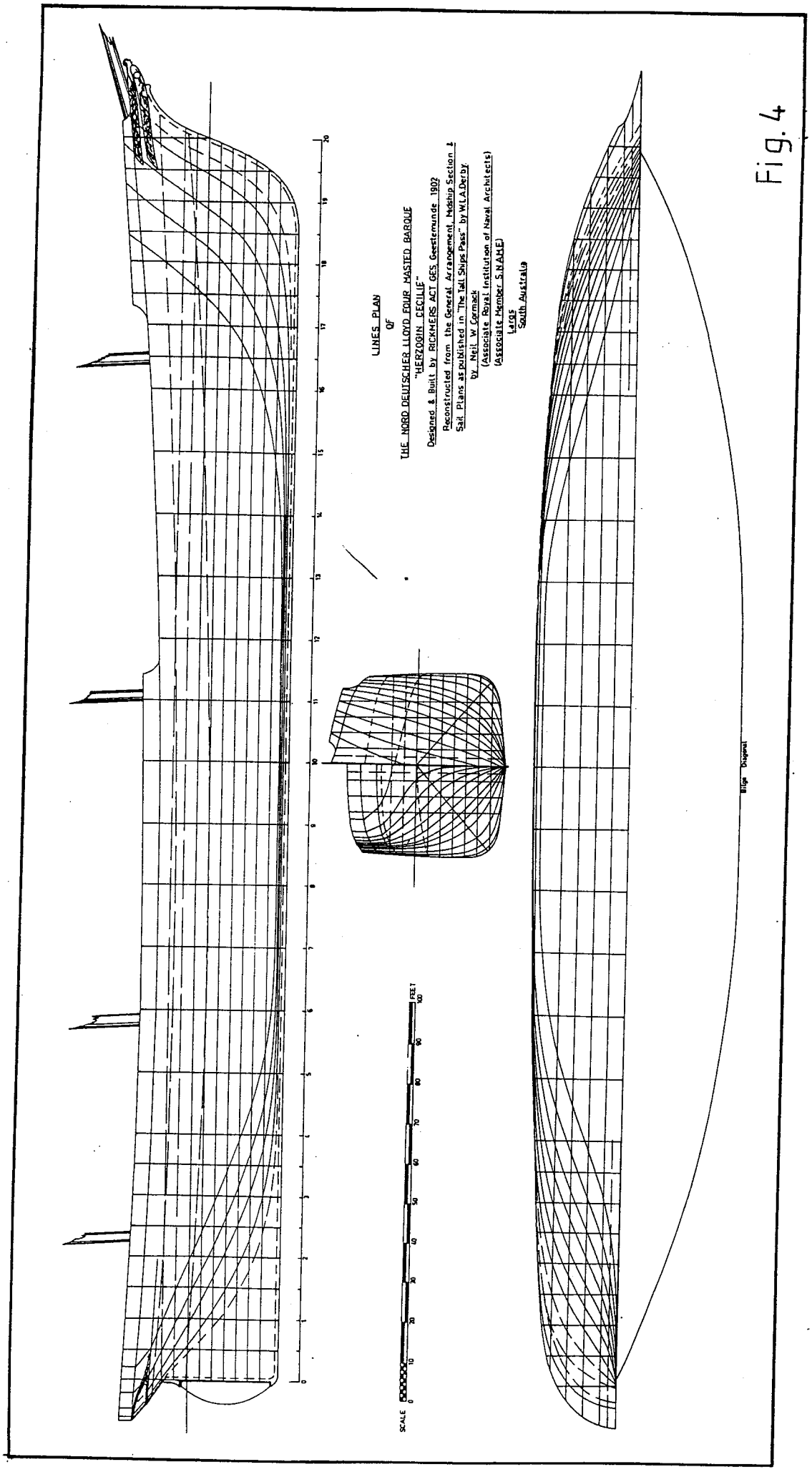

LINES PLAN
OF
THE NORD DEUTSCHER LLOYD FOUR MASTED BARQUE
"HERZOGIN CECILIE"
Designed & Built by RICKMERS ACT GES Geestemunde 1902
Reconstructed from the General Arrangement, Midship Section &
Sail Plans as published in "The Tall Ships Pass" by W.L.A.Derby
by Neil W Cormack
(Associate Royal Institution of Naval Architects)
(Associate Member S.N.A.M.E)
1.4.65
South Australia
SCALE
FEET
Bilge Diagonal

Fig. 4

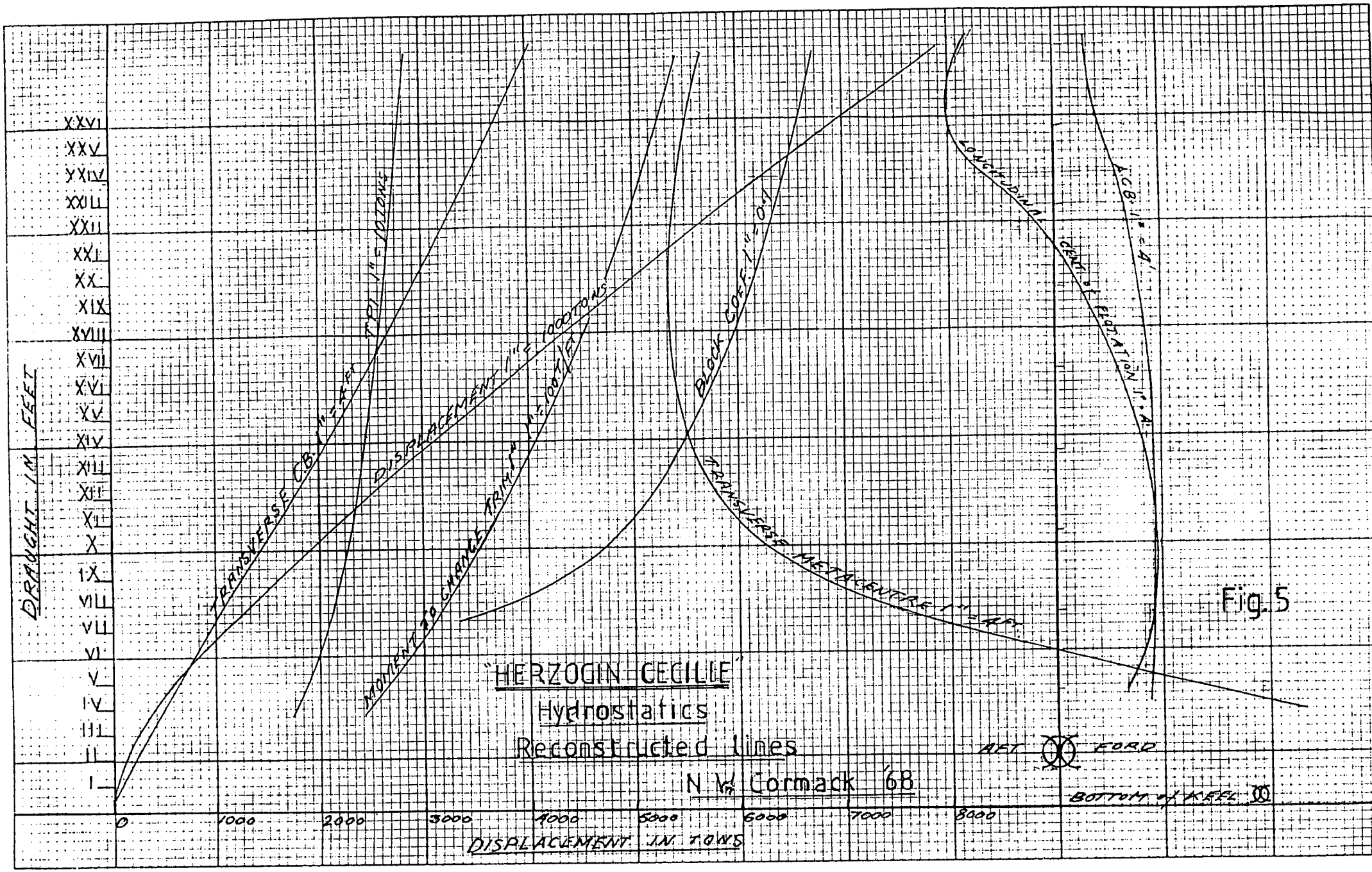

"HERZOGIN CECILIE"
Hydrostatics
Reconstructed lines
N W Cormack '68
DRAUGHT IN FEET
DISPLACEMENT IN TONS
TPI
MOMENT TO CHANGE TRIM 1"
DISPLACEMENT 1" = 100 TONS
TRANSVERSE GM 1" = 1 FEET
BLOCK COEFF 1" = 0.1
LONGITUDINAL METACENTRE 1" = 1 FEET
CENTRE OF BUOYANCY 1" = 1 FEET
AFT
FORD
BOTTOM OF KEEL

Fig. 5

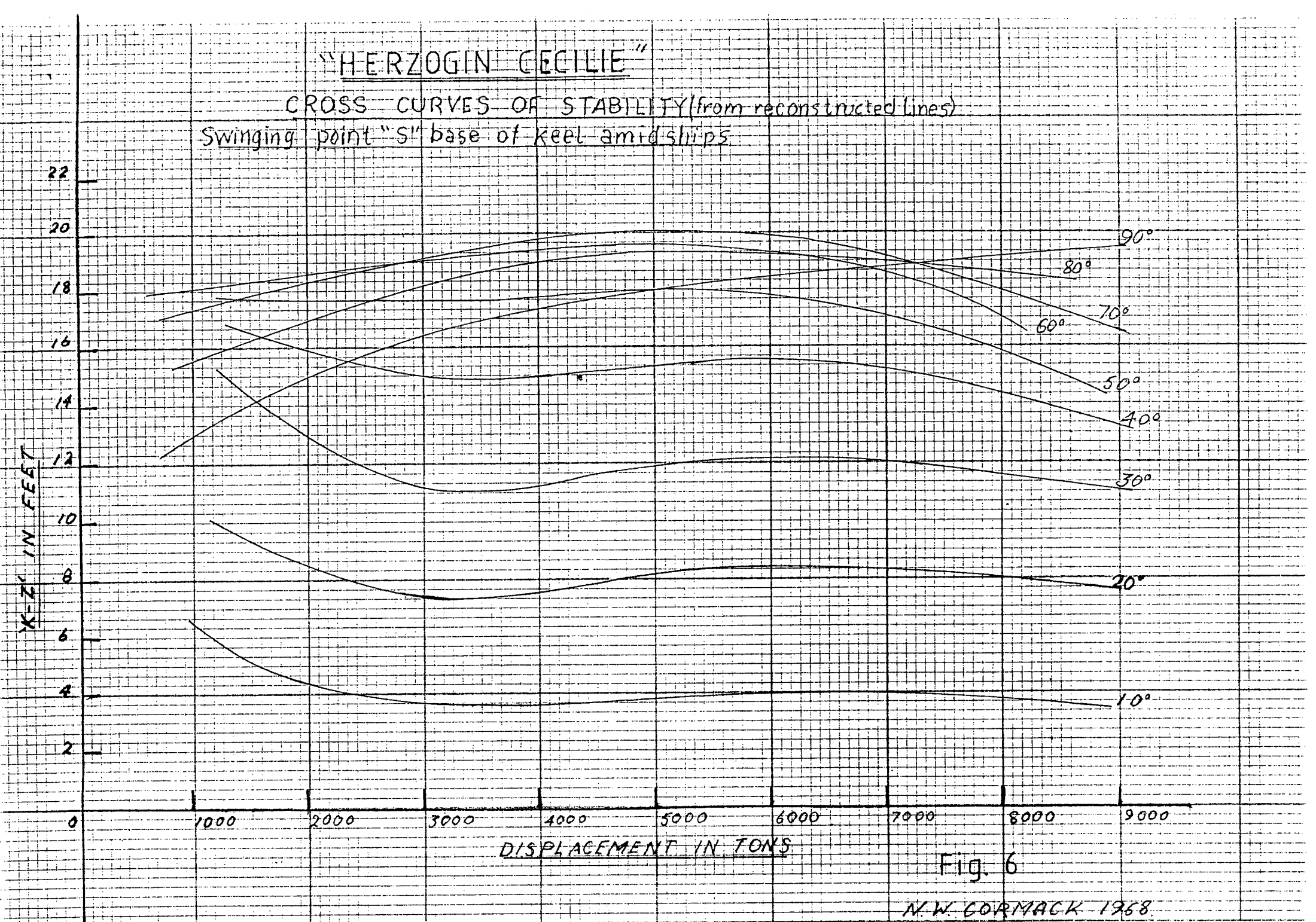
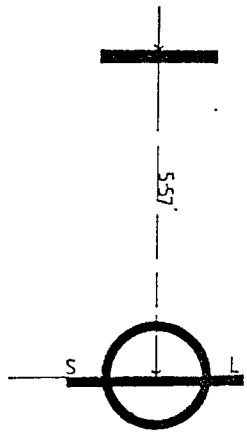
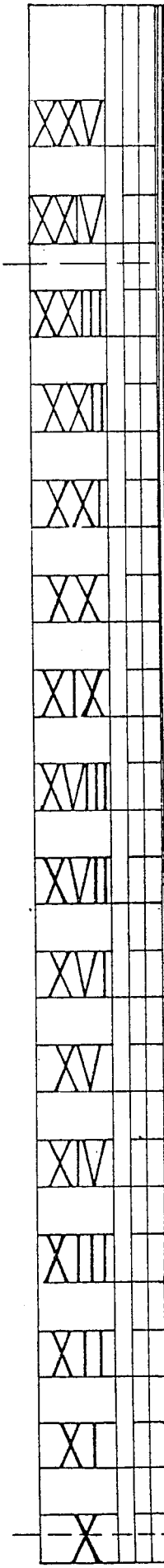


Fig. 6

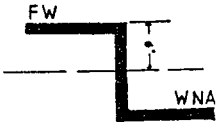
N.W. CORMACK 1968.

DISPLACEMENT/ DEADWEIGHT SCALE OF THE 4 MASTED BARQUE "HERZOGIN CECILIE"





DISPLACEMENT in TONS	DEADWEIGHT in TONS
6650	4700
6550	4600
6450	4500
6350	4400
6250	4300
6150	4200
6050	4100
5950	4000
5850	3900
5750	3800
5650	3700
5550	3600
5450	3500
5350	3400
5250	3300
5150	3200
5050	3100
4950	3000
4850	2900
4750	2800
4650	2700
4550	2600
4450	2500
4350	2400
4250	2300
4150	2200
4050	2100
3950	2000
3850	1900
3750	1800
3650	1700
3550	1600
3450	1500
3350	1400
3250	1300
3150	1200
3050	1100
2950	1000
2850	900
2750	800
2650	700
2550	600
2450	500
2350	400
2250	300
2150	200
2050	100
1950	0



Mean Light Draught

NEIL W. CORMACK
LARGS, SOUTH AUSTRALIA
June '94

TRIM & STABILITY

SHIP HERZOGIN CECILIE DATE May 1994

CONDITION NO. 1. Double bottom pressed, Hold clean swept.

ITEM	Weight TONS	KG F	Vert. Mom. T/F	LCG about ⌀	Aft Mom. T/F	Ford Mom. T/F	FSN T/F
Water Ballast	650	3.00'	1950				
Fresh Water	10	6.50'	65				0.05
Total D/Weight	660		2015				0.05
Lightship	1950	28.41	55408				
Displacement	2610	22,00	57423				0.05

F.S.Correction		0.05	MCT	LCB	LCF		
KG Fluid	6.72M	22.05	380t/f	3.75F	3.58F		
KM	7.09M	23.25	TRIM				
GM	0.37M	1.20	DRAUGHT ABOVE BASE AT LCF 12'4"				
N.W.Cormack, May '94			Draught aft		Draught for.		

TRIM & STABILITY

SHIP HERZOGIN CECILIE

DATE MAY 1994

CONDITION NO. 1

DISPLACEMENT 2610tons(2652tonnes)

K.G.(FLUID) 22.05Ft(6.72M)

$GZ = KN - KG \sin \theta$

ITEM									
	10°	20°	30°	40°	50°	60°	70°	80°	90°
K.N.	3.94	7.86	11.76	15.20	17.96	18.75			
K.G. sin θ	3.83	7.56	11.03	14.16	16.89	19.09			
G.Z.	0.11	0.31	0.73	1.04	1.07	-0.35			

AREA UNDER GZ CURVE

0° - 30°(IMCO = 10.34°/FT 3.15°M)

Ord.	G.Z.	S/M	fA
0	0	1	0
10	0.11	3	0.33
20	0.31	3	0.93
30	0.73	1	0.73
		$\int fA$	1.99

Area $= \int fA \times 3/8 \times 10°$

$= 1.99 \times 3/8 \times 10°$

$= 7.45°F(2.27°M)$

0° - 40°(IMCO = 16.93°/FT 5.16°M)

Ord.	G.Z.	S/M	fA
0	0	1	0
10	0.11	4	0.44
20	0.31	2	0.62
30	0.73	4	2.92
40	1.04	1	1.04
		$\int fA$	5.02

Area $= \int fA \times 10°/3$

$= 5.02 \times 10/3$

$= 16.73°F(5.10°M)$

30° - 40°(IMCO = 5.64°FT 1.72°M) = 9.27°F(2.83°M)

N.W.Cormack, May '94.

TRIM & STABILITY

SHIP HERZOGIN CECILIE DATE Ma

CONDITION NO. 1. Double bottom pressed, Hold clea

ITEM	Weight TONS	KG F	Vert. Mom. T/F	LCG about	Aft Mom T/F
Water Ballast	650	3.00'	1950		
Fresh Water	10	6.50'	65		
Total D/Weight	660		2015		
Lightship	1950	28.41	55408		
Displacement	2610	22.00	57423		
F.S.Correction		0.05	MCT	LCB	LCF
KG Fluid	6.72M	22.05	380t/f	3.75F	3.58F
KM	7.09M	23.25	TRIM		
GM	0.37M	1.20	DRAUGHT ABOVE BASE		
N.W.Cormack, May '94			Draught aft		Dr

TRIM & STABILITY

HERZOGIN CECILIE — DATE MAY 1994

DITION NO. 1

DISPLACEMENT 2610tons(2652tonnes)
K.G.(FLUID) 22.05Ft(6.72M)

GZ = KN - KG Sin θ

0°	20°	30°	40°	50°	60°	70°	80°	90°
.94	7.86	11.76	15.20	17.96	18.75			
.83	7.56	11.03	14.16	16.89	19.09			
.11	0.31	0.73	1.04	1.07	-0.35			

UNDER GZ CURVE

30°(IMCO = 10.34°/FT 3.15°M)

.	G.Z.	S/M	fA
	0	1	0
	0.11	3	0.33
	0.31	3	0.93
	0.73	1	0.73
		∫fA	1.99

Area = $\int fA \times 3/8 \times 10°$

= $1.99 \times 3/8 \times 10°$

= 7.45°F(2.27°M)

40°(IMCO = 16.93°/FT 5.16°M)

d.	G.Z.	S/M	fA
	0	1	0
)	0.11	4	0.44
)	0.31	2	0.62
)	0.73	4	2.92
)	1.04	1	1.04
		∫fA	5.02

Area = $\int fA \times 10°/3$

= $5.02 \times 10/3$

= 16.73°F(5.10°M)

° - 40°(IMCO = 5.64°FT 1.72°M) = 9.27°F(2.83°M)

N.W.Cormack, May '94.

TRIM & STABILITY

SHIP HERZOGIN CECILIE DATE MAY 1994

CONDITION NO. 1. Royal Yards on deck.

ITEM	Weight TONS	KG F	Vert. Mom. T/F	LCG about ⌀	Aft Mom. T/F	Ford Mom. T/F	FSN T/F
Water ballast	650	3.00	1950				
Fresh water	10	6.50	65				0.05
Royal yards	1.3	175	228				
			1787				
Royal yards	1.3	35	46				
Total D/Weight	660		1833				0.05
Lightship	1950	28.41	55408				
Displacement	2610	21.93	57241				

F.S.Correction	0.65	MCT	LCB	LCF	
KG Fluid	21.98	380t/f	3.75F	3.58F	
KM	23.25	TRIM			
GM	1.27	DRAUGHT ABOVE BASE AT LC 12'4"			
N.W.Cormack, May '94		Draught aft		Draught for.	

TRIM & STABILITY

SHIP HERZOGIN CECILIE

DATE MAY 1994

CONDITION NO. 1A Royals on Deck.

DISPLACEMENT 2610 tons(2652tonnes)

K.G.(FLUID) 21.98 Feet(6.68M)

$GZ = KN - KG \sin \theta$

ITEM									
	10°	20°	30°	40°	50°	60°	70°	80°	90°
K.N.	3.94	7.87	11.76	15.20	17.96	18.75			
K.G. sin θ	3.82	7.54	10.99	14.11	16.84	19.03			
G.Z.	0.12	0.33	0.77	1.09	1.12	-0.28			

AREA UNDER GZ CURVE

0° - 30°(IMCO = 10.34°/FT 3.15°M)

Ord.	G.Z.	S/M	fA
0	0	1	0
10	0.12	3	0.36
20	0.33	3	0.99
30	0.77	1	0.77
		$\int fA$	2.12

$$\text{Area} = \int fA \times {}^{3}/_{8} \times 10^{\circ}$$

$$= 2.12 \times {}^{3}/_{8} \times 10$$

$$= 7.95^{\circ}\text{Ft}(2.42^{\circ}\text{M})$$

0° - 40°(IMCO = 16.93°/FT 5.16°M)

Ord.	G.Z.	S/M	fA
0	0	1	0
10	0.12	4	0.48
20	0.33	2	0.66
30	0.77	4	3.08
40	1.09	1	1.09
		$\int fA$	5.31

$$\text{Area} = \int fA \times {}^{10^{\circ}}/_{3}$$

$$= 5.31 \times {}^{10}/_{3}$$

$$= 17.7^{\circ}\text{Ft}(5.39^{\circ}\text{M})$$

30° - 40°(IMCO = 5.64°FT 1.72°M) 9.75°Ft(2.97°M)

N.W.Cormack, May '94.

CONDITIONS Nos 1 & 1A.

HERZOGIN CECILIE

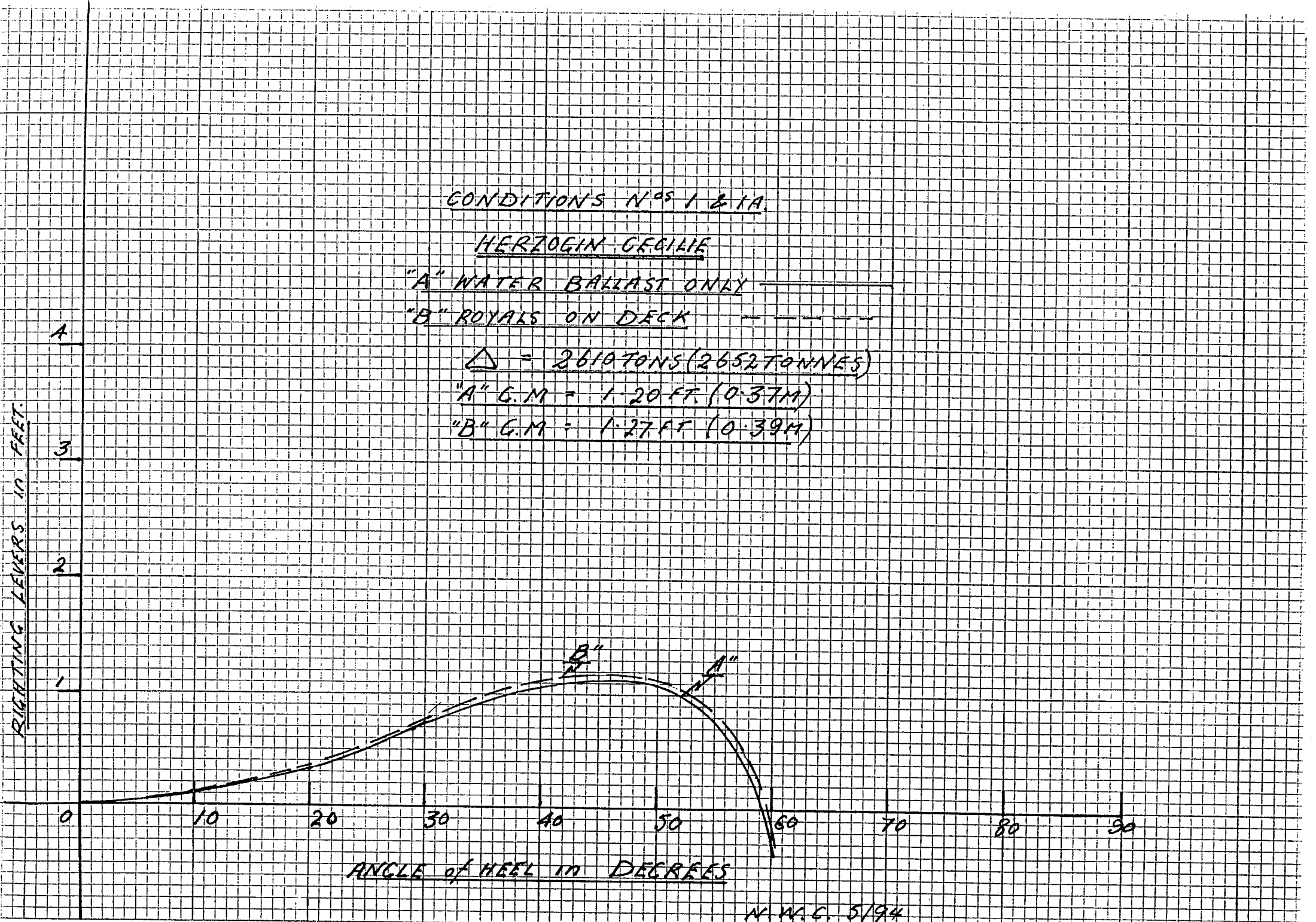
"A" WATER BALLAST ONLY ———

"B" ROYALS ON DECK - - - - - -

Δ = 2610 TONS (2652 TONNES)

"A" G.M = 1.20 FT. (0.37M)

"B" G.M = 1.27 FT (0.39M)



N.W.C. 5/94

TRIM & STABILITY

SHIP HERZOGIN CECILIE DATE MAY 1994

CONDITION NO. 2. Light Ballast

ITEM	Weight TONS	KG F	Vert. Mom. T/F	LCG about ⊗	Aft Mom. T/F	Ford Mom. T/F	FSN T/F
Water Ballast	650	3	1950				
Fresh Water	10	6	60				0.04
Sand Ballast	700	8	5600				
Total D/Weight	1360		7610				0.04
Lightship	1950	28.41	55408				
Displacement	3310	19.03	63018				

F.S.Correction		0.04	MCT	LCB	LCF		
KG Fluid	5.81M	19.07	410t/f	3.5F	3.1F		
KM	6.71M	22.00	TRIM				
GM	0.90M	2.93	DRAUGHT ABOVE BASE AT LCF 15'0"				
			Draught aft		Draught for.		

TRIM & STABILITY

SHIP HERZOGIN CECILIE

DATE MAY 1994

CONDITION NO. 2. Light Ballast.

DISPLACEMENT 3310 tons (3363 tonnes)

K.G.(FLUID) 19.07 feet (5.81M)

$GZ = KN - KG \sin \theta$,

ITEM									
	10°	20°	30°	40°	50°	60°	70°	80°	90°
K.N.	3.66	7.34	11.01	14.79	17.57	19.07	19.25	18.40	16.70
K.G. sin θ	3.32	6.54	9.54	12.24	14.61	16.51	17.93	18.78	17.93
G.Z.	0.34	0.80	1.47	2.55	2.96	2.56	1.32	-0.38	-2.37

AREA UNDER GZ CURVE

0° - 30° (IMCO = 10.34°/FT 3.15°M)

Ord.	G.Z.	S/M	fA
0	0	1	0
10	0.34	3	1.02
20	0.80	3	2.40
30	1.47	1	1.47
		$\int$fA	4.89

Area = $\int fA \times 3/8 \times 10°$

= $4.89 \times 3/8 \times 10$

= $18.36°Ft(5.59°M)$

0° - 40° (IMCO = 16.93°/FT 5.16°M)

Ord.	G.Z.	S/M	fA
0	0	1	0
10	0.34	4	1.36
20	0.80	2	1.60
30	1.47	4	5.88
40	2.55	1	2.55
		$\int$fA	11.39

Area = $\int fA \times 10°/3$

= $11.30 \times 10/3$

= $37.97°Ft(11.57°M)$

30° - 40° (IMCO = 5.64°FT 1.72°M) 19.64°Ft(5.98°M)

N.W.Cormack, May, '94.

SHIP HERZOGIN CECILIE.

CONDITION NO. 2 Light Ballast

WIND HEELING LEVERS.

DISPLACEMENT = 3310 tons (3363 tonnes)

Sail Area = 45000 feet^2 (4180 M^2)

C.L.R. - C.E. = 96 feet (29.26M)

ALL PLAIN SAIL SET.

Wind force 7 Beaufort Scale(up to 3.6 lbs. per foot^2)

= 45000 x 96 3.6 x $^1/_{2240}$ x $^1/_{3310}$.

= 2.10 feet (0.64M)

Heeling Levers = Lever x cos.$^2\theta$

10^o	20^o	30^o	40^o	50^o	60^o	70^o	80^o	90^o
2.04	1.85	1.57	1.23	0.86	0.52	0.24	0.06	0

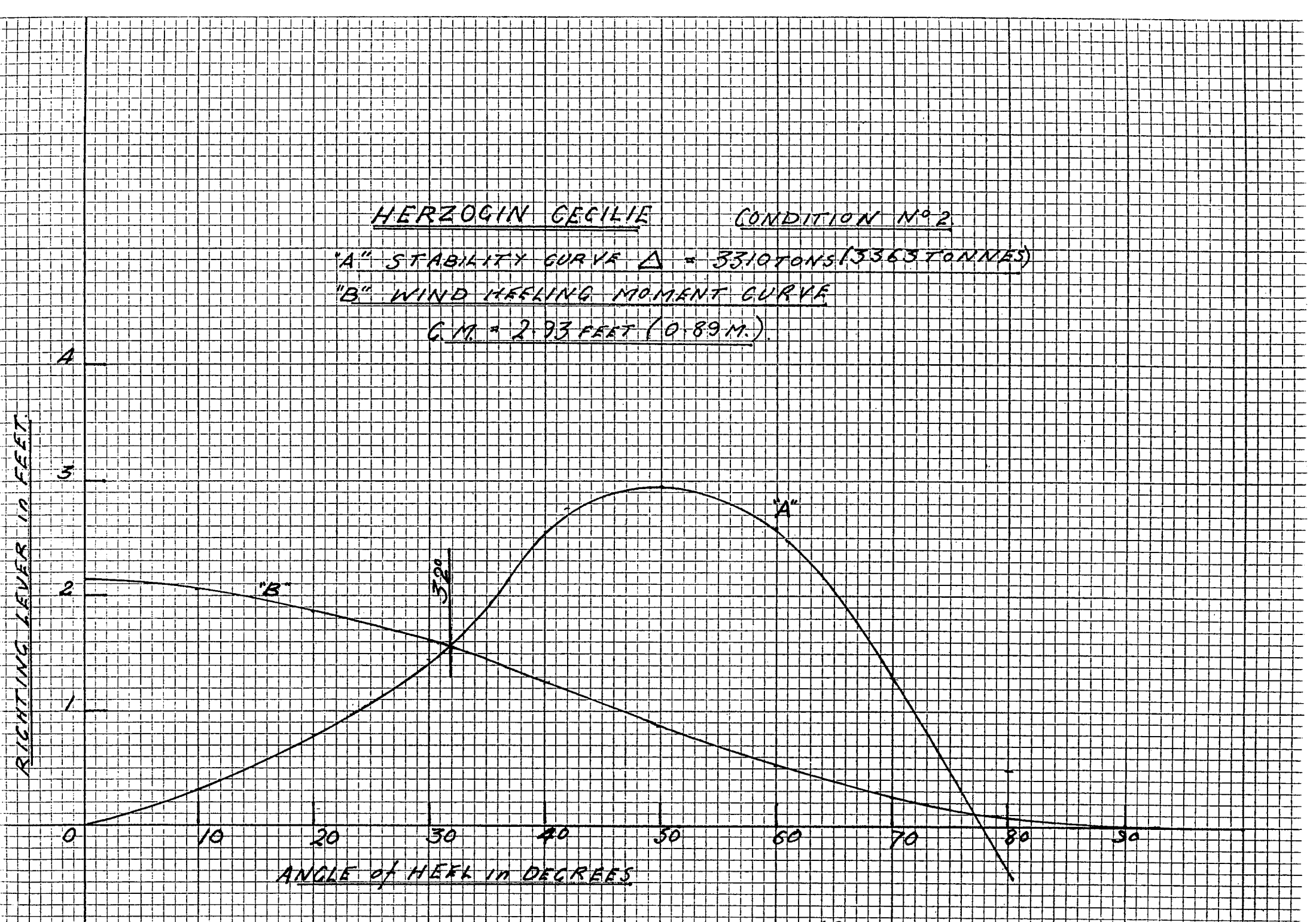
N.W.CORMACK,
LARGS,
SOUTH AUSTRALIA,
MAY '94.

HERZOGIN CECILIE CONDITION Nº 2

"A" STABILITY CURVE Δ = 3310 TONS (3363 TONNES)

"B" WIND HEELING MOMENT CURVE

G.M. = 2.93 FEET (0.89 M.)



TRIM & STABILITY

SHIP HERZOGIN CECILIE DATE MAY 1994

CONDITION NO. 3 GRAIN CARGO(4240tons)

ITEM	Weight TONS	KG F	Vert. Mom. T/F	LCG about ⊗	Aft Mom. T/F	Ford Mom. T/F	FSN T/F
GRAIN	4240	14.9	63176				
FRESH WATER	10	6	60				0.02
STORES	2	24	48				
COAL	3	20	60				
CREW(30)	2.2	30	145.2				
Total D/Weight	4257.2		63489.2				0.02
Lightship	1950	28.41	55408				
Displacement	6207.2	19.15	118897.2				0.02

F.S.Correction		0.02	MCT 510t/f	LCB 2.4F	LCF 3.6A		
KG Fluid	5.84M	19.17					
KM	6.65M	21.83	TRIM				
GM	0.81M	2.66	DRAUGHT ABOVE BASE AT LCF 23.75ft.				
N.W.Cormack, MAY '94.			Draught aft		Draught for.		

TRIM & STABILITY

SHIP HERZOGIN CECILIE

DATE MAY 1994

CONDITION NO.3. GRAIN CARGO

DISPLACEMENT 6207.2 tons(6306.5tonnes)

K.G.(FLUID) 19.17 feet(5.84M)

$GZ = KN - KG \sin \theta$

ITEM									
	10°	20°	30°	40°	50°	60°	70°	80°	90°
K.N.	4.00	8.40	12.20	15.40	17.58	19.00	19.70	19.20	18.41
K.G sin θ	3.34	6.58	9.59	12.31	14.68	16.60	18.00	18.88	19.17
G.Z.	0.66	1.82	2.61	3.09	2.90	2.40	1.70	0.32	-0.76

AREA UNDER GZ CURVE

0° - 30°(IMCO = 10.34°/FT 3.15°M)

Ord.	G.Z.	S/M	fA
0	0	1	0
10	0.66	3	1.98
20	1.82	3	5.46
30	2.61	1	2.61
		$\int fA$	10.05

Area = $\int fA \times {}^{3}/_{8} \times 10^{\circ}$

= $10.05 \times {}^{3}/_{8} \times 10$

= 37.69°F(11.49°M)

0° - 40°(IMCO = 16.93°/FT 5.16°M)

Ord.	G.Z.	S/M	fA
0	0	1	0
10	0.66	4	2.64
20	1.82	2	3.64
30	2.61	4	9.44
40	3.09	1	3.09
		$\int fA$	18.81

Area = $\int fA \times {}^{10^{\circ}}/_{3}$

= $18.81 \times {}^{10}/_{3}$

= 62.7°F(19.11°M)

30° - 40°(IMCO = 5.64°FT 1.72°M) = 25.01°F(7.62°M)

N.W.Cormack, '94.

SHIP: HERZOGIN CECILIE.

CONDITION NO. 3 GRAIN CARGO (4240tons)

WIND HEELING LEVERS.

DISPLACEMENT + 6207.2tons(6306.5tonnes)

SAIL AREA + 45000 feet^2 (4180 M^2)

CER _- CE = 87 feet (26.52M)

ALL PLAIN SAIL SET.

Wind force 6 Beaufort Scale (2.3 lbs. per foot^2)

$= 45000 \times 87 \quad 2.3 \times {}^{1}/_{2240} \times {}^{1}/_{6207.2}$

$= 0.64 \text{ feet.} \times \cos^2\theta$

10^o	20^o	30^o	40^o	50^o	60^o	70^o	80^o	90^o
0.63	0.57	0.49	0.38	0.27	0.16	0.08	0.02	0

N.W.CORMACK,
LARGS,
SOUTH AUSTRALIA,
MAY '94.

CONDITION N°3 GRAIN

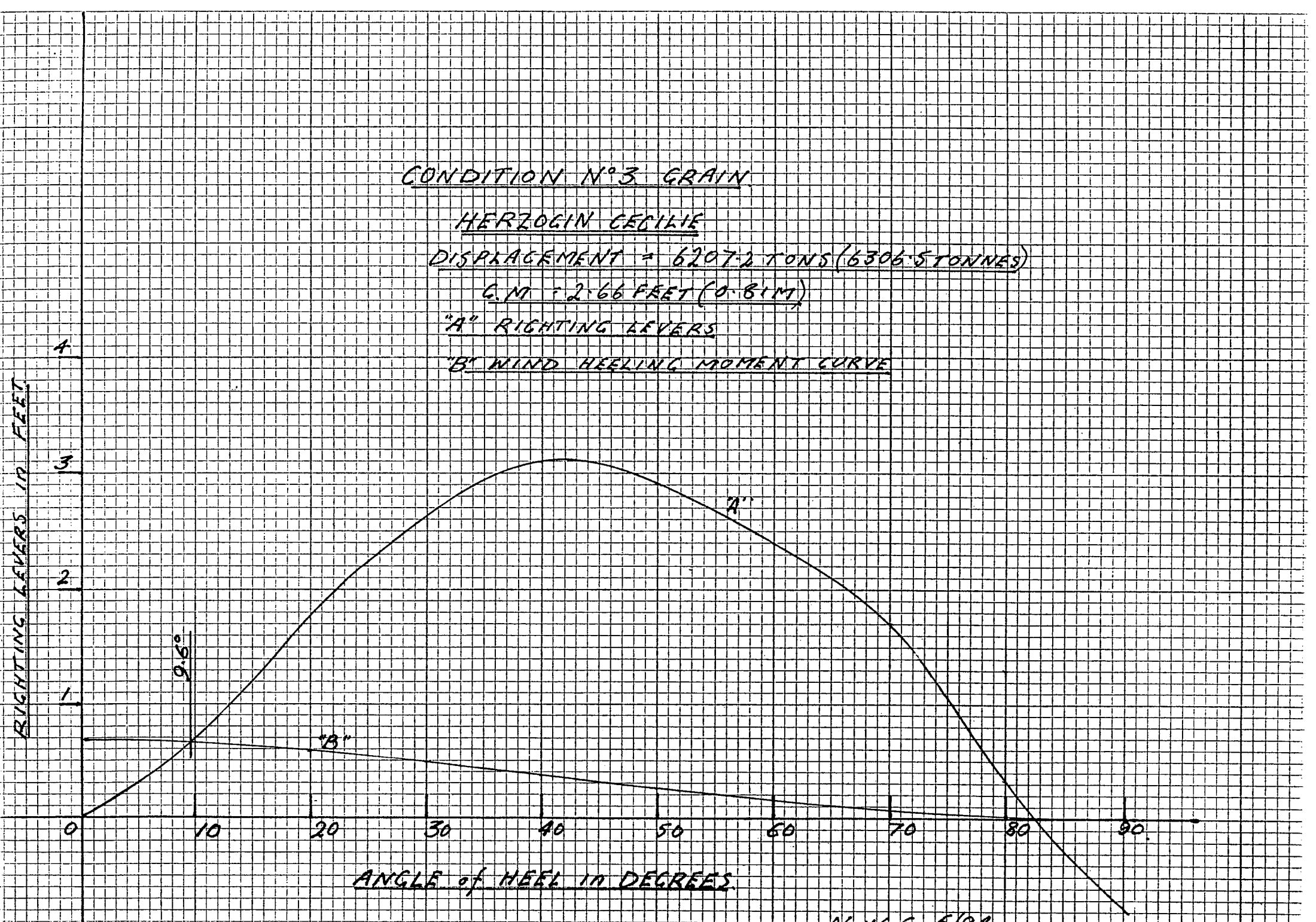
HERZOGIN CECILIE

DISPLACEMENT = 6207·2 TONS (6306·5 TONNES)

G.M = 2·66 FEET (0·81M)

"A" RIGHTING LEVERS

"B" WIND HEELING MOMENT CURVE



TRIM & STABILITY

SHIP HERZOGIN CECILIE DATE MAY 1994

CONDITION NO. 4 NITRATE CARGO

ITEM	Weight TONS	KG F	Vert. Mom. T/F	LCG about ⊗	Aft Mom. T/F	Ford Mom. T/F	FSN T/F
NITRATE	4240	13.5	57240				
FRESH WATER	10	6	60				0.02
STORES	2	24	48				
COAL	3	20	60				
CREW(30)	2.2	30	145.2				
Total D/Weight	4257.2		57553.2				0.02
Lightship	1950	28.41	55408				
Displacement	6207.2	18.20	112961.2				0.02

F.S.Correction		0.02	MCT 510t/f	LCB 2.4F	LCF 3.6A		
KG Fluid	5.55M	18.22					
KM	6.65M	21.83	TRIM				
GM	1.106M	3.63	DRAUGHT ABOVE BASE AT LCF 23.75ft.				
N.W.Cormack, '94			Draught aft		Draught for.		

TRIM & STABILITY

SHIP HERZOGIN CECILIE

DATE MAY 1994

CONDITION NO. 4. NITRATE CARGO

DISPLACEMENT 6207.2 tons(6306.5tonnes)

K.G.(FLUID) 18.22feet(5.55M)

$GZ = KN - KG \sin \theta$

ITEM									
	10°	20°	30°	40°	50°	60°	70°	80°	90°
K.N.	4.00	8.40	12.20	15.40	17.58	19.00	19.70	19.20	18.41
K.G. sin θ	3.17	6.25	9.11	11.70	13.96	15.77	17.13	17.95	18.22
G.Z.	0.83	2.15	3.09	3.70	3.62	3.23	2.57	1.25	0.19

AREA UNDER GZ CURVE

0° - 30°(IMCO = 10.34°/FT 3.15°M)

Ord.	G.Z.	S/M	fA
0	0	1	0
10	0.83	3	2.49
20	2.15	3	6.45
30	3.09	1	3.09
		$\int$fA	12.03

Area = $\int fA \times {}^{3}/_{8} \times 10^{\circ}$

= $12.03 \times {}^{3}/_{8} \times 10$

= 45.11°F(13.75°M)

0° - 40°(IMCO = 16.93°/FT 5.16°M)

Ord.	G.Z.	S/M	fA
0	0	1	0
10	0.83	4	3.32
20	2.15	2	4.30
30	3.09	4	12.36
40	3.70	1	3.70
		$\int$fA	23.68

Area = $\int fA \times {}^{10^{\circ}}/_{3}$

= $23.68 \times {}^{10}/_{3}$

= 78.93°F(24.06°M)

30° - 40°(IMCO = 5.64°FT 1.72°M) 33.83°F(10.31°M)

N.W.CORMACK, '94

CONDITION No. A NITRATE

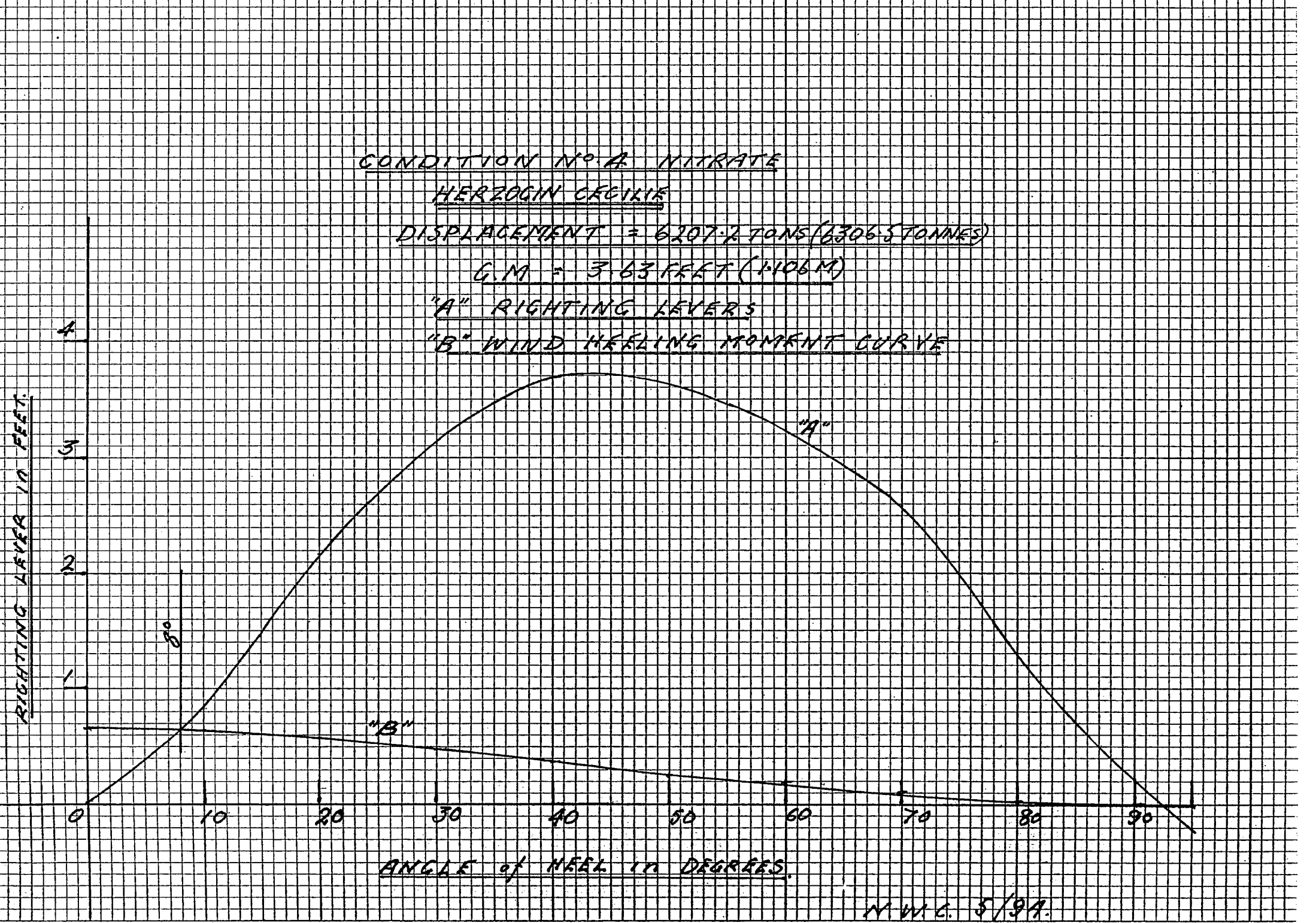
HERZOGIN CECILIE

DISPLACEMENT = 6207.2 TONS (6306.5 TONNES)

G.M = 3.63 FEET (1.106 M)

"A" RIGHTING LEVERS

"B" WIND HEELING MOMENT CURVE



W.W.C. 5/94.

APPENDIX II.

STABILITY DATA & HYDROSTATICS
of the
FOUR-MASTED BARQUE
POMMERN.

N.B. Figs. 7 & 8 designated in the text are included as integral with the Stability Data.

POMMERN

STABILITY & HYDROSTATIC

DATA

"POMMERN"

STABILITY DATA AND HYDROSTATIC INFORMATION.

DESCRIPTION: STEEL BARQUE.

RIG: "JUBILEE" RIGGED FOUR-MASTED BARQUE.

DESIGNERS & BUILDERS: J. REID & CO.,
GLASGOW.

YEAR: 1903.

DIMENSIONS.

L.O.A. 317.5 FEET(FIGUREHEAD TO TAFFRAIL) 96.77METRES.

LENGTH. 288 FEET(BETWEEN PERPENDICULARS) 87.78METRES

BEAM. 43.24 FEET. (13.18 METRES)

DEPTH. 26.5 FEET (8.08 METRES)

DRAUGHT. 22.15 FEET (6.75 METRES)

GROSS TONS. 2423.

NET TONNAGE. 2266.

DEADWEIGHT. 3950 TONS 4013.2 TONNES.

PENULTIMATE OWNERS: CAPTAIN GUSTAF ERIKSON, MARIEHAMN.

OWNERS: THE TOWN OF MARIEHAMN.

CUSTODIANS: AALANDS SJOFARTSMUSEUM, MARIEHAMN.

CLAES EKSTROM.
NAVAL ARCHITECT.

NEIL W. CORMACK
SHIPWRIGHT & NAVAL ARCHITECT

JYRKI ABRAHAMSSON
INTENDANT, MUSIEFARTYGET "POMMERN"

ALANDIA YARDS
ALGOTS & LUNMEK

4 masted barque POMMERN

Inclining test

Mariehamn 1993-09-20

Performed by: Ab Alandia Yards Oy, Ltd.
Claes Ekström
Naval Architect

AB ALANDIA YARDS OY LTD

Postadress	Telefon	Telefax	Banker	Postgiro
PB 65	Int +358-(9)28-21122	Int +358-(9)28-22882	ÅAB 660100-1035997	552448
SF-22101 Mariehamn		17266	ÅSb 441010-110118	

ALANDIA YARDS
ALGOTS & LUNMEK

4-m/b "Pommern"-Inclining test

The inclining test was performed by the undersigned in the Western Harbour of Mariehamn with slack lines and no tide, no wind and no waves. The following facts was noted during the test:

-Temperature of sea water		11,5 Centergrades
-Specific gravity of sea water:		1,004 tons/m3
-Draft aft		11,8´ = 3,60 m
-Draft fwd		10,75´= 3,28 m
-Mean draft		3,44 m
-Inclining weight Nr. 1		3,145 tons
-Inclining weight Nr. 2		3,195 tons
-Inclining weight Nr. 3		3,195 tons
-Inclining weight Nr. 4		3,319 tons
-Position/shifting of weights:		
-Inclining weight Nr. 1:	X= -4,23 m	Y=8,50 m
-Inclining weight Nr. 2:	0,69 m	8,50 m
-Inclining weight Nr. 3:	7,18 m	8,50 m
-Inclining weight Nr. 4:	11,86 m	8,50 m

Deflections, moments, calculations and results are found as enclosures to this statement.

Mariehamn 1993-10-10

Claes Ekström

Encls.

INCLINING EXPERIMENT

Name of Vessel: 4-Masted Barque "POMMERN"

Date of Experiment: September 29th, 1993

Experiment conducted by: CLAES EKSTROM

Witnessed by: JYRKI ABRAHAMSSON

No. of persons on board: Three(3)

Location: WEST HARBOUR MARIEHAMN.

Vessel headed: Sou-sou-east.

State of tide: slack

Weather conditions: Calm

Specific gravity of water: 1.004 (11.5 degrees centigrade)

Draft forward: 3.28 Metres(10.75 feet)

Draft aft: 3.60 Metres(11.8 feet)

Mean draft: 3.44 Metres(11.286 feet)

Inclining weights:

No. 1.	3.145 tonnes	(3.095 tons)
No. 2.	3.195 "	(3.145 ")
No. 3.	3.195 "	(3.145 ")
No. 4.	3.319 "	(3.267 ")

Length of pendulums: 4.110Metres(13.68feet) & 3.441Metres(11.29ft)

Distance moved:

SB(STARBOARD)	PS(PORT)
5.40 M(17.72feet)	5.38 M(17.65feet)
5.38 M(17.65 ")	5.38 M(17.65 ")
5.38 M(17.65 ")	5.36 M(17.59 ")
5.37 M(17.62 ")	5.37 M(17.62 ")

DISPLACEMENT AT INCLINING: 2239.16 tonnes(2203.897tons)

DISPLACEMENT AFTER REMOVAL OF INCLINING WEIGHTS AND THREE PERSONEL:

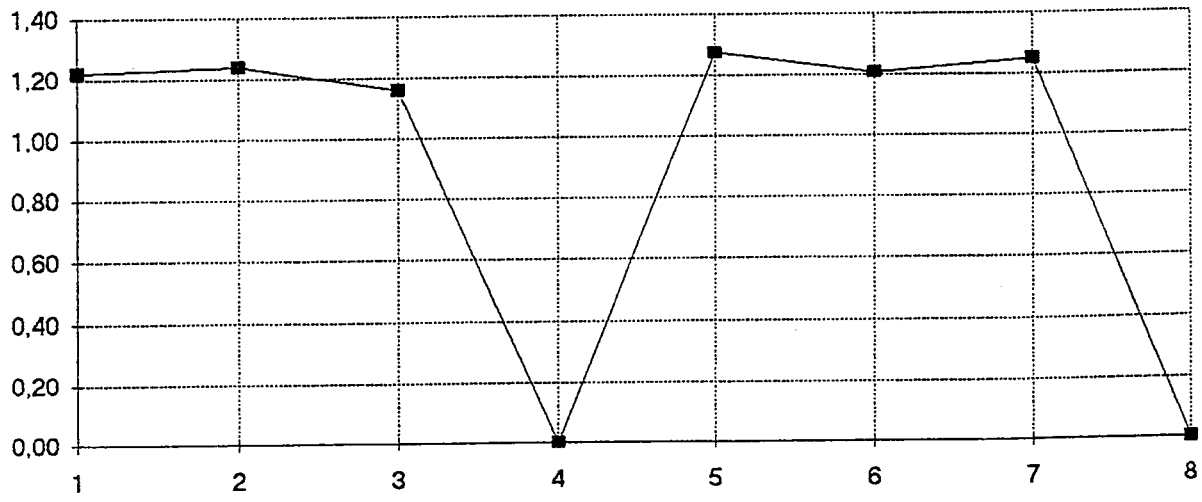
2226.07 tonnes(Metric)

2191.01 tons (Imperial)

ALANDIA YARDS
ALGOTS & LUNMEK

INCL. Diagram 1

GM 1



AB ALANDIA YARDS OY LTD

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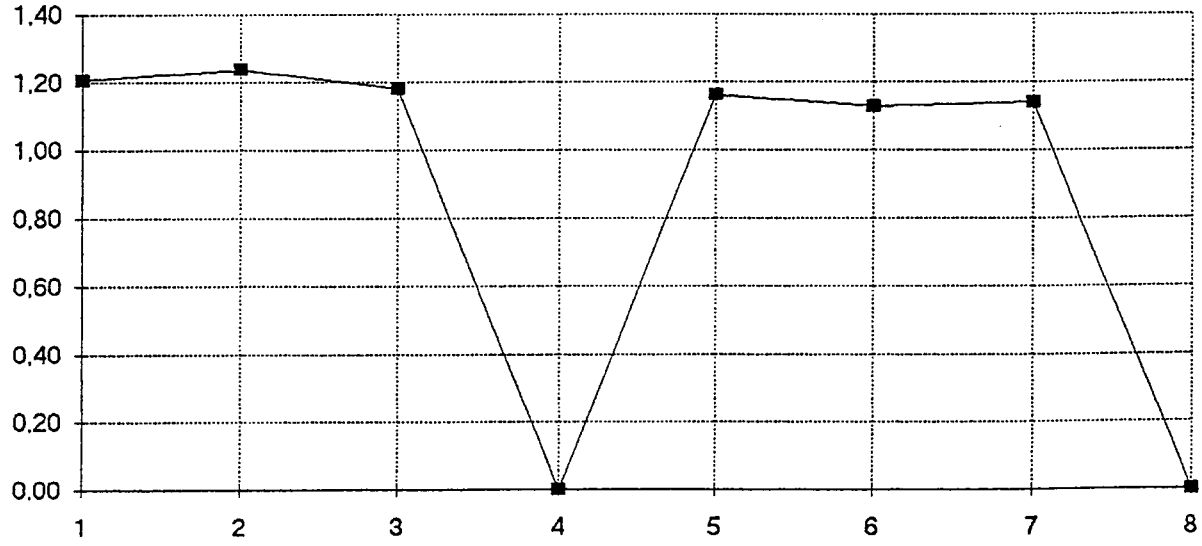
PB 65	Int +358-(9)28-21122	Int +358-(9)28-22882	ÅAB 660100-1035997	552448
SF-22101 Mariehamn		17266	ÅSb 441010-110118	

ALANDIA YARDS
ALGOTS & LUNMEK

INCL. Diagram 1

GM 2



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SF-22101 Mariehamn		17266	ÅSb 441010-110118	

ALANDIA YARDS
ALGOTS & LUNMEK

INCL.

INCLINATION TEST:			Per.Imm=	4170	Per.Imm=	3441	Displ.ton
Movem.	Weight	Arm	Perp.	GM 1	Perp.	GM 2	2155
Nr.	tonnes	m (+/-)	shift mm		shift mm		
1	10	3,474	55	1,22	46	1,21	
2	10	6,906	108	1,24	89	1,24	
3	10	3,474	58	1,16	47	1,18	
4	10	0	3	0,00	1	0,00	
5	10	3,354	51	1,27	46	1,16	
6	10	6,918	111	1,21	98	1,13	
7	10	3,354	52	1,25	47	1,14	
8	10	0	1	0,00	1	0,00	
9				########		########	
				7,35		7,06	
Average:				1,22		1,18	
Average:					1,20		

ALANDIA YARDS

ALGOTS & LUNMEK

INCL2.XLS

Weight description	Tons	X	X Moment	Y	Y Moment	
Ballast sand	12,05	-26,55	-319,93	1,14	13,74	
Ballast sand	183,28	-20,52	-3350,51	2,22	362,48	
Ballast sand	167,96	-11,72	-1968,49	2,65	445,09	
Ballast sand	221,08	8,51	1881,39	2,24	495,22	
Ballast sand	190,95	22,69	4332,66	2,65	506,02	
Ballast sand	87,38	28,90	2525,28	2,70	235,93	
	0,00	0,00	0,00	0,00	0,00	
Chain + rope	1,50	-33,00	-49,50	0,90	1,35	
Hatchcover beams	0,50	-22,50	-11,25	1,40	0,70	
Cabel	2,00	-44,00	-88,00	1,00	2,00	
Derrick (spare)	1,70	-2,80	-4,76	6,05	10,29	
Sails + wires	5,00	-37,50	-187,50	6,30	31,50	
Chain	0,50	-43,50	-21,75	6,00	3,00	
Furnitures,cable,wire,boards	5,00	35,50	177,50	6,30	31,50	
Rope	1,00	-33,50	-33,50	8,20	8,20	
Rope	1,00	33,50	33,50	8,20	8,20	
Inclining weights totally	12,85	3,98	51,14	8,50	109,23	
3 persons onboard	0,24	0,00	0,00	9,70	2,33	
			0,00		0,00	
Total of Weights and Moments:	873,99		2966,08		2266,78	
Centers of Gravity		3,39		2,59		

INPUT VALUES:	GM	LCB	KM	Displ.	MCTrim	Trim
	1,20	-1,02	6,67	2239,16	11,92	0,32

LIGHT SHIP VALUES:	Displ.	KGT	LG-test	LG-LShip		
	1365,17	7,31	-0,85	-3,57		

INPUT VALUES:	KM LShip					
	8,35		GMLship=	1,04		
					93-12-07	CE/-

"POMMERN"

THE STABILITY DATA CONTAINED IN THIS BOOKLET ONLY HOLDS GOOD PROVIDED THE BALLAST AND OR CARGO DOES NOT SHIFT. GREAT CARE SHOULD BE EXERCISED BY THE MASTER AND HIS OFFICERS TO SAFELY SECURE THE BALLAST AND OR CARGO.

FOR THE CARGOES LISTED FOR THE VARIOUS CONDITIONS THE FOLLOWING STOWAGE FACTORS WERE USED:-

	CARGO	STOWAGE FACTOR
1.	NITRATE	34 CUBIC FEET/TON
2.	SALT	40 " " "
3.	COAL	45 " " "
4.	WHEAT	50 " " "

WITH THE SALT, NITRATE AND COAL CARGOES IT WAS CONSIDERED THAT THE ENTIRE CARGO WAS STOWED IN THE LOWER HOLD.

TIMBER CARGOES HAVE NOT BEEN CONSIDERED AS IT IS NOT NOW KNOWN WHAT TONNAGES WERE STOWED, QUOTES REGARDING THESE CARGOES ARE ONLY GIVEN IN NUMBER OF STANDARDS. SIMILARLY THERE ARE NO FIGURES QUOTED FOR THE VARIOUS GENERAL CARGOES SHE CARRIED WHEN UNDER THE GERMAN FLAG.

ACTUAL TRIMS IN THE LOADED CONDITION IN THE LISTED CONDITIONS ARE ALSO NOW DIFFICULT TO CALCULATE AS DEPARTURE AND OR ARRIVAL DRAUGHT MARKS ARE NOT AVAILABLE. HOWEVER, MEAN DRAUGHT IS GIVEN FOR EACH CONDITION.

THE INCREASE IN LENGTH OF RIGHTING LEVERS IN THE SEVENTY DEGREE RANGE IS CAUSED BY THE INFLUENCE OF THE POOP WHICH WAS TAKEN INTO CONSIDERATION IN CALCULATING THE CROSS. CURVES.

DECEMBER, 1993.

NEIL W. CORMACK,
LARGS,
SOUTH AUSTRALIA.

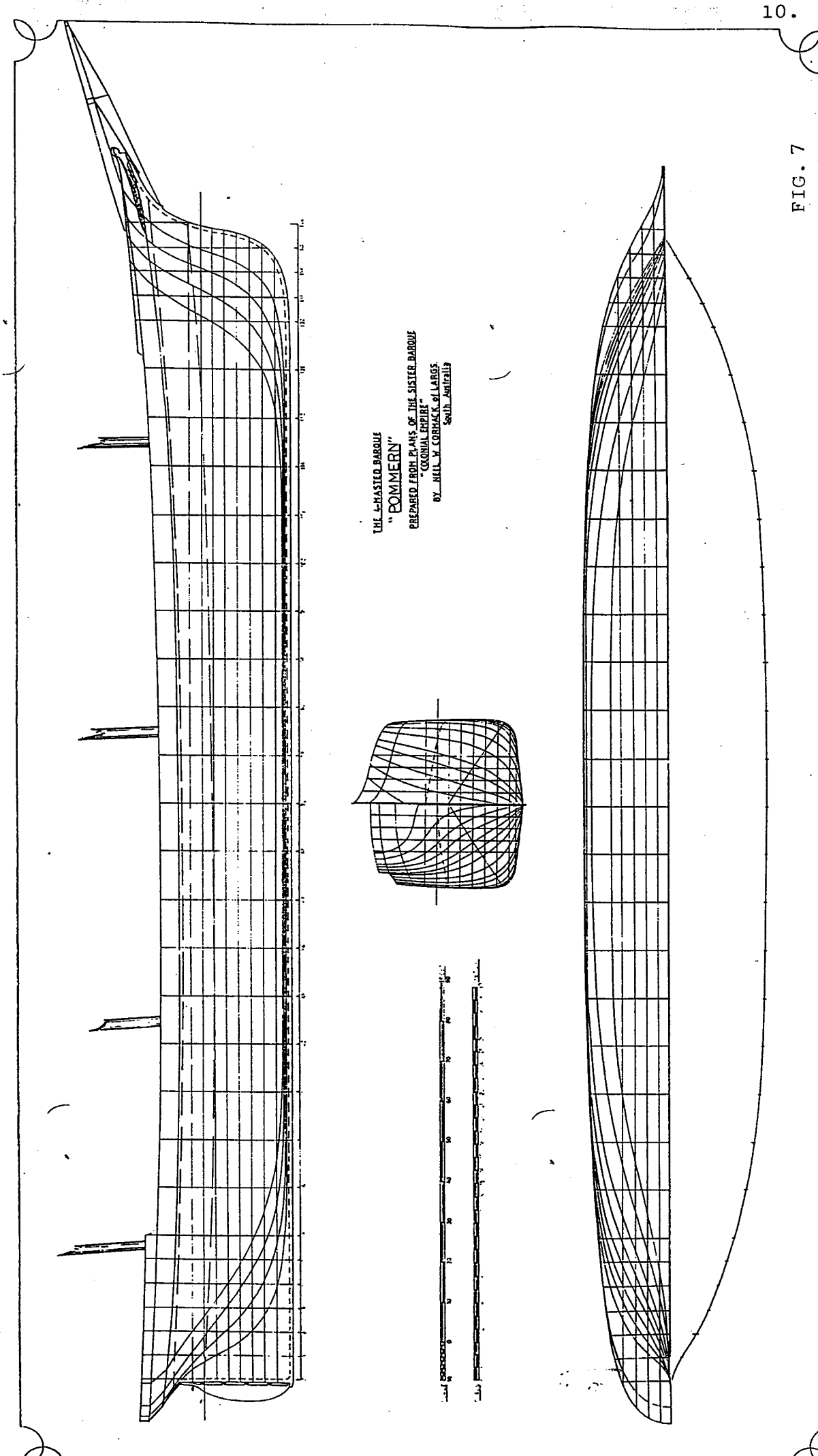
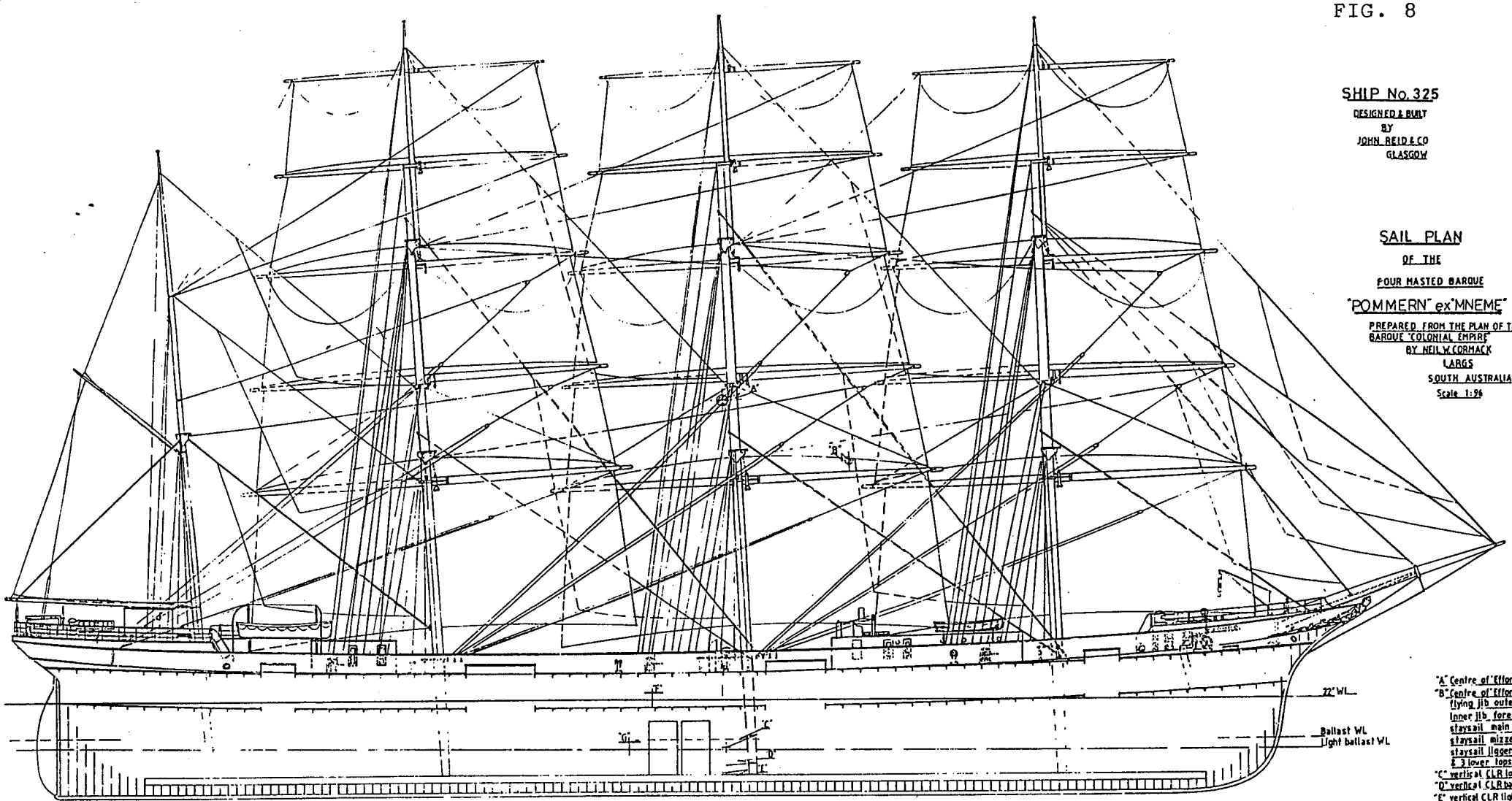

THE 4-MASTED BARQUE
"POMMERN"
PREPARED FROM PLANS OF THE SISTER BARQUE
"COLONIAL EMPIRE"
BY NEIL W CORMACK of LARGS.
South Australia

FIG. 7

FIG. 8



SHIP No. 325

DESIGNED & BUILT
BY
JOHN REID & CO
GLASGOW

SAIL PLAN

OF THE

FOUR MASTED BARQUE

"POMMERN" ex "MNEME"

PREPARED FROM THE PLAN OF THE SISTER
BARQUE "COLONIAL EMPIRE"
BY NEIL W. CORMACK
LARGS
SOUTH AUSTRALIA.
Scale 1:96

"A" Centre of Effort
"B" Centre of Effort with flying jib outer jib inner jib fore topmast staysail main topmast staysail mizzen topmast staysail jigger staysail & 3 lower topsails set
"C" vertical C.L.R loaded
"D" vertical C.L.R ballast
"E" vertical C.L.R light ballast

"A" - "C" 80·5 ft (26·54M)
"B" - "E" 72·25 (N 22 H)

"F" longitudinal C.L.R loaded. "G" longitudinal C.L.R light ballast

N.W. CORMACK. MAR 72

The 4-masted barque

"POMMERN"

SAIL & SPAR DETAILS

SAIL AREAS

Flying jib	630ft²
Outer "	593 "
Inner "	490 "
Fore topmast staysail	410 "
Foresail	2800 "
Fore lower topsail	1640 "
" upper "	1780 "
" lower t'gallant sail	1265 "
" upper " "	1240 "
Main topmast staysail	880 "
" t'gallant "	638 "
" sail	3040 "
" lower topsail	1640 "
" upper	1780 "
" lower t'gallant sail	1265 "
" upper " "	1240 "
Mizzen topmast staysail	880 "
" t'gallant "	638 "
Crossjack	3040 "
Mizzen lower topsail	1640 "
" upper "	1780 "
" lower t'gallant	1265 "
" upper "	1240 "
Jigger staysail	563 "
" topmast staysail	640 "
" t'gallant "	415 "
Spanker	1400 "
" topsail	665 "
TOTAL	35497ft²
= 3297 Metres²	

MASTS & SPARS

	Fore	dia.	Main	dia.	Mizzen	dia.	Jigger	dia.
Heel to main deck	25·82'	23·25"	23·92'	23·25"	23·46'	23·25"	31·82'	18·11"
Main deck to top	49·35'	28·35"	49·35'	28·35"	49·35'	28·35"	48·39'	22"
" " " topmast cap	114·8'		116·48'		116·8'		105·48'	
T'gallant masts	44·46'		44·46'		44·46'			
Doublings	17·88'		17·88'		17·88'			
Pole	6·56		7·21'		6·56'		5·08'	
Heel to truck	173·76'		174·19'		173·4'		142·38'	
Course yards	91·87'	20·5"	91·87'	20·5"	91·87'	20·5"		
Lower topsail yards	83·8'	19·29"	83·8'	19·29"	83·8'	19·29"		
Upper " "	78·35'	16·92"	78·35'	16·92"	78·35'	16·92"		
Lower t'gallant "	68·9'	15·36"	68·9'	15·36"	68·9'	15·36"		
Upper " "	61·09'	14·57"	61·09'	14·57"	61·09'	14·57"		
Spanker boom							44·46'	
" gaff							31·5'	
Bowsprit l.o.a	53·48'							
" free length	41·67'							

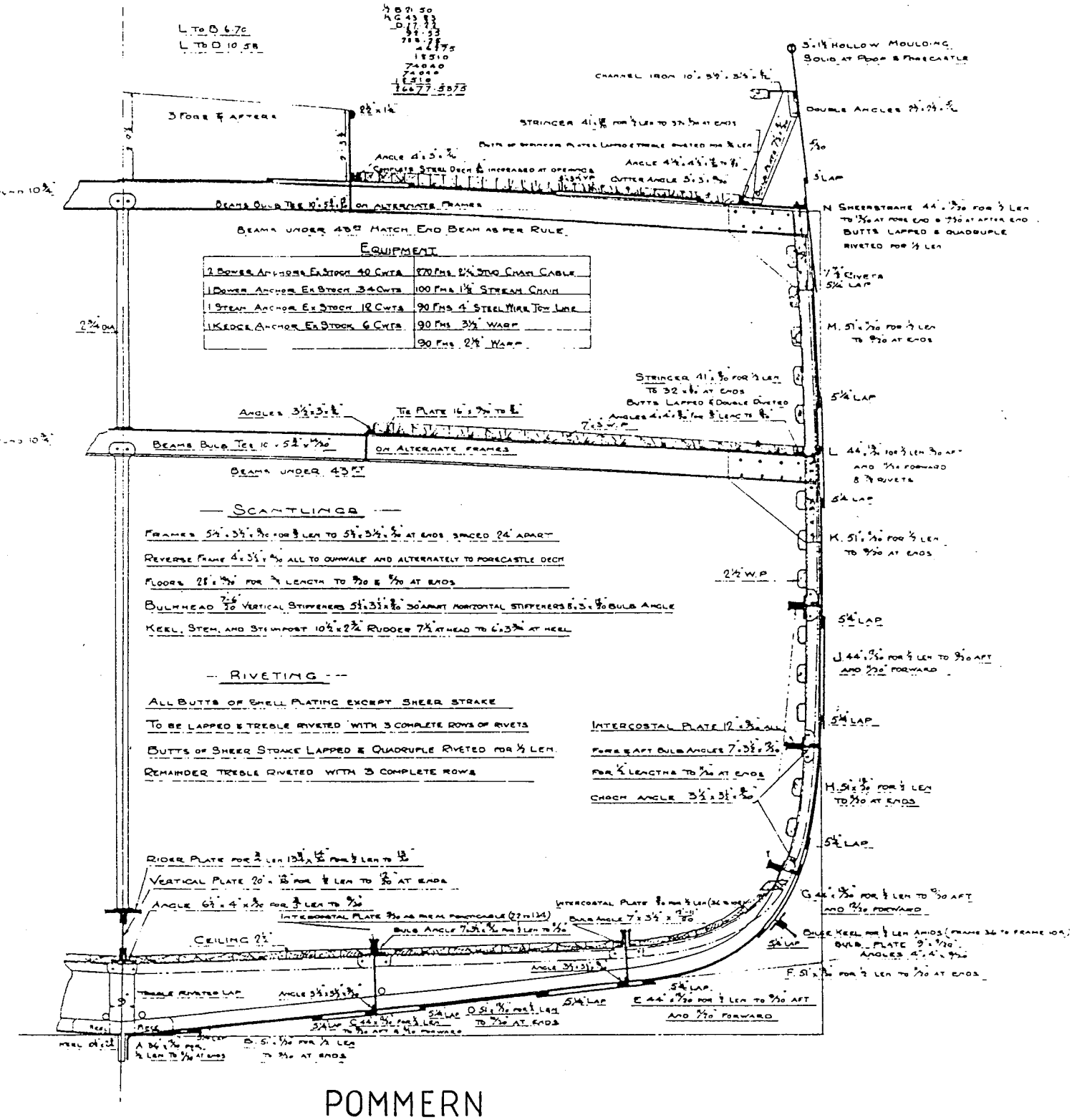
Vertical C.L.R. - C.E. loaded & under all plain sail = 80·5ft

Horizontal C.L.R. - C.E. " " " " " " = 17·25ft (5·97% LWL)

With flying jib, outer jib, inner jib, fore-topmast, staysail main-topmast staysail, mizzen-topmast staysail, jigger staysail, & 3 lower topsails set:--

Vertical C.L.R. - C.E. = 72·25ft (light ballast)

Horizontal C.L.R. - CE = 22·75ft (7·98% - light ballast W.L)


L To B 6.7c
L To D 10.5B
3 Fore & Afters
Beams Bulb Tee 10 × 5½ × ⅝ on alternate frames
Beams under 40ft Match End Beam as per Rule
Equipment
2 Bower Anchors Ex Stock 40 Cwts
1 Bower Anchor Ex Stock 34 Cwts
1 Stream Anchor Ex Stock 18 Cwts
1 Kedge Anchor Ex Stock 6 Cwts
270 Fms 2¼ Stud Chain Cable
100 Fms 1⅛ Stream Chain
90 Fms 4" Steel Wire Tow Line
90 Fms 3½ Warp
90 Fms 2½ Warp
Beams Bulb Tee 10 × 5½ × ⅝ on alternate frames
Beams under 43ft
Scantlings
Frames 5½ × 3½ × ⅝ for ⅓ len to 5½ × 3½ × ⅝ at ends spaced 24" apart
Reverse Frame 4 × 3½ × ⅝ all to gunwale and alternately to forecastle deck
Floors 28 × ⅝ for ⅓ length to ⅝ & ⅝ at ends
Bulkhead 7-6/10 Vertical Stiffeners 5½ × 3½ × ⅝ 30" apart Horizontal Stiffeners 5 × 3 × ⅝ Bulb Angle
Keel, Stem, and Stempost 10½ × 2¾ Rudder 7½ at head to 6 × 3¾ at heel
Riveting
All Butts of Shell Plating except Sheer Strake
To be lapped & treble riveted with 3 complete rows of rivets
Butts of Sheer Strake Lapped & Quadruple Riveted for ⅓ len.
Remainder treble riveted with 3 complete rows
Rider Plate for ⅔ len 13½ × ⅝ for ⅓ len to ½
Vertical Plate 20 × ½ for ⅓ len to ⅝ at ends
Angle 6½ × 4 × ⅝ for ⅓ len to ⅝
Ceiling 2½
Treble riveted lap
Keel
Stringer 41 × ⅝ for ⅓ len to 32 × ⅝ at ends
Butts lapped & Double Riveted
Angles 4 × 4 × ⅝ for ⅓ length ⅝
Tie Plate 16 × ⅞ to ⅝
Angles 3½ × 3 × ⅝
7 × 3 W.P.
2½ W.P.
Intercostal Plate 12 × ⅜ all
Fore & aft Bulb Angles 7 × 3½ × ⅜
for ⅓ lengths to ⅝ at ends
Chock Angle 3½ × 3½ × ⅝
Intercostal Plate ⅝ for ⅓ len (36 to 108)
Bulb Angle 7 × 3½ × ⅝
Angle 3½ × 3½ × ⅜
Bulb Keel for ⅓ len Amids (Frame 36 to Frame 108)
Bulb Plate 9 × ⅝
Angles 4 × 4 × ⅝
5" Hollow Moulding Solid at Poop & Forecastle
Channel Iron 10 × 3½ × 3½ × ⅝
Double Angles 2½ × 2½ × ⅝
Stringer 41 × ⅝ for ⅓ len to 32 × ⅝ at ends
Angle 4½ × 4½ × ⅝ to ⅝
Gutter Angle 5 × 3 × ⅝
Angle 4 × 3 × ⅝
Compleate Steel Deck & increased at openings
Outer Angle 5 × 3 × ⅝
N Sheerstrake 44 × ⅞ for ⅓ len to ⅝ at fore end & ⅞ at after end
Butts lapped & quadruple riveted for ⅓ len
7/8" Rivets
5½ Lap
M. 51 × ⅝ for ⅓ len to ⅝ at ends
5½ Lap
L 44 × ⅝ for ⅓ len ⅝ aft and ⅞ forward
⅞ Rivets
5½ Lap
K. 51 × ⅝ for ⅓ len to ⅝ at ends
5½ Lap
J 44 × ⅝ for ⅓ len to ⅝ aft and ⅞ forward
5½ Lap
H. 51 × ⅝ for ⅓ len to ⅝ at ends
5½ Lap
G 44 × ⅝ for ⅓ len to ⅝ aft and ⅞ forward
5½ Lap
F. 51 × ⅝ for ⅓ len to ⅝ at ends
5½ Lap
E 44 × ⅝ for ⅓ len to ⅝ aft and ⅞ forward
5½ Lap
D 51 × ⅝ for ⅓ len to ⅝ at ends
5½ Lap
C 44 × ⅝ for ⅓ len to ⅝ aft & ⅞ forward
5½ Lap
B. 51 × ⅝ for ⅓ len to ⅝ at ends
A 54 × ⅝ for ⅓ len to ⅝ at ends

POMMERN

See-Berufsgenossenschaft.

Freibord-Zertifikat.

Segelschiff: Minnie Untersch.-Signal: R M C K Brutto-Tonnengehalt: 2406

Reeder: B. Wencke Söhne Heimatshafen: Hamburg

Für Bestimmung des Freibords der in der langen und atlantischen Fahrt sowie in der grofsen Küstenfahrt beschäftigten Fahrzeuge gelten die in der Genossenschafts-Versammlung vom 6. Juni 1903 angenommenen und vom Reichs-Versicherungsamt genehmigten Vorschriften über den Freibord für Dampfer und Segelschiffe.

Auf Grund dieser Vorschriften ist die Berechnung des Freibords obigen Segelschiffs vom Germanischen Lloyd ausgeführt, und sind folgende Resultate ermittelt worden:

Freibord in Seewasser . . . . . F = 1,65 Meter

Abzug vom Freibord in Frischwasser . . . . . d = 0,13 "

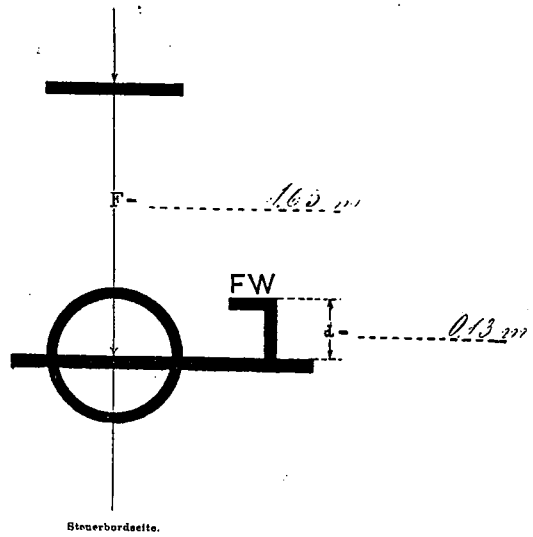
Die Stelle (Decklinie), von welcher ab der Freibord gemessen wird, liegt 93 mm über der Oberkante Stringerplatte des Hauptdecks an der Bordseite.

Berlin, den 20. November 1905

Germanischer Lloyd.

Unter Zugrundelegung vorstehender Angaben wird die Tiefladelinie obigen Segelschiffs wie folgt festgesetzt und angemarkt in Übereinstimmung mit den in der Skizze angegebenen Zahlen:

M



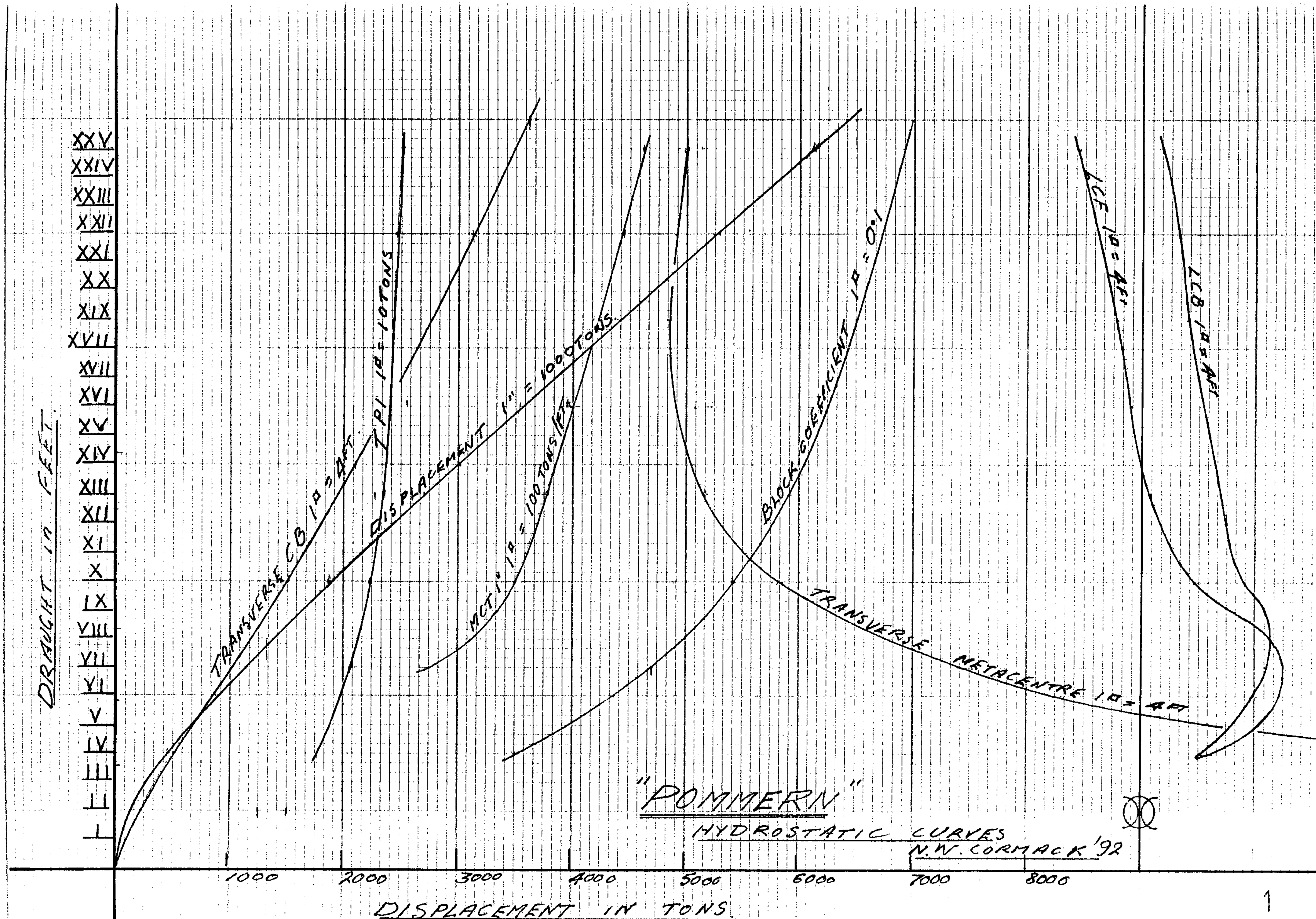
Das Schiff darf in Seewasser bis zur Oberkante der horizontalen Mittellinie des Kreises beladen werden.

" " " " Frischwasser " " " " mit FW bezeichneten Marke " "

Segelschiffe mit einem Brutto-Tonnengehalt von weniger als 100 Register-Tons dürfen auf Fahrten, welche die Grenzen der kleinen Küstenfahrt nicht erheblich überschreiten, im Sommer in Seewasser bis zur Oberkante der mit FW bezeichneten Marke beladen werden, in Frischwasser um die Entfernung „d" tiefer.

Hamburg, den 1. Dezember 1905.

Der Vorstand der See-Berufsgenossenschaft.

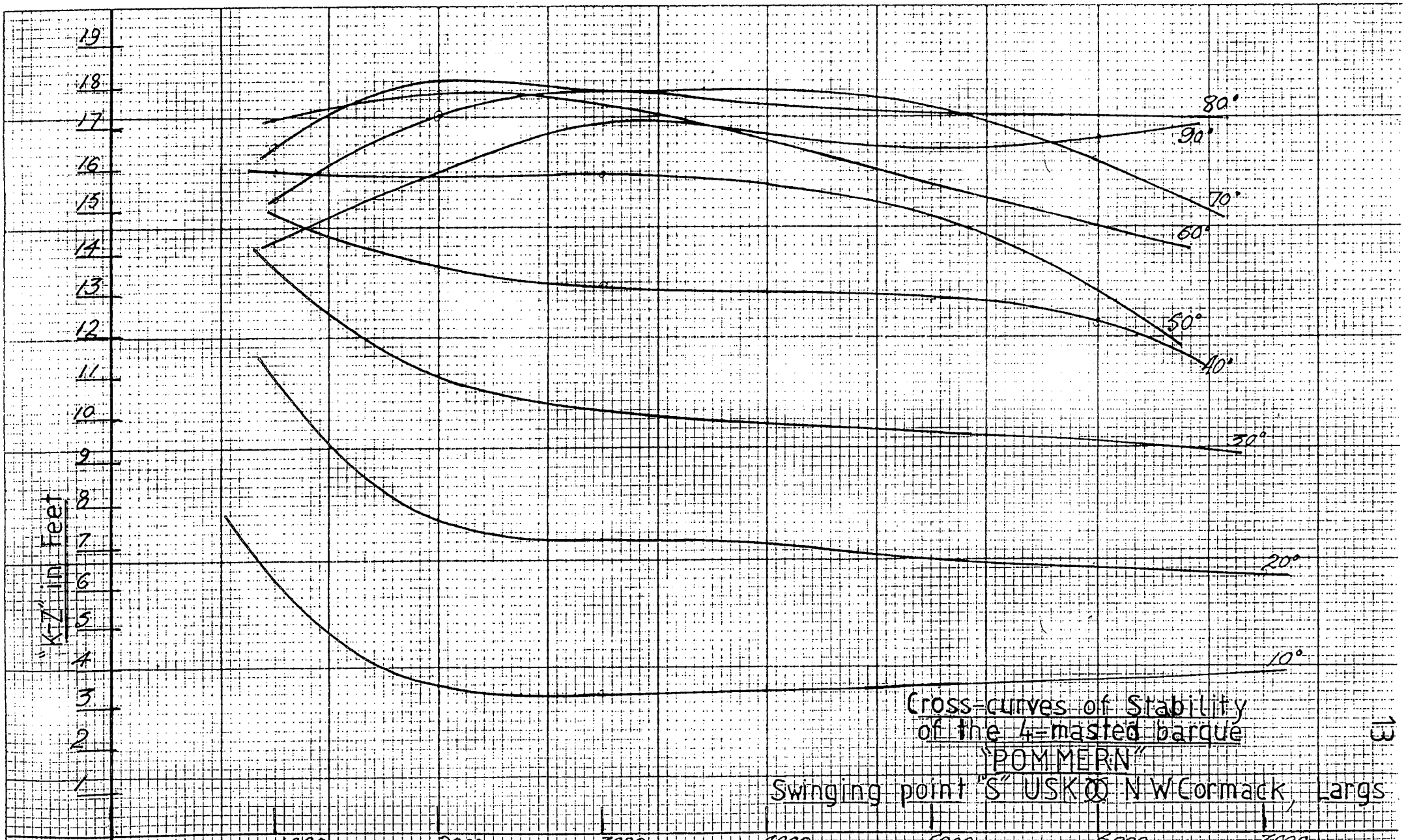


"POMMERN"

HYDROSTATIC CURVES

N.W. CORMACK '92

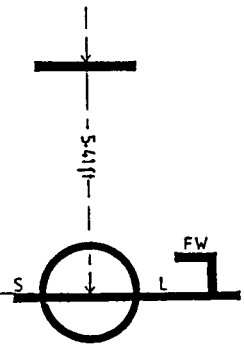
1



Cross-curves of Stability
of the 4-masted barque
"POMMERN"
Swinging point "S" USK ⊗ N W Cormack, Largs

DISPLACEMENT/DEADWEIGHT SCALE OF THE 4-MASTED BARQUE "POMMERN"

MEAN DRAUGHT IN FEET	DISPLACEMENT IN TONS	DEADWEIGHT IN TONS
	5500	4200
XXII	5400	4100
	5300	4000
	5200	3900
XXI	5100	3800
	5000	3700
	4900	3600
XX	4800	3500
	4700	3400
	4600	3300
XIX	4500	3200
	4400	3100
	4300	3000
XVIII	4200	2900
	4100	2800
	4000	2700
XVII	3900	2600
	3800	2500
	3700	2400
XVI	3600	2300
	3500	2200
	3400	2100
XV	3300	2000
	3200	1900
	3100	1800
XIV	3000	1700
	2900	1600
	2800	1500
XIII	2700	1400
	2600	1300
	2500	1200
XII	2400	1100
	2300	1000
	2200	900
XI	2100	800
	2000	700
	1900	600
X	1800	500
	1700	400
	1600	300
IX	1500	200
	1400	100
VIII	1300	0



Mean light draught 7'11¾"

LENGTH BETWEEN PERPENDICULARS ... 290' 0"
BEAM ... 43' 2½"
DEPTH ... 26' 6"

NEIL W. CORMACK
LARGS, SOUTH AUSTRALIA
AUGUST 1993

"POMMERN"

METACENTRIC HEIGHT(G.M.) NO. 1 PENDULIM

$$GM = \frac{W \times d}{W \times \tan \theta}$$

1. $GM = \frac{3.145 \times 10.78 \times 4170}{2239.16 \times 55} = 1.479$ metres

2. $GM = \frac{6.340 \times 10.76 \times 4170}{2239.16 \times 108} = 1.176$ "

3. $GM = \frac{3.195 \times 10.76 \times 4170}{2239.16 \times 58} = 1.104$ "

4. 0

5. $GM = \frac{3.195 \times 10.74 \times 4170}{2239.16 \times 51} = 1.255$ "

6. $GM = \frac{6.515 \times 10.74 \times 4179}{2239.16 \times 111} = 1.174$ "

7. $GM = \frac{3.319 \times 10.74 \times 4170}{2239.16 \times 52} = 1.277$ "

Average 1.244 "

GM No.1 pendulum = 1.244 metres.

GM NO. 2 PENDULUM.

1. $GM = \frac{3.145 \times 10.78 \times 3441}{2239.16 \times 46} = 1.133$ "

2. $GM = \frac{6.340 \times 10.76 \times 3441}{2239.16 \times 89} = 1.178$ "

3. $GM = \frac{3.195 \times 10.76 \times 3441}{2239 \times 47} = 1.123$ "

4. 0

5. $GM = \frac{3.195 \times 10.74 \times 3441}{2239.16 \times 46} = 1.143$ "

6. $GM = \frac{6.514 \times 10.74 \times 3441}{2239.16 \times 98} = 1.097$ "

7. $GM = \frac{3.319 \times 10.74 \times 3441}{2239.16 \times 47} = 1.166$ "

Average 1.140 "

GM NO. 2 pendulum = 1.140 metres
" " 1 " = 1.244 "
2.384 "

$GM = 2.384/2$

N.W.CORMACK, DEC. '93

GM = 1.192 or 1.20 metres

TRIM & STABILITY

SHIP "POMMERN" DATE DECEMBER 1993

CONDITION NO. 1 LIGHT SHIP

ITEM	weight TONS	KG F	Vert. Mom. T/F	LCG about ℄	Aft Mom. T/F	Ford. Mom. T/F	FSN T/F
Total D/Weight							
Lightship	1343.67	23.98	32221.21	11.71	F	15738.6	
Displacement	1343.67	23.98	32221.21	11.71	F	15738.6	
F.S. Correction			MCT 12^T/F	LCB 3/71'	LCF 5.18'		
KG Fluid 23.98ft.							
KM 27.40ft.			TRIM				
GM 3.42f t.			DRAUGHT ABOVE BASE AT LCF 7:11¾"				
N.W.CORMACK DEC. '93			Draught aft			Draught For	

TRIM & STABILITY

SHIP "POMMERN" DATE DECEMBER 1993

CONDITION NO. 1 LIGHT SHIP

DISPLACEMENT 1343.67 tons

K.G.(FLUID) 23.98feet.

$GZ = KN - KG \sin \theta$

ITEM	10°	20°	30°	40°	50°	60°	70°	80°	90°
K.N.	4.534'	9.430'	12.028'	14.056'	15.778'	16.310'	18.054'	16.352'	15.079
K.G sinθ	4.172'	8.225'	11.990'	15.395'	18.368'	20.766'	22.541'	23.620'	23.980
G.Z.	0.362	1.205'	0.038'	-1.339'	-2.590'	-4.456'	-4.487	-7.268	-8.901

AREA UNDER GZ CURVE

0° - 30° (IMCO = 10.34°/FT (3.15°M)

Ord.	G.Z.	S/M	fA
0	0	1	0
10	0.362	3	1.086
20	1.205	3	3.615
30	0.038	1	0.038
		$\int$fA	4.739

Area = $\int$fA x 3/8 x 10°

= 4.739 x 3/8 x 10

= 17.77° ft

5.41°M

0° - 40° (IMCO = 16.93°/FT(5.16°M)

Ord.	G.Z.	S/M	fA
0	0	1	0
10	0.362	4	1.448
20	1.205	2	2.410
30	0.038	4	0.152
40	-1.339	1	-1.339
		$\int$fA	2.671

Area = $\int$fA x 10°/3

= 2.671 x 10/3

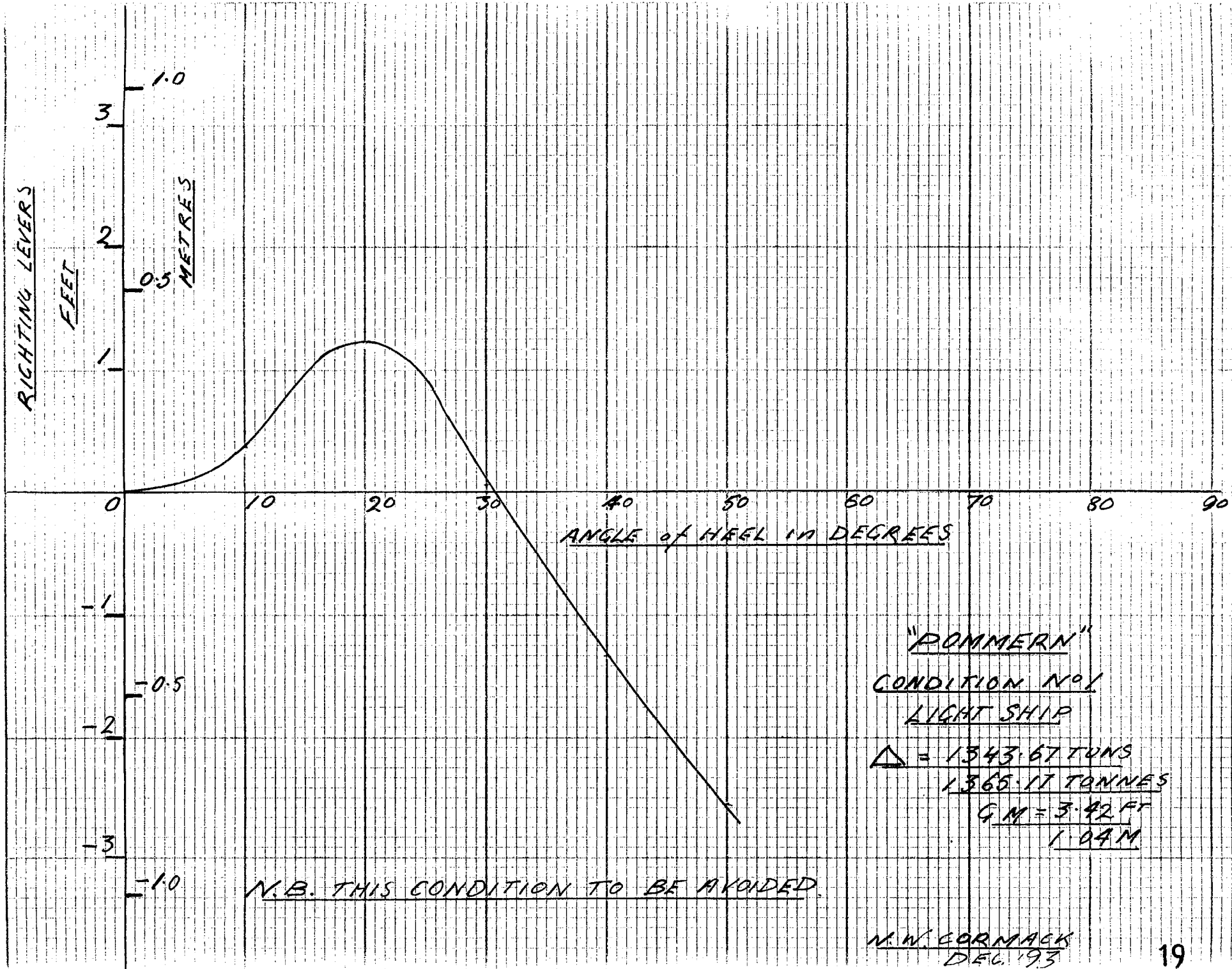
= 8.90° ft

2.71°M

30° - 40° (IMCO = 5.64°FT (1.72) -8.88° -2.71°M

N.B. IN THIS CONDITION THE "POMMERN" DOES NOT COMPLY WITH IMCO.

N.W.C.


RIGHTING LEVERS
FEET
METRES
1.0
3
2
0.5
1
0
10
20
30
40
50
60
70
80
90
ANGLE of HEEL in DEGREES
1
0.5
2
3
1.0
N.B. THIS CONDITION TO BE AVOIDED.
"POMMERN"
CONDITION No 1
LIGHT SHIP
Δ = 1343.67 TONS
1365.11 TONNES
G M = 3.42 FT
1.04 M
N. W. CORMACK
DEC. 193

TRIM & STABILITY

SHIP POMMERN DATE DECEMBER 1993

CONDITION NO. 2 CURRENT STATUS

ITEM	weight TONS	KG F	Vert. Mom. T/F	LCG about ⌀	Aft Mom. T/F	Ford. Mom. T/F	FSN T/F
ITEMS SHOWN ON INCL2XLS	8602.3	8.50	73105	11.12	9565.76		
ITEMS OFF							
INCLINING WEIGHTS	12.64	27.89	325.74	13.058	165.06		
PERSONEL	0.236	31.83	7.5				
Total D/Weight	847.35		6949.81	11.09	9400.7		
Lightship	1343.67	23.98	32221.21	11.71F		15738.6	
Displacement	2191.02	17.88	39171.02	2.89F		6337.9	
F.S. Correction			MCT	LCB	LCF		
KG Fluid		17.88	14.23'	3.3'	0.8'		
KM		21.88	TRIM				
GM		4.00'	DRAUGHT ABOVE BASE AT LCF			11.28'	3.44M
N.W.CORMACK, DEC. 1993			Draught aft			Draught For	

TRIM & STABILITY

SHIP "POMMERN" DATE DECEMBER 1993

CONDITION NO.2 CURRENT STATUS

DISPLACEMENT 2191.02 tons 2226.08 tonnes

K.G.(FLUID) 17.88 ft (5.45Metres)

$GZ = KN - KG \sin \theta$

ITEM	10°	20°	30°	40°	50°	60°	70°	80°	90°
K.N.	3.30	7.63	10.62	13.50	15.70	17.75	18.08	17.50	16.50
K.G sin θ	3.11	6.13	8.94	11.47	13.70	15.48	16.80	17.61	17.88
G.Z.	0.19	1.50	1.68	2.03	2.00	2.27	1.28	-0.11	-1.38

AREA UNDER GZ CURVE

0° - 30°(IMCO = 10.34°/FT 3.15°M)

Ord.	G.Z.	S/M	fA
0	0	1	0
10	0.19	3	0.57
20	1.50	3	4.50
30	1.68	1	1.68
		$\int fA$	6.75

Area = $\int fA \times 3/8 \times 10°$

= $6.75 \times 3/8 \times 10$

= 25.31°ft

7.71°M

0° - 40°(IMCO = 16.93°/FT 5.16°M)

Ord.	G.Z.	S/M	fA
0	0	1	0
10	0.19	4	0.76
20	1.50	2	3.00
30	1.68	4	6.72
40	2.03	1	2.03
		$\int fA$	12.51

Area = $\int fA \times 10°/3$

= $12.51 \times 10/3$

= 41.7°ft

12.71°M

30° - 40°(IMCO = 5.64°FT 1.72°M) 16.39°M

4.99°M

N.W.CORMACK, DEC. '93

CONDITION NO. 2 "POMMERN"

WIND HEELING LEVERS.

ALL PLAIN SAIL SET. AREA: 35497 FT^2 ($3297M^2$)

CLR - CE 85.5 FT (26.06M)

WIND FORCE 6 BEAUFORT SCALE.

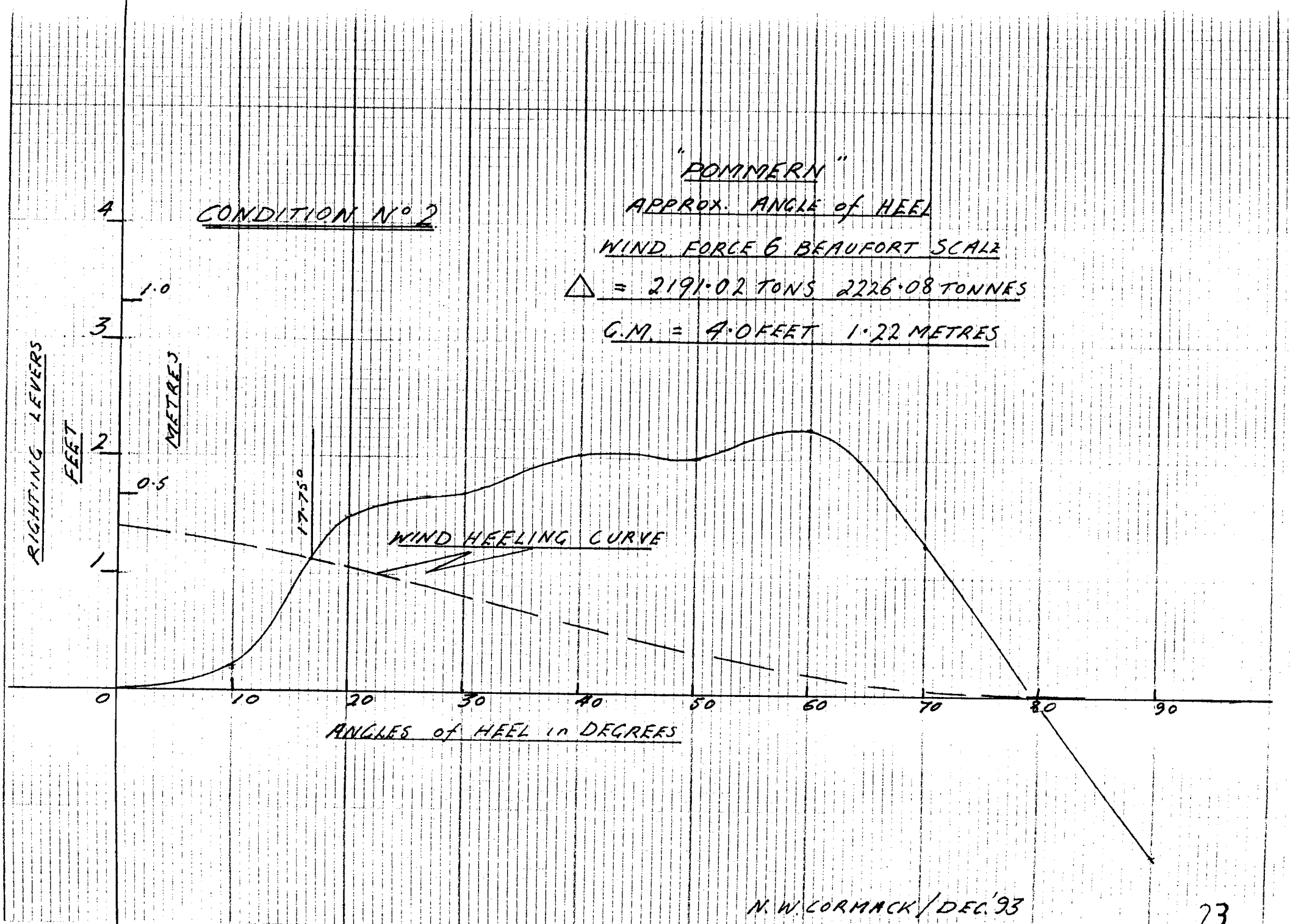
$$\text{HEALING LEVER} = \frac{35497 \times 85.5 \times 2.3}{2240 \times 2191.02}$$

$$= 1.42 \text{ FT } (0.43\text{M})$$

$$\text{HEALING LEVERS} = \text{Lever} \times \cos^2 \theta$$

10^o	20^o	30^o	40^o	50^o	60^o	70^o	80^o	90^o
1.38	1.257	1.066	0.83	0.59	0.36	0.17	0.043	0

NEIL W. CORMACK
LARGS, SOUTH AUSTRALIA
DECEMBER, 1993



N.W. CORMACK / DEC. '93

TRIM & STABILITY

SHIP "POMMERN" DATE DECEMBER 1993

CONDITION NO. 3. OCEAN GOING BALLAST TRIM.

ITEM	Weight TONS	KG F	Vert. Mom. T/F	LCG about ⊗	Aft Mom. T/F	Ford Mom. T/F	FSN T/F
BALLAST	1400	8	11200				
STORES	2	24	48	130A	260		
WATER	27	10	270	2F		54	
CREW	206	31.82	66.56				
COAL	4	29.50	118	24F		96	
SAILS(BENT)	5	91	455				
Total D/Weight	1440.06		12156.56		260	150	
Lightship	1343.67	23.98	32221.21	11.71F		15738.6	
Displacement	2783.73	15.94	44377.17				

F.S.Correction		0	MCT	LCB	LCF		
KG Fluid	4.86M	15.94'	10.91	1.8'F	0.2'F		
KM	6.19M	20.30'	TRIM				
GM	1.33M	4.36'	DRAUGHT ABOVE BASE AT LCF 13.11 feet.				
N.W.CORMACK, DEC."93			Draught aft		Draught for.		

TRIM & STABILITY

SHIP "POMMERN" DATE DECEMBER 1993

CONDITION NO.3. OCEAN GOING BALLAST TRIM.

DISPLACEMENT 2783.73 TONS 2828.27 TONNES.

K.G.(FLUID) 15.94FEET. 4.85METRES.

$GZ = KN - KG \sin \theta$

ITEM	10°	20°	30°	40°	50°	60°	70°	80°	90°
K.N.	3.25	7.20	10.39	13.30	15.80	17.60	17.80	17.98	17.00
K.G. sin θ	2.77	5.45	7.97	10.23	12.21	13.88	14.98	15.70	15.94
G.Z.	0.48	1.75	2.42	3.07	3.59	3.72	2.82	2.28	1.06

AREA UNDER GZ CURVE

0° - 30°(IMCO = 10.34°/FT 3.15°M)

Ord.	G.Z.	S/M	fA
0	0	1	0
10	0.48	3	1.44
20	1.75	3	5.25
30	2.42	1	2.42
		$\int$fA	9.11

Area = $\int fA \times 3/8 \times 10°$

= $9.11 \times 3/8 \times 10$

= 34.16°ft. 10.41°M

0° - 40°(IMCO = 16.93°/FT 5.16°M)

Ord.	G.Z.	S/M	fA
0	0	1	0
10	0.48	4	1.92
20	1.75	2	3.50
30	2.42	4	9.68
40	3.07	1	3.07
		$\int$fA	18.17

Area = $\int fA \times 10°/3$

= $18.17 \times 10/3$

= 60.57°ft 18.4°M

30° - 40°(IMCO = 5.64°FT 1.72°M) 26.41°ft. 8.04°M

N.W.CORMACK, DEC.'93

CONDITION NO. 3 "POMMERN"

WIND HEELING LEVERS.

ALL PLAIN SAIL SET. AREA: 35497 FT^2 (3297M^2)

CLR - CE 85ft. (25.9M)

WIND FORCE-6 BEAUFORT SCALE

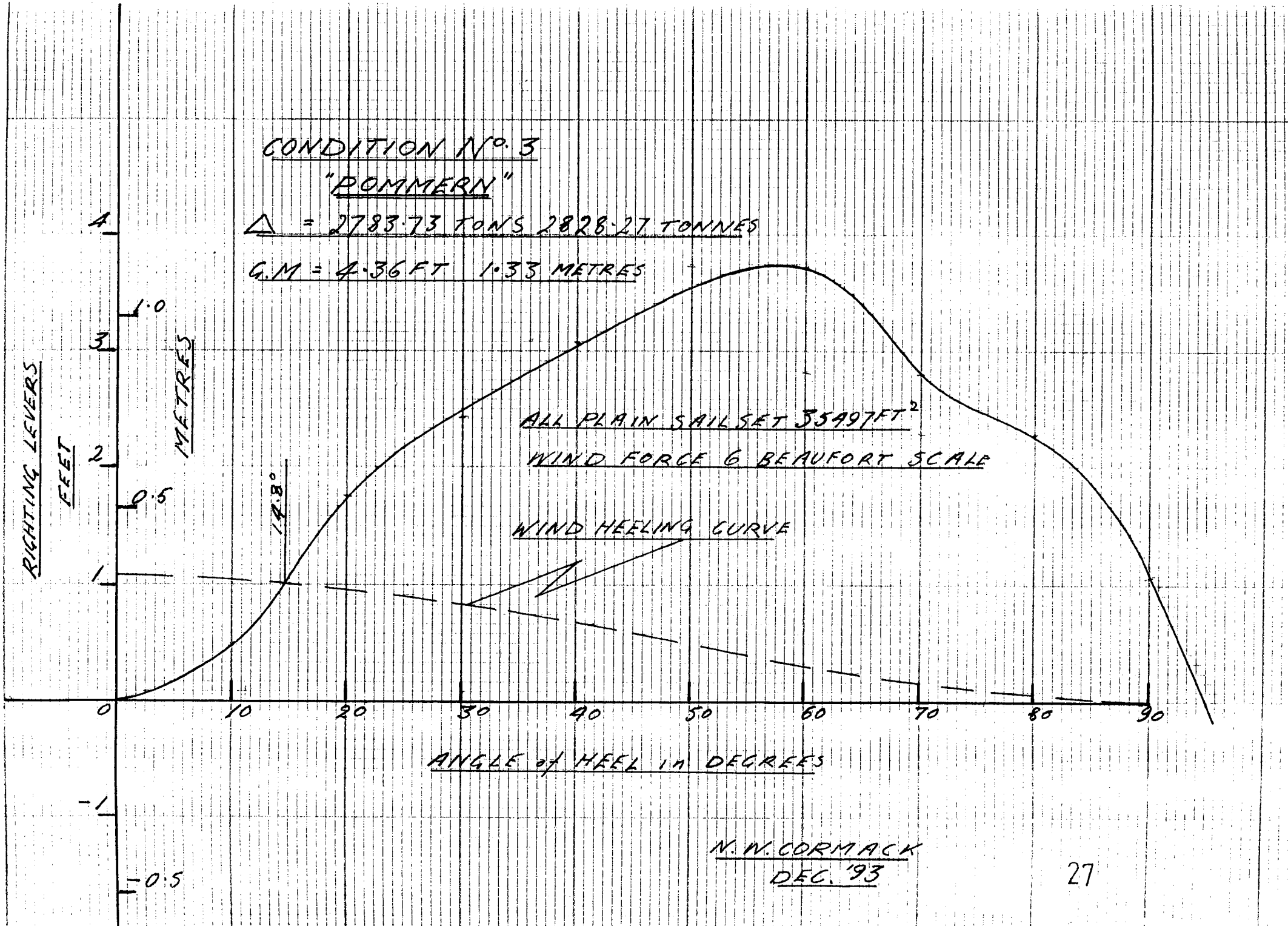
$$\text{LEVER} = \frac{35497 \times 85 \times 2.3}{2240 \times 2783.73}$$

$$= 1.11 \text{ feet}$$

$$\text{Levers} = \text{LEAVER} \times \cos^2 \theta$$

10°	20°	30°	40°	50°	60°	70°	80°	90°
1.08	0.985	0.836	0.654	0.459	0.28	0.13	0.03	0

N.W.CORMACK,
LARGS, SOUTH AUSTRALIA,
DEC. '93


CONDITION No. 3
"POMMERN"
Δ = 2783·73 TONS 2828·27 TONNES
G.M = 4·36 FT 1·33 METRES
ALL PLAIN SAIL SET 35497FT²
WIND FORCE 6 BEAUFORT SCALE
WIND HEELING CURVE
14·8°
RIGHTING LEVERS
FEET
METRES
4
3
2
1
0
-1
1·0
0·5
-0·5
0
10
20
30
40
50
60
70
80
90
ANGLE of HEEL in DEGREES
N. W. CORMACK
DEC. '93

TRIM & STABILITY

SHIP "POMMERN" DATE DECEMBER, '93

CONDITION NO. 4. BALLAST(DELFZIJL 1923)

ITEM	weight TONS	KG F	Vert. Mom. T/F	LCG about ℄	Aft Mom. T/F	Ford. Mom. T/F	FSN T/F
BALLAST	325	5.5	1787.5				
Total D/Weight	325		1787.5				
Lightship	1343.67	23.98	32221.21	11.71F		15738.6	
Displacement	1668.67	20.38	34008.71				
F.S. Correction		0	MCT	LCB	LCF		
KG Fluid	6.21M	20.38'	13.10	3.8'F	3.00'F		
KM	7.47M	24.50'	TRIM				
GM	1.26M	4.12'	DRAUGHT ABOVE BASE AT LCF 9.10ft				
N.W.CORMACK, DEC. '93			Draught aft		Draught For		

TRIM & STABILITY

SHIP "POMMERN" DATE DECEMBER. 1993

CONDITION NO.4. BALLAST (DELFZIJL, 1923)

DISPLACEMENT 1668.67 TONS 1695.37 TONNES

K.G.(FLUID) 20.38 FT. 6.21 METRES

$GZ = KN - KG \sin \theta$

ITEM	10°	20°	30°	40°	50°	60°	70°	80°	90°
K.N.	3.83	8.61	11.30	13.75	15.75	17.82	18.19	16.90	15.70
K.G. sin θ	3.55	6.99	10.19	13.08	15.61	17.64	19.36	20.70	19.36
G.Z.	0.28	1.62	1.11	0.67	0.14	0.18	-1.17	-3.8	-4.68

AREA UNDER GZ CURVE

0° - 30° (IMCO = 10.34°/FT 3.15°M

Ord.	G.Z.	S/M	fA
0	0	1	0
10	0.28	3	0.84
20	1.62	3	4.86
30	1.11	1	1.11
		$\int fA$	6.81

Area = $\int fA \times 3/8 \times 10°$

= $6.81 \times 3/8 \times 10$

= 20.43°ft

6.23°M

0° - 40° (IMCO = 16.93°/FT 5.16°M

Ord.	G.Z.	S/M	fA
0	0	1	0
10	0.28	4	1.12
20	1.62	2	3.24
30	1.11	4	4.44
40	0.67	1	0.67
		$\int fA$	9.47

Area = $\int fA \times 10°/3$

= $9.47 \times 10/3$

= 31.57°ft

9.60°M

30° - 40° (IMCO = 5.64°FT 11.14 ft 3.40°M

N.W.CORMACK,
DEC. '93.

"POMMERN"

$\triangle$ = 1668·67 TONS

1695·37 TONNES

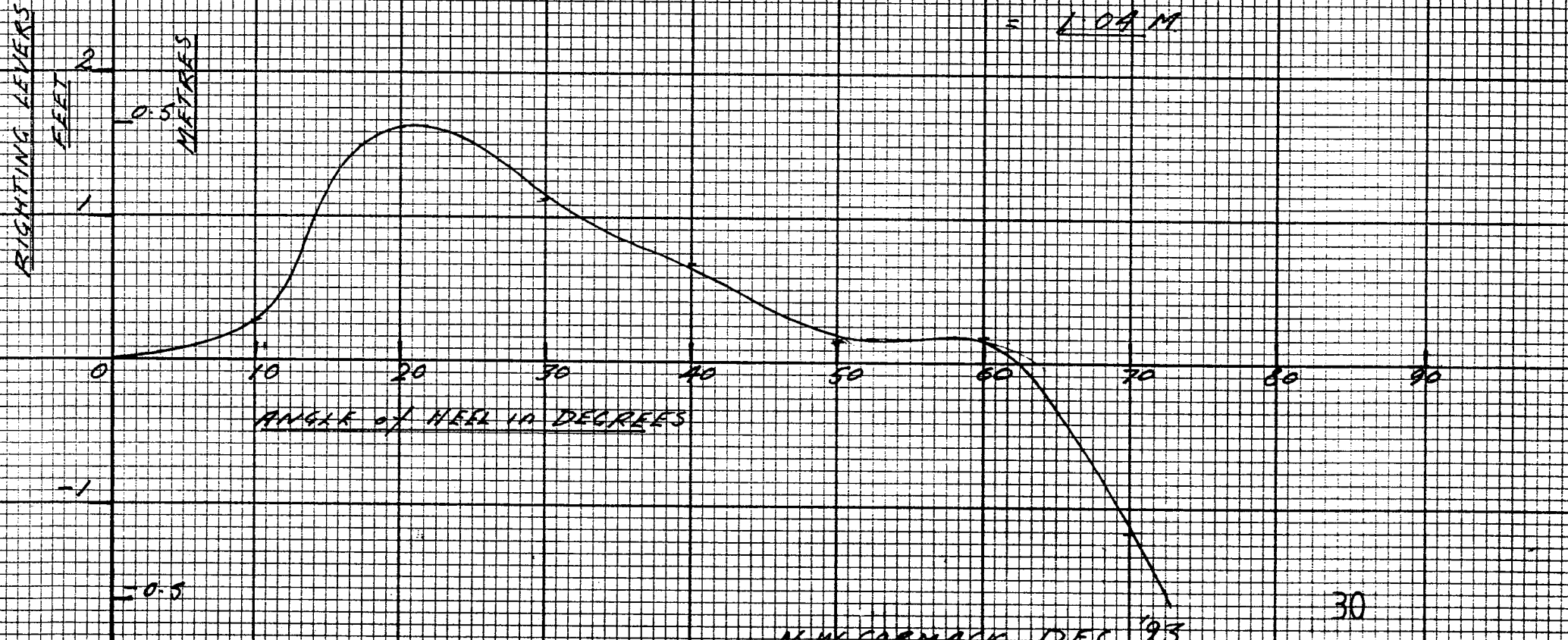
GM = 3·92 FT

= 1·04 M

CONDITION N° 4

IN LIGHT BALAST

DELFZIJL 1923



TRIM & STABILITY

SHIP "POMMERN" DATE DECEMBER, 1993

CONDITION NO.5. NITRATE

ITEM	Weight TONS	KG F	Vert. Mom. T/F	LCG about ⊗	Aft Mom. T/F	Ford Mom. T/F	FSN T/F
NITRATE	3950	12	47400				
STORES	2	24	48	130A	230		
WATER	13	10	130	2F		26	
CREW	2.06	31.82	65.56				
SAILS(BENT)	5	91	455				
Total D/Weight	3972		48098.56		230	26	
Lightship	1343.67	23.98'	32221.21	11.71		15738.6	
Displacement	5315.67	15.11	80319.77				

F.S.Correction		0	MCT	LCB	LCF		
KG Fluid	4.61M	15.11'	11.90tf	1.24F	1.55A		
KM	5.98M	19.60'	TRIM				
GM	1.37M	4.49'	DRAUGHT ABOVE BASE AT LCF 22.16' 6.75M				
N.W.CORMACK, DEC.;93.			Draught aft		Draught for.		

TRIM & STABILITY

SHIP "POMMERN" DATE DECEMBER,'93

CONDITION NO.5 NITRATE.

DISPLACEMENT 5315.67TONS 5400.72 TONNES

K.G.(FLUID) 15.11FEET 4.61METRES.

$GZ = KN - KG \sin \theta$

ITEM									
	10°	20°	30°	40°	50°	60°	70°	80°	90°
K.N.	3.59	6.53	9.50	12.63	14.04	15.25	16.92	17.21	16.43
K.G. sin θ	2.63	5.18	7.56	9.70	11.57	13.09	14.20	14.88	15.11
G.Z.	0.96	1.35	1.94	2.93	2.47	2.16	2.76	2.33	1.32

AREA UNDER GZ CURVE

0° - 30°(IMCO = 10.34°/FT 3.15°M)

Ord.	G.Z.	S/M	fA
0	0	1	0
10	0.96	3	2.88
20	1.35	3	4.05
30	1.94	1	1.94
		$\int fA$	8.87

Area = $\int fA \times 3/8 \times 10°$

= $8.87 \times 3/8 \times 10$

= 33.26°ft 10.14°M

0° - 40°(IMCO = 16.93°/FT 5.16°M)

Ord.	G.Z.	S/M	fA
0	0	1	0
10	0.96	4	3.84
20	1.35	2	2.70
30	1.94	4	7.76
40	2.93	1	2.93
		$\int fA$	17.23

Area = $\int fA \times 10°/3$

= $17.23 \times 10/3$

= 57.43°ft 17.50°M

30° - 40°(IMCO = 5.64°FT 1.72°M) 24.17°ft 7.36°M

N.W.CORMACK, DEC. '93.

CONDITION NO.5. "POMMERN"

WIND HEELING LEVERS.

ALL PLAIN SAIL SET AREA; 35497 FT^2 ($3297M^2$)

WIND FORCE 6 BEAUFORT SCALE.

$$\text{HEALING LEVER} = \frac{35497 \times 80.5 \times 2.3}{2240 \times 5315.67}$$

$$= 0.552 \text{ FEET}$$

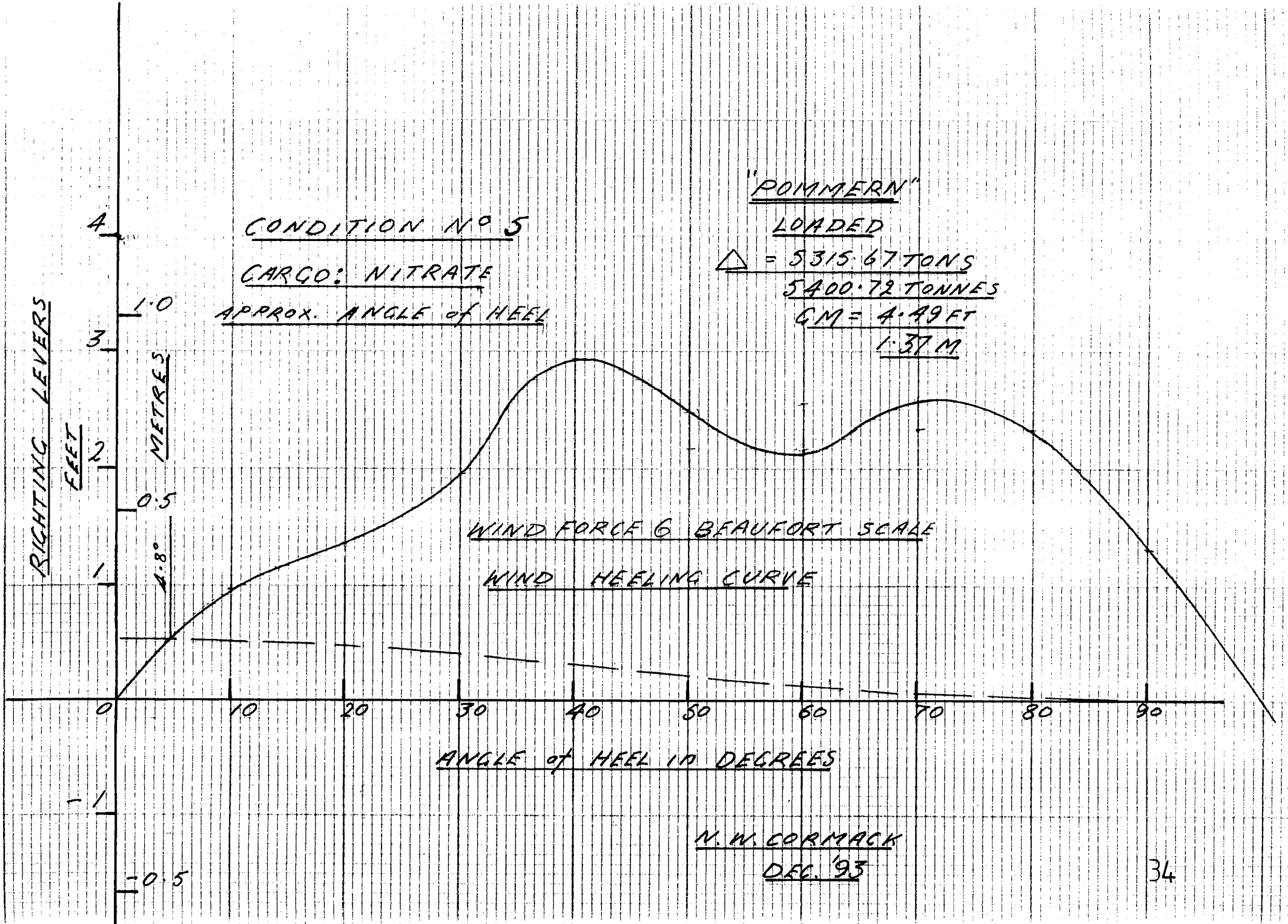
$$\text{HEALING LEVERS} = \text{Lever} \times \cos^2\theta$$

10^o	20^o	30^o	40^o	50^o	60^o	70^o	80^0	90^0
0.536	0.499	0.414	0.324	0.227	0.138	0.065	0/017	0

N.W.CORMACK

LARGS, SOUTH AUSTRALIA

DECEMBER, 1993.


"POMMERN"
LOADED
△ = 5315.67 TONS
5400.72 TONNES
GM = 4.49 FT
1.37 M
CONDITION Nº 5
CARGO: NITRATE
APPROX. ANGLE of HEEL
4.8°
WIND FORCE 6 BEAUFORT SCALE
WIND HEELING CURVE
RIGHTING LEVERS
FEET
METRES
4
3
2
1
0
-1
1.0
0.5
-0.5
0
10
20
30
40
50
60
70
80
90
ANGLE of HEEL IN DEGREES
N. W. CORMACK
DEC. '93

TRIM & STABILITY

SHIP "POMMERN" DATE DECEMBER, 1993.

CONDITION NO.6. SALT CARGO (LIVERPOOL - SYDNEY, 1928)

ITEM	Weight TONS	KG F	Vert. Mom. T/F	LCG about ⊗	Aft Mom. T/F	Ford Mom. T/F	FSN T/F
SALT	3257	13	42341				
STORES	2	24	48	130A	260		
WATER	26.75	10	267.5	2F		53.5	
CREW (28)	2.06	31.82	65.56				
COAL	1.00	29.50	29.50	24F		24	
SAILS(BENT)	5	91	455				
Total D/Weight	3293.81		43206.51		260	77.5	
Lightship	1343.67	23.98	32221.21	11.71F		15738.6	
Displacement	4637.48	16.26	75427.72				

F.S.Correction		0	MCT	LCB	LCF		
KG Fluid	4.96M	16.26'	11.5tf	1.5F	1.0A		
KM	5.87M	19.25'	TRIM				
GM	0.91M	2.99'	DRAUGHT ABOVE BASE AT LCF			19.8'	6.03M
N.W.CORMACK, DEC. '93.			Draught aft		Draught for.		

TRIM & STABILITY

SHIP "POMMERN" DATE DECEMBER, 1993.

CONDITION NO.6. SALT CARGO (LIVERPOOL - SYDNEY, 1928)

DISPLACEMENT 4637.48 TONS 4711.68 TONNES.

K.G.(FLUID) 16.26 FEET 4.96 METRES.

$GZ = KN - KG \sin \theta$

ITEM	10°	20°	30°	40°	50°	60°	70°	80°	90°
K.N.	3.50	6.83	9.70	12.90	15.18	16.00	17.60	17.40	16.48
K.G. sin θ	2.83	5.58	8.13	10.43	12.46	14.08	15.28	16.02	16.26
G.Z.	0.67	1.25	1.57	2.47	2.72	1.94	2.32	1.38	0.22

AREA UNDER GZ CURVE

0° - 30°(IMCO = 10.34°/FT 3.15°M)

Ord.	G.Z.	S/M	fA
0	0	1	0
10	0.67	3	2.01
20	1.25	3	3.75
30	1.57	1	1.57
		$\int$fA	7.33

Area = $\int fA \times 3/8 \times 10°$

= $7.33 \times \frac{3}{8} \times 10$

= 27.49°ft 8.38°M

0° - 40°(IMCO = 16.93°/FT 5.16°M)

Ord.	G.Z.	S/M	fA
0	0	1	0
10	0.67	4	2.68
20	1.25	2	2.50
30	1.57	4	6.28
40	2.47	1	2.47
		$\int$fA	13.93

Area = $\int fA \times 10°/3$

= $13.93 \times \frac{10}{3}$

= 46.43°ft 14.15°M

30° - 40°(IMCO = 5.64°FT 1.72°M) 18.94°ft 5.77°M

N.W.CORMACK.

DEC.'93.

CONDITION NO. 6 "POMMERN"

WIND HEALING LEVERS.

ALL PLAIN SAIL SET AREA 35497 FT^2 3297 M^2

WIND FORCE 6 BEAUFORT SCALE

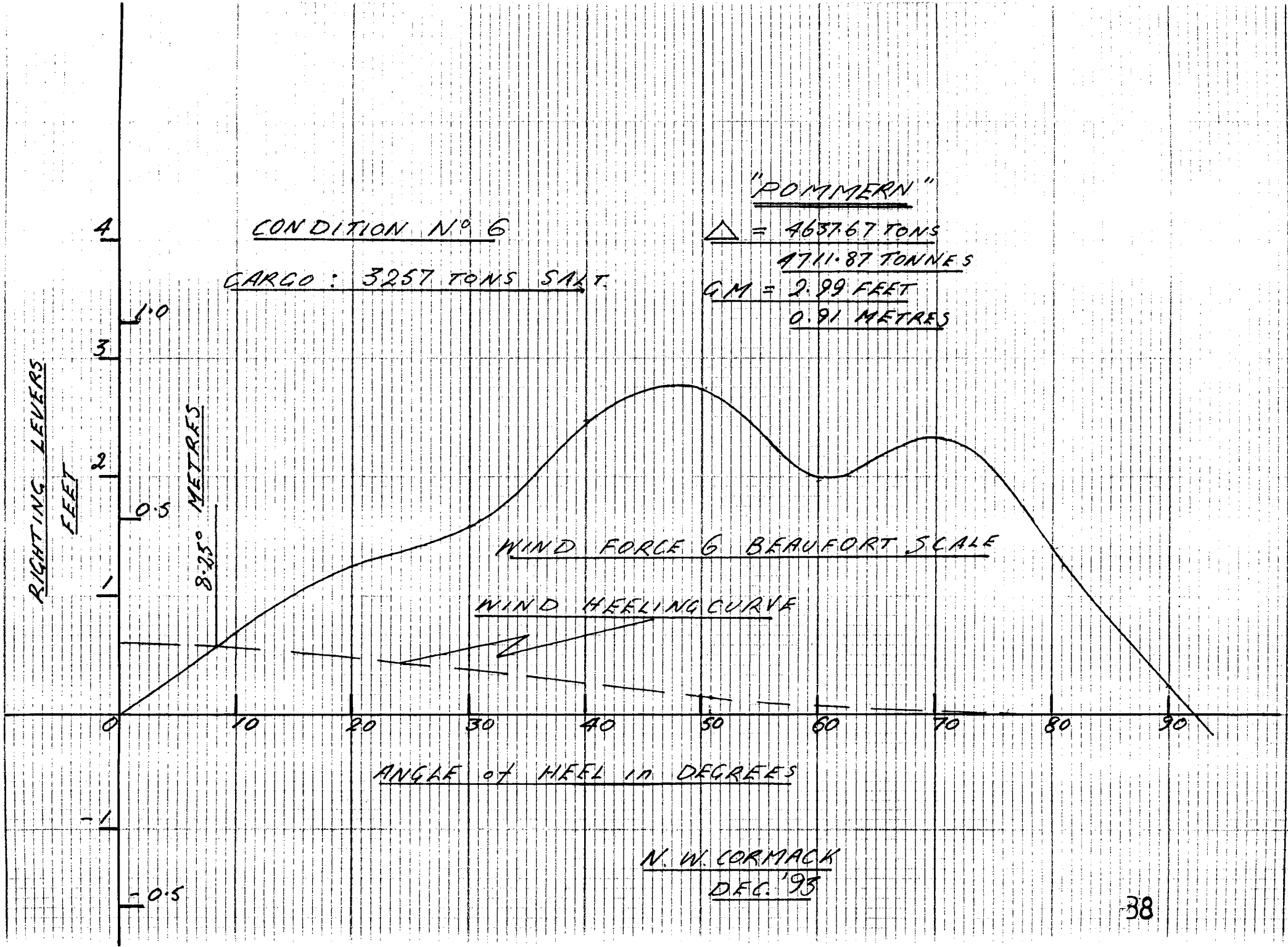
$$\text{HEALING LEVER} = \frac{35497 \times 81 \times 2.3}{2240 \times 4637.48}$$

$$= 0.64\text{ft.}$$

$$\text{HEALING LEVERS} = \text{Lever} \times \cos^2\theta$$

10^o	20^o	30^o	40^o	50^o	60^o	70^o	80^o	90^o
0.62	0.56	0.47	0.36	0.25	0.15	0.072	0.018	0

N.W.CORMACK, DEC. '93


"POMMERN"
CONDITION N° 6
△ = 463.67 TONS
4711.87 TONNES
CARGO : 3257 TONS SALT
GM = 2.99 FEET
0.91 METRES
RIGHTING LEVERS
FEET
METRES
4
3
2
1
-1
1.0
0.5
-0.5
8.25°
WIND FORCE 6 BEAUFORT SCALE
WIND HEELING CURVE
0
10
20
30
40
50
60
70
80
90
ANGLE of HEEL in DEGREES
N. W. CORMACK
DEC. '93

TRIM & STABILITY

SHIP "POMMERN" DATE DECEMBER, 1993

CONDITION NO. 7 COAL - NEWCASTLE(NSW) to CALLAO 1926

ITEM	Weight TONS	KG F	Vert. Mom. T/F	LCG about ⊗	Aft Mom. T/F	Ford Mom. T/F	FSN T/F
COAL	3293	13	42809				
STORES	2	24	48	130A	260		
WATER	26.75	10	267.5	2F		53.5	
CREW(28)	2.06	31.82	65.56				
SAILS(BENT)	5	91	455				
Total D/Weight	3328.81		43645.15		260	53.5	
Lightship	1343.67	23.98	32221.21	11.71		15738.6	
Displacement	4672.48	16.23	75866.27				

F.S.Correction		0	MCT	LCB	LCF		
KG Fluid	4.95M	16.23'	11.5tf	1.5F	1.0A		
KM	5.87M	19.26'	TRIM				
GM	0.92M	3.03'	DRAUGHT ABOVE BASE AT LCF			19.9'	6.07M
N.W.CORMACK, DEC. '93			Draught aft			Draught for.	

TRIM & STABILITY

SHIP "POMMERN" DATE DECEMBER, 1993

CONDITION NO. 7. COAL. NEWCASTLE(NSW) to CALLAO. 1926.

DISPLACEMENT 4672.48 TONS 4645.64 TONNES.

K.G.(FLUID) 16.23 FEET 4.95 METRES.

$GZ = KN - KG \sin \theta$

ITEM	10°	20°	30°	40°	50°	60°	70°	80°	90°
K.N.	3.50	6.78	9.66	12.86	15.03	15.88	17.50	17.34	16.42
K.G. sin θ	2.82	5.57	8.12	10.42	12.43	14.06	15.26	15.99	16.23
G.Z.	0.68	1.21	1.54	2.44	2.60	1.82	2.24	1.35	0.19

AREA UNDER GZ CURVE

0° - 30° (IMCO = 10.34°/FT 3.15°M)

Ord.	G.Z.	S/M	fA
0	0	1	0
10	0.68	3	2.04
20	1.21	3	3.63
30	1.54	1	1.54
		$\int$fA	7.21

Area = $\int fA \times 3/8 \times 10°$

= $7.21 \times 3/8 \times 10$

= 27.04°ft 8.24°M

0° - 40° (IMCO = 16.93°/FT 5.16°M)

Ord.	G.Z.	S/M	fA
0	0	1	0
10	0.68	4	2.72
20	1.21	2	2.42
30	1.54	4	6.16
40	2.44	1	2.44
		$\int$fA	13.74

Area = $\int fA \times 10°/3$

= $13.74 \times 10/3$

= 45.8°ft 13.96°M

30° - 40° (IMCO = 5.64°FT 1.72°M) 18.76°ft 5.72°M

N.W.CORMACK,
DECEMBER, 1993.

CONDITION NO.7 "POMMERN"

WIND HEELING LEVERS.

ALL PLAIN SAIL SET. AREA: 35497FT^2 3297M^2

WIND FORCE 6 BEAUFORT SCALE.

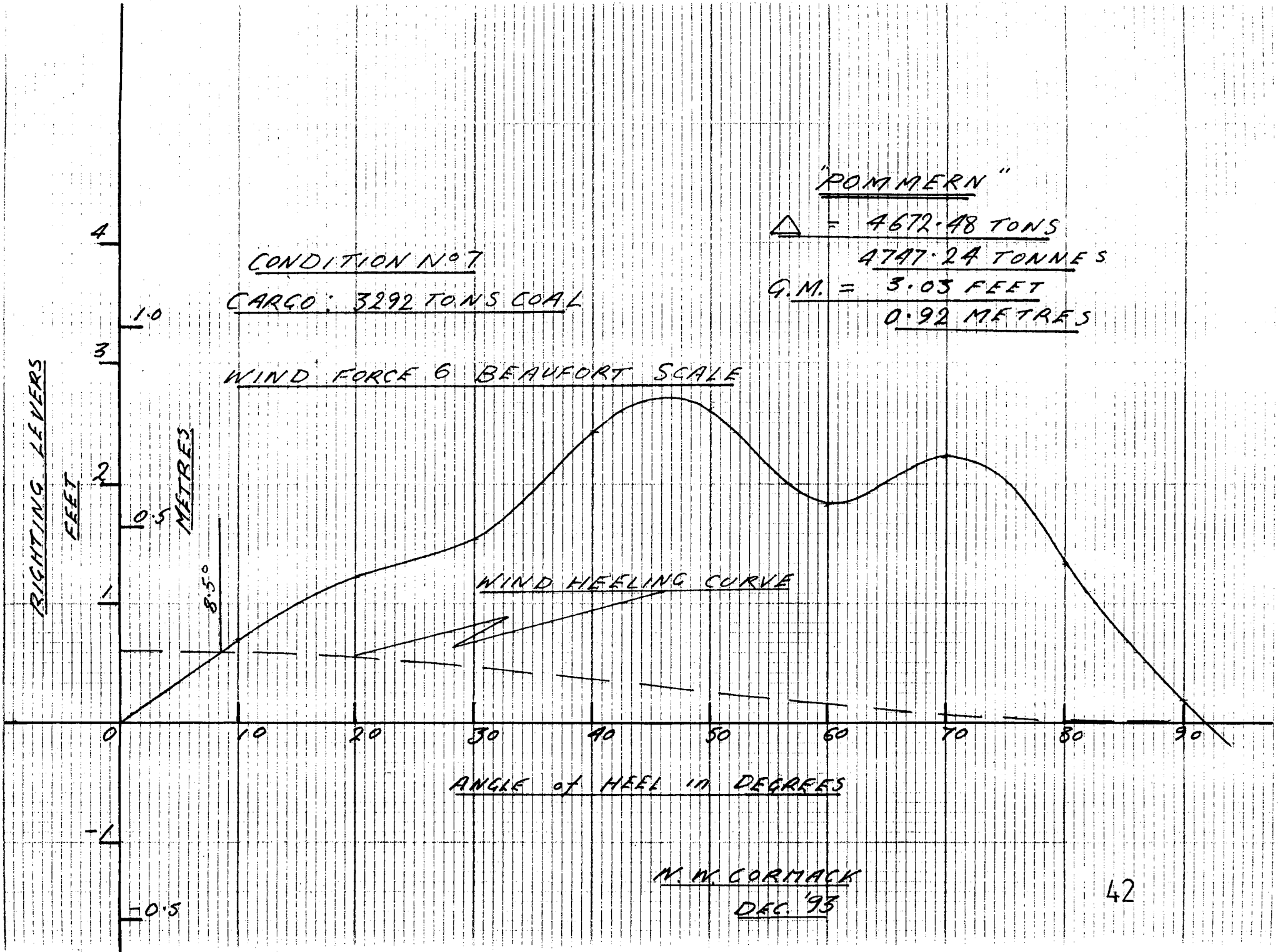
$$\text{HEALING LEVER} = \frac{35497 \times 81 \times 2.3}{2240 \times 4672.48}$$

$$= 0.63 \text{ FT.}$$

$$\text{HEALING LEVERS} = \text{Lever} \times \cos^2\theta$$

10°	20°	30°	40°	50°	60°	70°	80°	90°
0.61	0.56	0.466	0.36	0.25	0.153	0.072	0.018	0

N.W.CORMACK,
DECEMBER, 1993.


"POMMERN"
△ = 4672·48 TONS
4747·24 TONNES
G.M. = 3·03 FEET
0·92 METRES
CONDITION N°7
CARGO: 3292 TONS COAL
WIND FORCE 6 BEAUFORT SCALE
WIND HEELING CURVE
8·5°
RIGHTING LEVERS
FEET
METRES
4
3
2
1
0
-1
1·0
0·5
0·5
0
10
20
30
40
50
60
70
80
90
ANGLE of HEEL in DEGREES
N. W. CORMACK
DEC. '93

TRIM & STABILITY

SHIP "POMMERN" DATE DECEMBER, 1993

CONDITION NO. 8 STIFFENING(GRAIN) PT. VICTORIA/PT GERMEIN, 1935

ITEM	Weight TONS	KG F	Vert. Mom. T/F	LCG about ⊗	Aft Mom. T/F	Ford Mom. T/F	FSN T/F
WHEAT(in bags)	520	6	3120				
STORES	1	24	24	130A	130		
WATER	4	5	20	2F		8	
CREW(28)	2.06	31.82	65.56				
COAL	5	29.5	147.5	24F		120	
SAILS(BENT)	5	91	455				
Total D/Weight	537.06		3832.06		130	128	
Lightship	1343.67	23.98'	32221.21	11.71		15738.6	
Displacement	1890.73	19.06'	36053.27				

F.S.Correction		0	MCT	LCB	LCF		
KG Fluid	5.81M	19.06'	8.75tf	3.00F	1.90F		
KM	7.09M	23.25'	TRIM				
GM	1.28M	4.19'	DRAUGHT ABOVE BASE AT LCF9.85ft 3.0M				
N.W.CORMACK, DEC,'93			Draught aft		Draught for.		

TRIM & STABILITY

SHIP "POMMERN" DATE DECEMBER, 1993

CONDITION NO.8. STIFFENING - PORT VICTORIA/PORT GERMEIN, 1935.
DISPLACEMENT 1890.73 TONS 1920.98 TONNES.
K.G.(FLUID) 19.06 FEET 51.81M

$GZ = KN - KG \sin \theta$

ITEM	10°	20°	30°	40°	50°	60°	70°	80°	90°
K.N.	3.50	8.10	10.97	13.62	15.50	17.80	18.20	17.20	16.05
K.G. sin θ	3.31	6.54	9.53	12.24	14.60	16.50	17.92	18.77	19.06
G.Z.	0.19	1.56	1.44	1.38	0.90	1.30	0.28	-1.57	-3.01

AREA UNDER GZ CURVE

0° - 30° (IMCO = 10.34°/FT 3.15°M)

Ord.	G.Z.	S/M	fA
0	0	1	0
10	0.19	3	0.57
20	1.56	3	4.68
30	1.44	1	1.44
		$\int$fA	6.69

Area = $\int fA \times 3/8 \times 10°$

= $6.69 \times \frac{3}{8} \times 10$

= 25.09°ft 7.65°M

0° - 40° (IMCO = 16.93°/FT 5.16°M)

Ord.	G.Z.	S/M	fA
0	0	1	0
10	0.19	4	0.76
20	1.56	2	3.12
30	1.44	4	5.76
40	1.38	1	1.38
		$\int$fA	11.02

Area = $\int fA \times 10°/3$

= $11.02 \times \frac{10}{3}$

= 36.73°ft 11.20°M

30° - 40° (IMCO = 5.64°FT 1.72°M) 11.64°ft 3.55°M

N.W.CORMACK, DEC. '93

CONDITION NO. 8 "POMMERN"

WIND HEELING LEVERS.

RUNNING UP SPENCER GULF FROM PORT VICTORIA TO PORT GERMEIN WITH 520 TONS OF GRAIN ONLY IN THE LOWER HOLD AS STIFFENING. MAXIMUM SAIL AREA SET AS USED IN THIS CALCULATION IS 18500 SQUARE FEET(1718 SQUARE METRES) WIND FORCE 6 BEAUFORT SCALE. N.B. AT THE TIME OF THE YEAR THE AFTERNOON SEA BREEZE(SOU-WESTERLY) THE WIND WOULD APPROXIMATE THIS VELOCITY.

$$\text{HEALING LEVER} = \frac{18500 \times 85 \times 2.3}{2240 \times 1890.73}$$

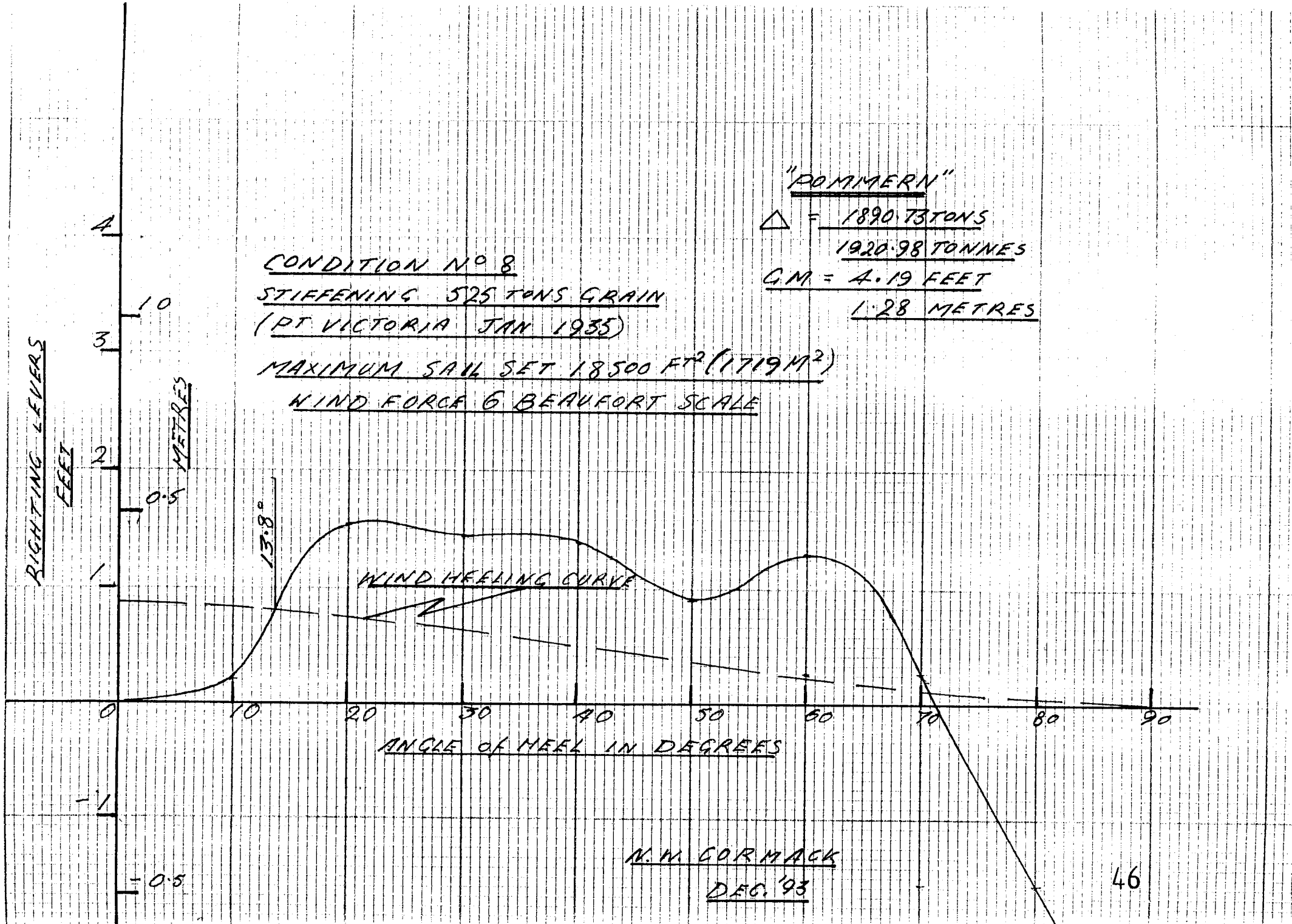
$$= 0.86\text{feet.}$$

$$\text{HEALING LEVERS} = \text{Lever} \times \cos^2\theta$$

10°	20°	30°	40°	50°	60°	70°	80°	90°
0.83	0.77	0.64	0.50	0.35	0.22	0.10	0.30	0

N.W.CORMACK,

DECEMBER, 1993.


"POMMERN"
△ = 1890·73 TONS
1920·98 TONNES
G.M = 4.19 FEET
1·28 METRES
CONDITION N° 8
STIFFENING 525 TONS GRAIN
(PT VICTORIA JAN 1935)
MAXIMUM SAIL SET 18500 FT² (1719 M²)
WIND FORCE 6 BEAUFORT SCALE
RIGHTING LEVERS
FEET
METRES
4
3
2
1
0
-1
1·0
0·5
-0·5
13·8°
WIND HEELING CURVE
0
10
20
30
40
50
60
70
80
90
ANGLE OF HEEL IN DEGREES
N. M. CORMACK
DEC. '93

TRIM & STABILITY

SHIP "POMMERN" DATE DECEMBER, 1993.

CONDITION NO. 9 WHEAT (LOADED IN PORT VICTORIA, 1939)

ITEM	Weight TONS	KG F	Vert. Mom. T/F	LCG about ℄	Aft Mom. T/F	Ford Mom. T/F	FSN T/F
WHEAT	3920	14	54880				
CREW(28)	2.06	31.82	65.56				
WATER	13	10	130	2F		26	
STORES	2	24	48	130F	260		
COAL	2	29.5	59	24F		48	
SAILS(BENT)	5	91	455				
Total D/Weight	3944.06		55637.56		260	74	
Lightship	1343.67	23.98'	32221.21	11.71		15738.6	
Displacement	5287.78	16.62	87858.77				

F.S.Correction		0	MCT	LCB	LCF		
KG Fluid	5.06M	16.62'	11.9tf	1.5F	1.25A		
KM	5.91M	19.40'	TRIM				
GM	0.85M	2.78'	DRAUGHT ABOVE BASE AT LCF 22.1' 6.74M				
N.W.CORMACK,DEC.'93.			Draught aft		Draught for.		

TRIM & STABILITY

SHIP "POMMERN" DATE DECEMBER, 1993

CONDITION NO. 9 (WHEAT, LOADED IN PORT VICTORIA, 1939)

DISPLACEMENT 5287.73TONS 5372.33TONNES

K.G.(FLUID) 16.62FEET 5.06METRES.

$GZ = KN - KG \sin \theta$

ITEM	10°	20°	30°	40°	50°	60°	70°	80°	90°
K.N.	3.57	6.53	9.50	12.64	14.05	15.31	16.87	17.20	16.45
K.G. sin θ	2.89	5.70	8.31	10.67	12.73	14.39	15.62	16.37	16.62
G.Z.	0.68	0.83	1.19	1.97	1.32	0.92	1.25	0.83	-0.17

AREA UNDER GZ CURVE

0° - 30°(IMCO = 10.34°/FT 3.15°M)

Ord.	G.Z.	S/M	fA
0	0	1	0
10	0.68	3	2.04
20	0.83	3	2.49
30	1.19	1	1.19
		$\int$fA	5.72

Area = $\int fA \times 3/8 \times 10°$

= $5.72 \times \frac{3}{8} \times 10$

= 21.45°ft 6.54°M

0° - 40°(IMCO = 16.93°/FT 5.16°M)

Ord.	G.Z.	S/M	fA
0	0	1	0
10	0.68	4	2.72
20	0.83	2	1.66
30	1.19	4	4.76
40	1.97	1	1.97
		$\int$fA	11.11

Area = $\int fA \times 10°/3$

= $11.11 \times \frac{10}{3}$

= 37.03°ft 11.28°M

30° - 40°(IMCO = 5.64°FT 1.72°M) 15.58°ft 4.75°M

N.W.CORMACK, DEC. '93.

CONDITION NO.9 "POMMERN"

WIND HEELING LEVERS.

ALL PLAIN SAIL SET. AREA 35497 ft^2 3297 M^2

WIND FORCE 6 BEAUFORT SCALE.

$$\text{HEELING LEVER} = \frac{35497 \times 78 \times 2.3}{2240 \times 5287.73}$$

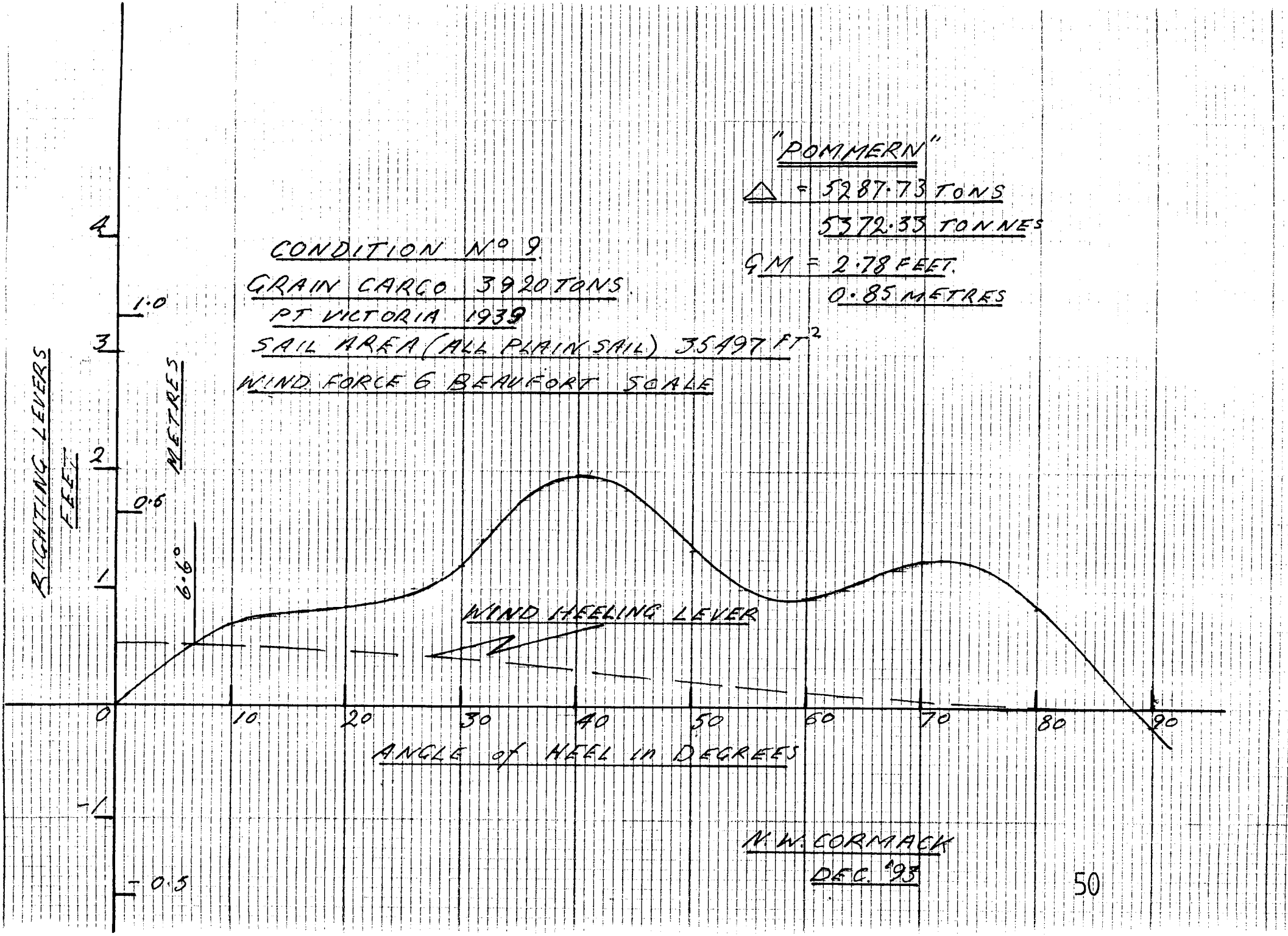
$$= 0.538 \text{ ft.}$$

$$\text{HEELING LEVERS} = \text{Lever} \times \cos^2\theta$$

10^o	20^o	30^o	40^o	50^o	60^o	70^o	80^o	90^o
0.52	0.48	0.40	0.32	0.22	0.13	0.063	0.016	0

N.W.CORMACK,

DECEMBER, 1993.


"POMMERN"
△ = 5287·73 TONS
5372·33 TONNES
GM = 2·78 FEET.
0·85 METRES
CONDITION Nº 9
GRAIN CARGO 3920 TONS
PT VICTORIA 1939
SAIL AREA (ALL PLAIN SAIL) 35497 FT²
WIND FORCE 6 BEAUFORT SCALE
RIGHTING LEVERS
FEET
METRES
4
3
2
1
0
1
1·0
0·6
0·5
6·6°
WIND HEELING LEVER
10
20
30
40
50
60
70
80
90
ANGLE of HEEL IN DEGREES
N. N. CORMACK
DEC. '93

APPENDIX III.

Lines, Sail Plan and Hydrostatic Data of the four-masted barque HOUGOMONT.

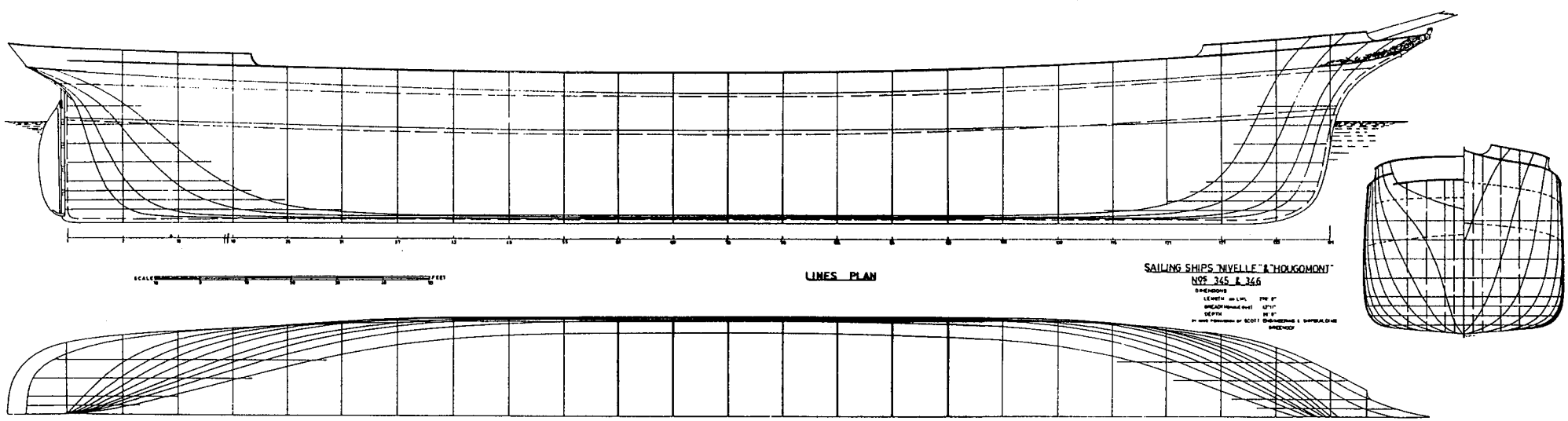
Also includes:-

Fig. 10. Illustration of ballast logs as described in the text.

Fig. 11. Comparison of the curves of Block Coefficient of the HERZOGIN CECILIE, POMMERN & HOUGOMONT.

DIMENSIONS OF THE HOUGOMONT:-

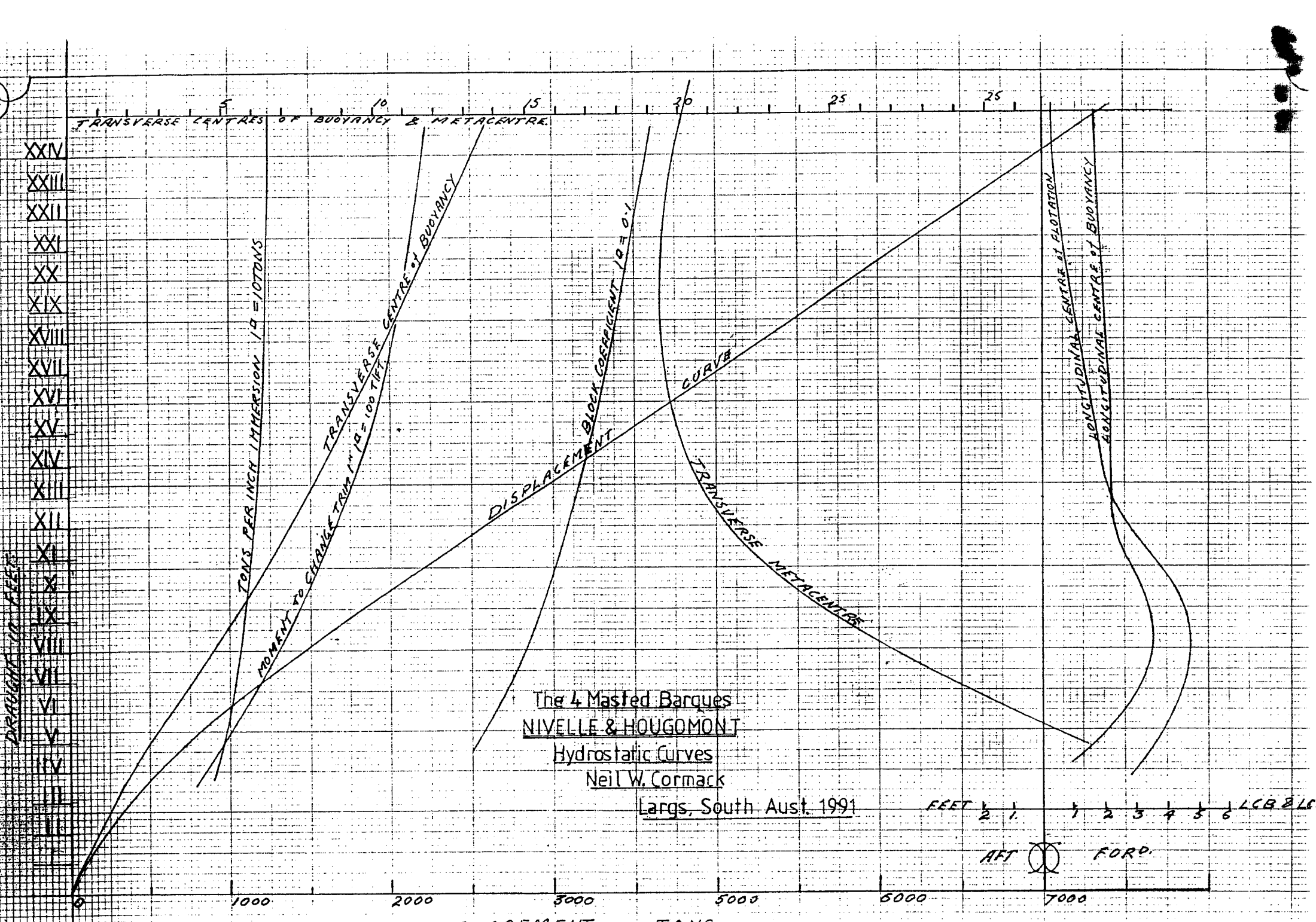
L.O.A.	313.16 feet(95.45 metres)
Length between perpenduculars	292.4 feet(89.12 metres)
Beam	43,2 feet(13.17 metres)
Depth	26.0 feet(7.92 metres)
Gross Tonnage	2428 tons.
Nett Tonnage	2261 tons.
Displacement(Loaded)	5340 tons(5425.44 tonnes)
Light Ship Displacement	1350 tons(1372 tonnes)
Deadweight Tonnage	3990 tons(4053 tonnes)
Summer Freeboard	5.58 feet(1.7 metres)
Sail Area	35131 feet (3263.5 metres)



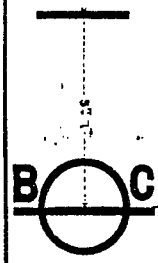
LINES PLAN

SAILING SHIPS "NIVELLE" & "HOUGOMONT"
NOS 345 & 346

Plate II


TRANSVERSE CENTRES OF BUOYANCY & METACENTRE
5
10
15
20
25
25
XXIV
XXIII
XXII
XXI
XX
XIX
XVIII
XVII
XVI
XV
XIV
XIII
XII
XI
X
IX
VIII
VII
VI
V
IIV
III
II
I
DRAUGHT IN FEET
TONS PER INCH IMMERSION 1/a = 10TONS
TRANSVERSE CENTRE of BUOYANCY
MOMENT TO CHANGE TRIM 1" 1/a = 100 TFT
DISPLACEMENT
BLOCK COEFFICIENT 1/a = 0.1
CURVE
TRANSVERSE METACENTRES
LONGITUDINAL CENTRE of FLOTATION
LONGITUDINAL CENTRE of BUOYANCY
The 4 Masted Barques
NIVELLE & HOUGOMONT
Hydrostatic Curves
Neil W. Cormack
Largs, South Aust. 1991
FEET
1/2
1.
1/1
1/2
1/3
1/4
1/5
1/6
LCB & LC
AFT
FORD.
0
1000
2000
3000
5000
6000
7000

DISPLACEMENT SCALE
OF
SAILING SHIPS,
"NIVELLE" AND "HOUGOMONT."
Nos. 345-6.



DRAUGHT OF WATER	DISPLACEMENT IN TONS	DEADWEIGHT IN TONS
	5500	3950
XXI	5200	3850
	5100	3750
XX	5000	3650
	4900	3550
	4800	3450
XIX	4700	3350
	4600	3250
	4500	3150
XVIII	4400	3050
	4300	2950
	4200	2850
XVII	4100	2750
	4000	2650
	3900	2550
XVI	3800	2450
	3700	2350
	3600	2250
XV	3500	2150
	3400	2050
	3300	1950
XIV	3200	1850
	3100	1750
	3000	1650
XIII	2900	1550
	2800	1450
	2700	1350
XII	2600	1250
	2500	1150
XI	2400	1050
	2300	950
	2200	850
X	2100	750
	2000	650
	1900	550
IX	1800	450
	1700	350
VIII	1600	250
	1500	150
	1400	50
VII	1300	

MEAN LIGHT DRAUGHT 5"-11" 1350 Tons

DIMENSIONS.

LENGTH BETWEEN PERPS ..... 276'-0"
BREADTH MOULDED ..... 42'-0"
DEPTH " ..... 26'-0"

SAIL AREAS

FLYING JIB	604 square feet(56.12M^2)
OUTER JIB	788 " " (73.2 ")
INNER JIB	620 " " (57.59")
FORE TOPMAST STAYSAIL	495 " " (45.98")
FORESAIL	2246 " " (208.64M^2)
FORE LOWER TOPSAIL	1450 " " (134.70 ")
FORE UPPER TOPSAIL	1580 " " (146.77 ")
FORE LOWER T'GALLANT	1120 " " (104.04 ")
FORE UPPER T'GALLANT	1090 " " (101.25 ")
FORE ROYAL	850 " " (78.96 ")
MAIN STAYSAIL	513 " " (47.65 ")
MAIN TOPMAST STAYSAIL	737 " " (68.46 ")
MAINSAIL	2806 " " (260.66 ")
MAIN LOWER TOPSAIL	1450 " " (134.70 ")
MAIN UPPER TOPSAIL	1580 " " (146.77 ")
MAIN LOWER T'GALLANT	1120 " " (104.04 ")
MAIN UPPER T'GALLANT	1090 " " (101.25 ")
MAIN ROYAL	850 " " (78.96 ")
MIZZEN STAYSAIL	513 " " (47.65 ")
MIZZEN TOPMAST STAYSAIL	737 " " (68.46 ")
CROSSJACK	2850 " " (264.75 ")
MIZZEN LOWER TOPSAIL	1450 " " (134.70 ")
MIZZEN UPPER TOPSAIL	1580 " " (146.77 ")
MIZZEN LOWER T'GALLANT	1120 " " (104.04 ")
MIZZEN UPPER T'GALLANT	1090 " " (101.25 ")
MIZZEN ROYAL	850 " " (78.96 ")
JIGGER STAYSAIL	732 " " (68.00 ")
JIGGER TOPMAST STAYSAIL	464 " " (43.10 ")
JIGGER T'GALLANT STAYSAIL	473 " " (43.94 ")
SPANKER	1485 " " (137.95 ")
SPANKER TOPSAIL	798 " " (74.13 ")
TOTAL	35131 " " (3263.5 ")

THE FOUR MASTED BARQUES
"NIVELLE", "HOUGOMONT" AND "ARCHIBALD RUSSELL".
SAILS AND STANDING RIGGING DETAILS.

FORE ROYAL STAY	2½ inch circumference steel wire
FORE T'GALLANT STAY	3¼ " " " " "
FORE TOPMAST STAY(OUTER JIB)	3½ " " " " "
" " " (INNER JIB)	3¾ " " " " "
" " STAYSAIL STAY	2/4 5/8 " " " " "
" STAY	2/4 5/8 " " " " "
LOWER SHROUDS P&S	5/4 5/8 " " " " "
LOWER MAST CAP SHROUDS P&S	2/ " " " " " "
TOP MAST SHROUDS P&S	3/ " " " " " "
TOPMAST CAP SHROUDS P&S	4 1/8 " " " " "
T'GALLANT SHROUDS P&S	2/3¼ " " " " "
ROYAL BACK STAYS P&S	2½ " " " " "
MAIN STAY.	2/4 5/8 " " " " "
MAIN TOPMAST STAY	2/ " " " " " "
MAIN T'GALLANT STAY	3¼ " " " " "
MAIN ROYAL STAY	2½ " " " " "
MIZZEN STAY	2/4 5/8 " " " " "
MIZZEN TOPMAST STAY	2/ " " " " " "
MIZZEN T'GALLANT STAY	3¼ " " " " "
MIZZEN ROYAL STAY	2½ " " " " "
JIGGER LOWER SHROUDS P&S	4/3½ " " " " "
" TOPMAST SHROUDS P&S	2/3½ " " " " "
" MASTHEAD " "	2 3/8 " " " " "
" STAY	2/3½ " " " " "
" TOPMAST STAY	3½ " " " " "
" MAST HEAD STAY	2 3/8 " " " " "

NEIL W. CORMACK,
LARGS,
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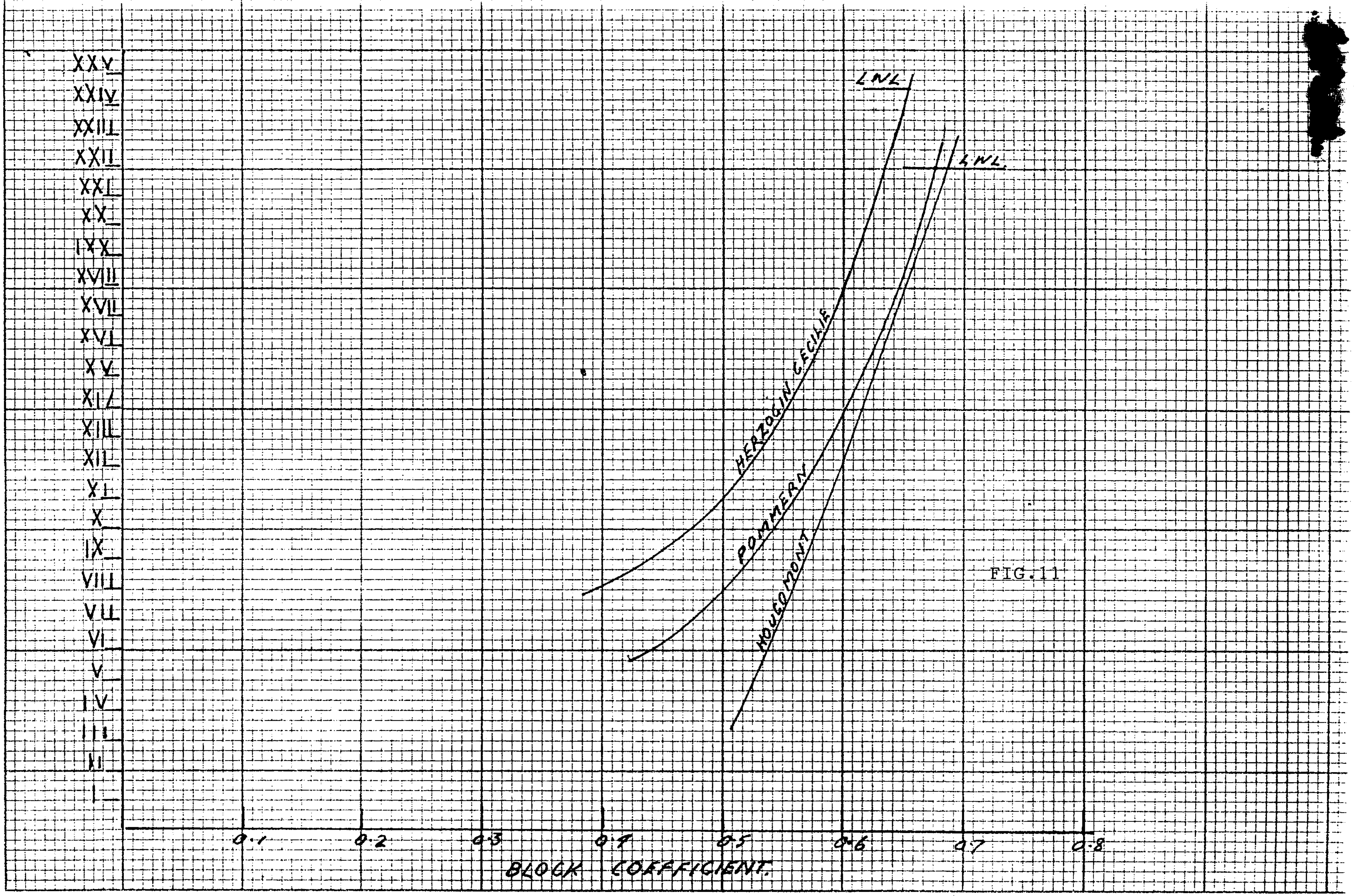
MAY 1994.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XX
XIX
XVIII
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VII
VI
V
IV
III
II
I
LWL
LWL
HERZOGIN CECILIE
POMMERN
HOUGOMONT
0·1
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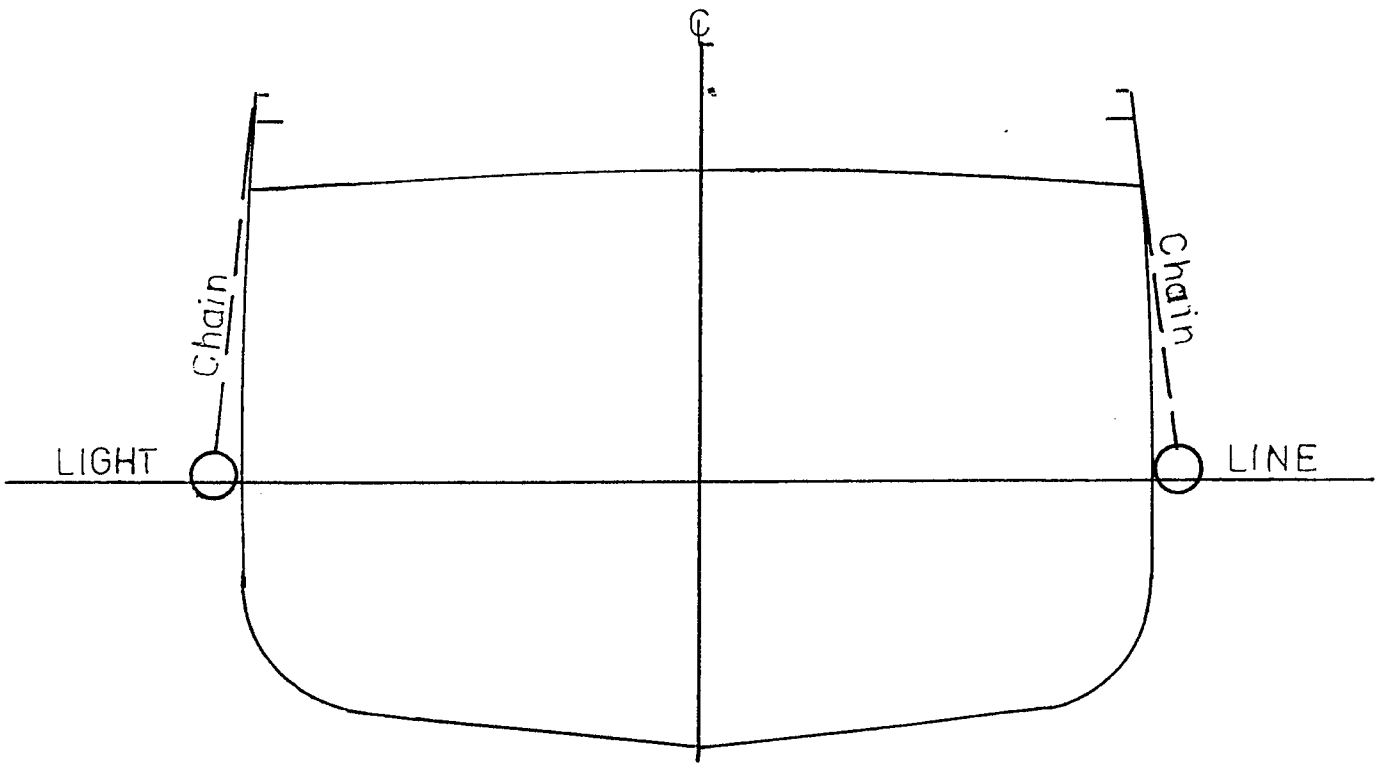
0·8
BLOCK COEFFICIENT.

FIG.11



MIDSHIP SECTION SHOWING BALLAST LOGS

FIG.10.