H.M.S. ORION AT CRETE, MAY, 1941

by

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At the Editor's request Commander Atkins, who is at present attached to the Damage Control School, Portsmouth, kindly agreed to write a series of articles on damage-control training and war-time experiences ; the first of these, " Damage Control Training," was published in Vol. 2, No. 4, and we now have pleasure in publishing the second in this series.

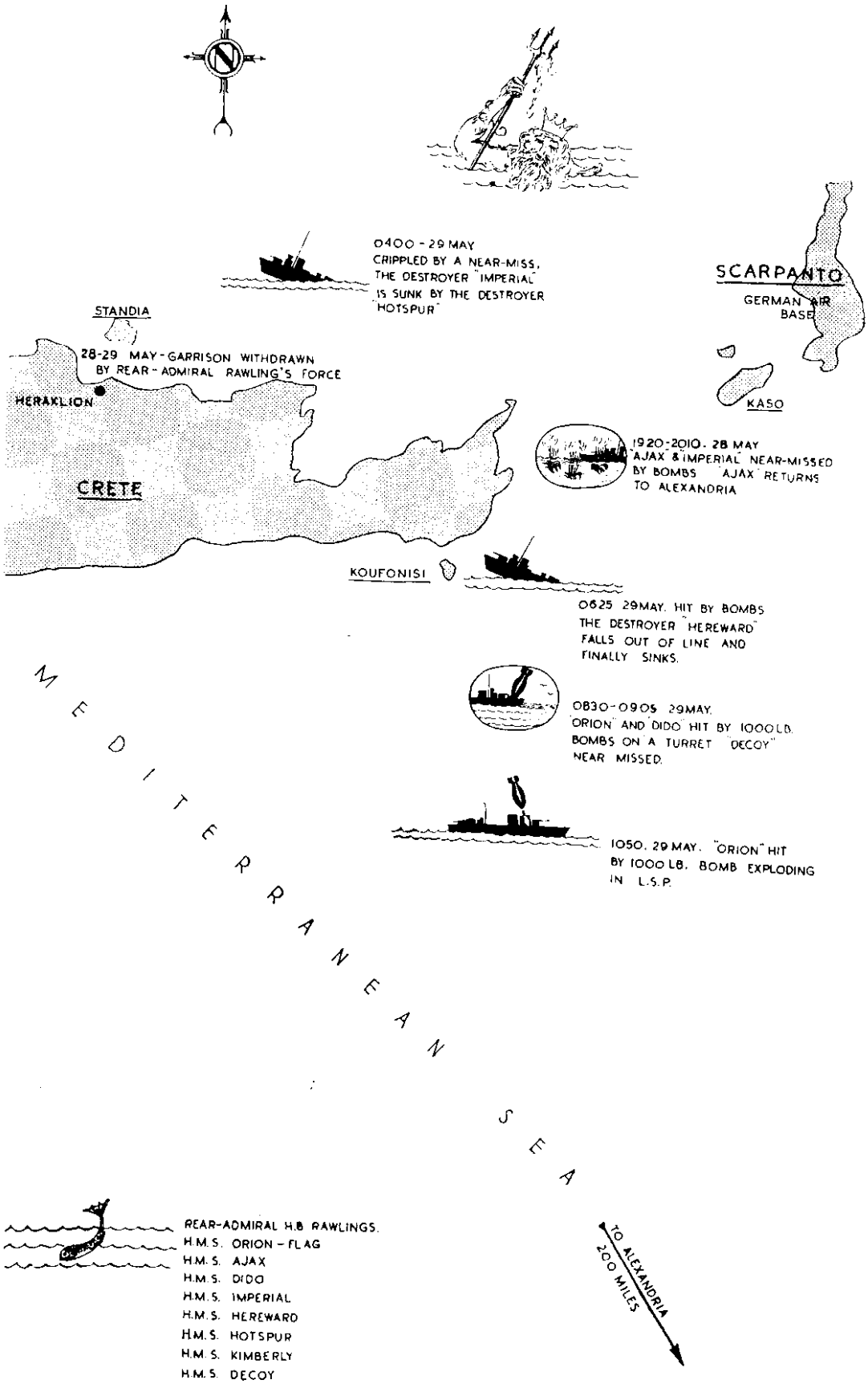
At the outbreak of the Second World War there were five cruisers of the *Leander* Class ; H.M.S. *Leander*, *Orion*, *Neptune*, *Ajax* and the New Zealand manned cruiser *Achilles*. Two of these, the *Ajax* and the *Achilles*, distinguished themselves at the Battle of the River Plate early in the war, but the *Orion* at the time was patrolling in the Caribbean, too far away to join in.

In April, 1940, when Mussolini showed that he was going to drag Italy into war, *Orion* crossed the Atlantic from Trinidad to Gibraltar at 25 knots and proceeded to Malta, where she embarked the second in command of the Mediterranean fleet, Vice-Admiral J. C. Tovey, C.B., D.S.O., and sailed for Alexandria.

There followed a year of gradually increasing excitement, during which Vice-Admiral Tovey was succeeded by Vice-Admiral H. D. Pridham-Wippell, C.B., C.V.O., and he by Rear-Admiral H. B. Rawlings, O.B.E. At first, " club runs " to Malta covering convoys or bombardments along the coast of Libya or Tripoli, or of Italian islands, meant rarely more than a few sticks of bombs suddenly whistling down out of the clear blue sky from Italian aircraft so high that the look-outs rarely saw them at all. A little publicized chase of the Italian Fleet off Calabria in June, 1940, did result in the cruisers being caught between the two battlefleets and large missiles seemed to be whistling down all round *Orion*. One or two chases after Italian destroyers expended lots of shot for a small bag. Convoys were more profitable game and *Orion* got a couple.

She towed H.M.S. *Liverpool* stern first from Crete to Alexandria after the latter's bows had been blown off abreast A turret by the explosion of vapour leaking aft from the petrol tank which had been damaged by an aerial torpedo. The spark was provided, it is believed, by a fan motor on A turret. *Orion* kept a couple of shackles of anchor cable ranged on the quarter-deck ready for towing aft, but *Liverpool* did not and the tow parted at her end. Fortunately she rescued a shackle of cable from her forecastle before her bow dropped off. With chain cable at each end of the tow and without her bow, which had been acting as a drogue, she towed quite steadily at 8 knots. Quite inexplicably, the Italian aircraft did not return to finish their job.

The small cruisers were the decoys on the morning of the Battle of Matapan, 28th March, 1941. They retired behind smoke. The last time the Captain of *Orion* had rung the smoke gong was a year before. He wished to exercise making smoke but forgot that the Admiralty had a few months previously altered the signal, so made the signal " Stop making Smoke " repeatedly. The first news the Commander (E) had of the incident was a request for his


0400 - 29 MAY
CRIPPLED BY A NEAR-MISS,
THE DESTROYER "IMPERIAL"
IS SUNK BY THE DESTROYER
"HOTSPUR"
SCARPANTO
GERMAN AIR
BASE
STANDIA
28-29 MAY - GARRISON WITHDRAWN
BY REAR - ADMIRAL RAWLING'S FORCE
HERAKLION
KASO
CRETE
1920-2010 - 28 MAY
"AJAX" & "IMPERIAL" NEAR-MISSED
BY BOMBS "AJAX" RETURNS
TO ALEXANDRIA
KOUFONISI
0625 29MAY. HIT BY BOMBS
THE DESTROYER "HEREWARD"
FALLS OUT OF LINE AND
FINALLY SINKS.
MEDITERRANEAN SEA
0830-0905 29MAY.
"ORION" AND "DIDO" HIT BY 1000LB.
BOMBS ON A TURRET "DECOY"
NEAR MISSED.
1050. 29 MAY. "ORION" HIT
BY 1000 LB. BOMB EXPLODING
IN L.S.P.
REAR-ADMIRAL H.B RAWLINGS.
H.M.S. ORION - FLAG
H.M.S. AJAX
H.M.S. DIDO
H.M.S. IMPERIAL
H.M.S. HEREWARD
H.M.S. HOTSPUR
H.M.S. KIMBERLY
H.M.S. DECOY
TO ALEXANDRIA
200 MILES

reasons in writing why smoke had not been made. It needed all his ingenuity to concoct a tactful reply. However at Matapan he had just heard a broadcast announcement that the ship had been straddled by shells from a 15 in battleship, so he did not wait for the first " S " to finish but the moment the smoke gong trembled ordered the boiler rooms to make the blackest and densest smoke they could. Unfortunately for *Orion* she was at first the windward ship not hidden by it and only a timely attack by H.M.S. *Formidable's* aircraft on the *Vittorio Veneto* saved her. The ballistic cap of a 15 in shell hit her starboard torpedo tubes, but luckily the shell did not follow it. In the evacuation from Greece, she was lucky getting clear of dive bomber range before dawn. The whole naval side of the operation was planned and executed by Vice-Admiral Pridham-Wippell, wearing his flag in her. Later she sank many caiques full of Germans bound for Crete during the nights without suffering overmuch retribution from the bombing when daylight came.

Blackouts

Orion did have some near misses which proved in the long run to be blessings as they resulted in the evolution of a drill for dealing with a blackout in a boiler-room caused by water being sucked from a damaged oil fuel tank and suddenly extinguishing all the sprayers. The manoeuvring valve of the affected unit was shut as soon as the steam pressure started to drop. A main steam cross-connection valve in the forward engine-room (F.E.R.) was opened slightly, to maintain 250 lb/sq. in. (the working pressure being 350 lb/sq. in.) and keep the fans, auxiliaries, and turbo-generator running on steam from another boiler room. Meanwhile the affected boiler-room changed to the stand-by oil fuel pump whose suction was open to one of the double-bottom oil fuel tanks under the boiler-room.

As there was a complete set of gauges for all three units at the control position in the forward engine-room and both main steam cross-connection valves were there it was easy to cross-connect and isolate main steam as necessary, levelling off the main feed tanks when required. The machinery lay-out is shown in Fig. 1. The three units were of equal power, the two inner shafts together giving the same power as one of the outers.

Once more unto the breach

At 0600 on the 28th May, 1941, Rear-Admiral Rawlings with his flag in *Orion* sailed from Alexandria with *Ajax*, *Dido*, and six destroyers to lift the garrison of Heraklion. Passing through the Kaso Straits the force was attacked by aircraft for four hours before dark, *Ajax* and *Imperial* being near missed. *Ajax* was damaged and had to return to Alexandria after dark. Later the " truth " came out that a newspaper correspondent had missed the ship and she felt lost without him.

The whole garrison, except the wounded who were too ill to move, was embarked by 0300 on the 29th May. The officer commanding the rearguard clicked his heels and saluted when reporting the embarkation complete to the Admiral, as smartly as though it were all a peace-time manoeuvre. The troops in the Heraklion area reckoned they had the measure of the Germans and were furious at being withdrawn. The squadron quickly increased speed to 28 knots. *Imperial* appeared suddenly to put her helm hard over and passed between *Orion* and *Dido*, missing, it seemed, the *Orion's* stern by inches and causing *Dido* to go full astern. *Imperial* signalled that her steering gear had failed due to the near miss the previous evening. The rudder locking gear could not be used and the rudder, being overbalanced, flopped " hard-over " to port or starboard as she tried to steer by main engines. Rear-Admiral

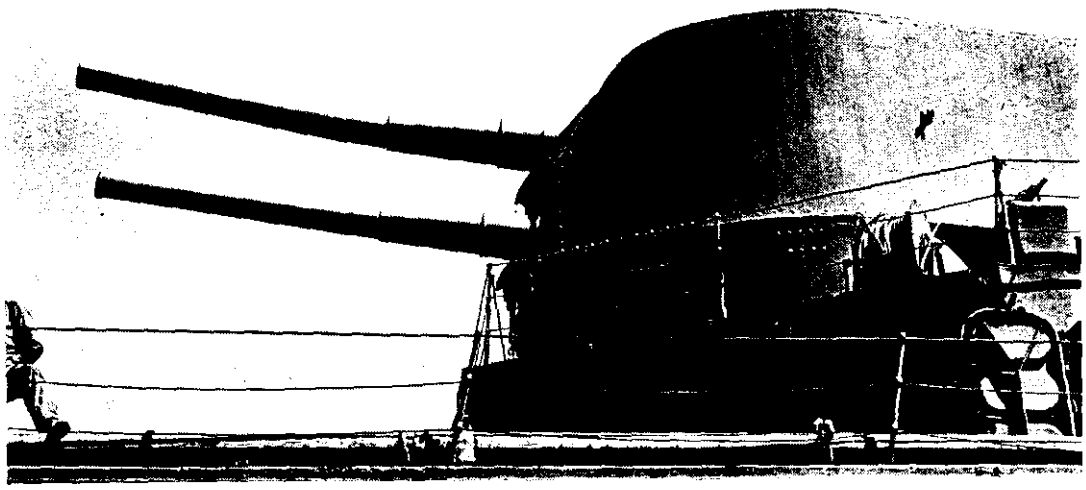


FIG. 2.—BENT GUN BARRELS OF " B " TURRET AFTER FIRST BOMB HIT.

Rawlings told *Hotspur* to embark *Imperial's* ship's company and soldiers, and to sink her.

This delayed the whole force so that at dawn it was still north of the Kaso Straits and at 0445 the Junkers began to attack. At 0625 *Hereward* was hit, fell out of line and had to be left sinking. A near miss on *Orion* which grazed the edge of her quarter deck started the after fuel tanks leaking, causing black-outs in ' B ' and ' C ' boiler-rooms which were both on main line suction from Y tanks.

Y 1 to 4 tanks were found to be leaking from the sea and useless, and leaking also into the after 6 in magazine. Men of No. 3 fire party, after vainly trying to keep the flood down by pumping, helped the magazine crew to salvage charges until they were up to their waists in oil. Other near misses caused leaks in A 3 and 4 tanks.

At 0735 machine gun bullets mortally wounded the Flag Captain (Captain G. R. B Back, R.N.) and hit Rear-Admiral Rawlings in the leg. The Admiral remained on the bridge in an arm-chair, cheerful and imperturbable as always. The Commander (Commander T. C. T. Wynne, R.N.) took command on the bridge while the First Lieutenant (Lieut. Cdr. C. M. Sarsfield-Hall, R.N.) took his place in the lower steering position (L.S.P.).

Blackouts continued. Water appeared in some of the ' A ' tanks due to near misses forward, and at 0855 ' B ' and ' C ' boilers were put on A7 and A8 through the main line suction, ' A ' boilers being supplied with oil from A10 through its independent suction.

First Hit

Dido was hit on a forward turret and then a Junker put in a suicidal attack on *Orion* and at 0905 scored a hit on ' A ' turret with a 1,000 pound bomb, the aircraft crashing on the ship's bow before falling into the sea. The bomb exploded on the after side of the roller path. The gunhouse was blown over the side, and in passing hit the muzzles of the guns of B turret, knocked the barrels up to maximum elevation and bent them through about 15°. The breech carrier arms snapped off under the shock, both breeches being open at the time.

Cordite fires started in ' A ' working space and spread forward and aft along the upper and lower mess decks. ' A ' magazine, ' A ' and ' B ' shell rooms

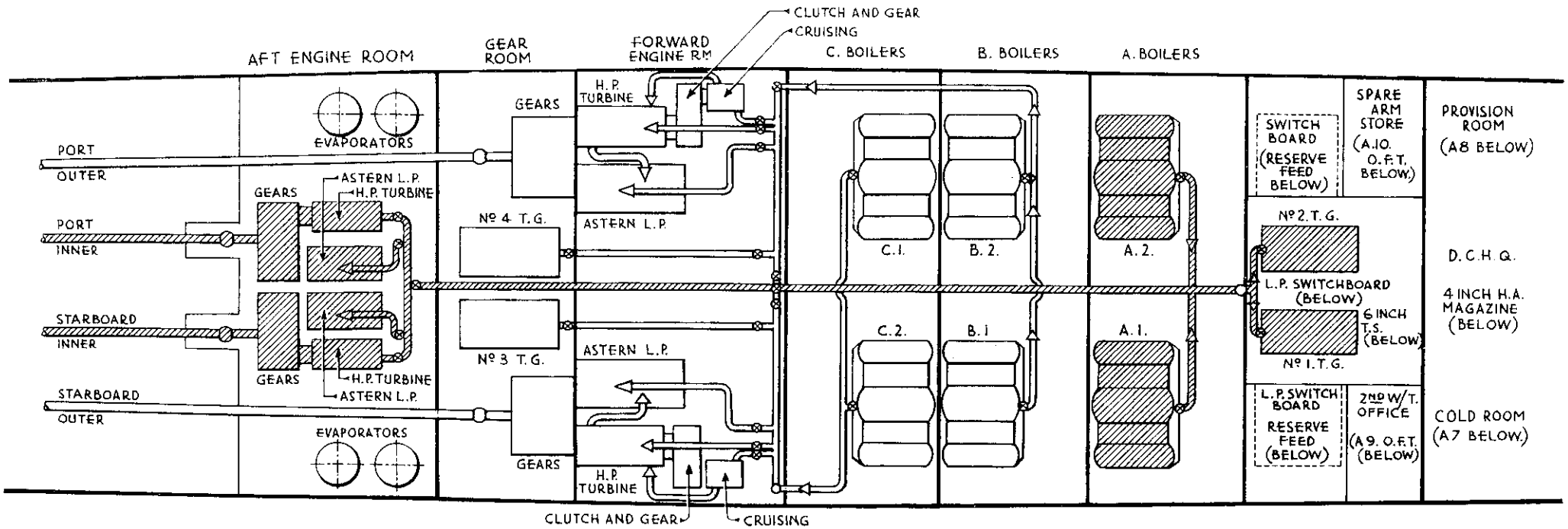


FIG. 1. H.M.S. "ORION" — MACHINERY ARRANGEMENT

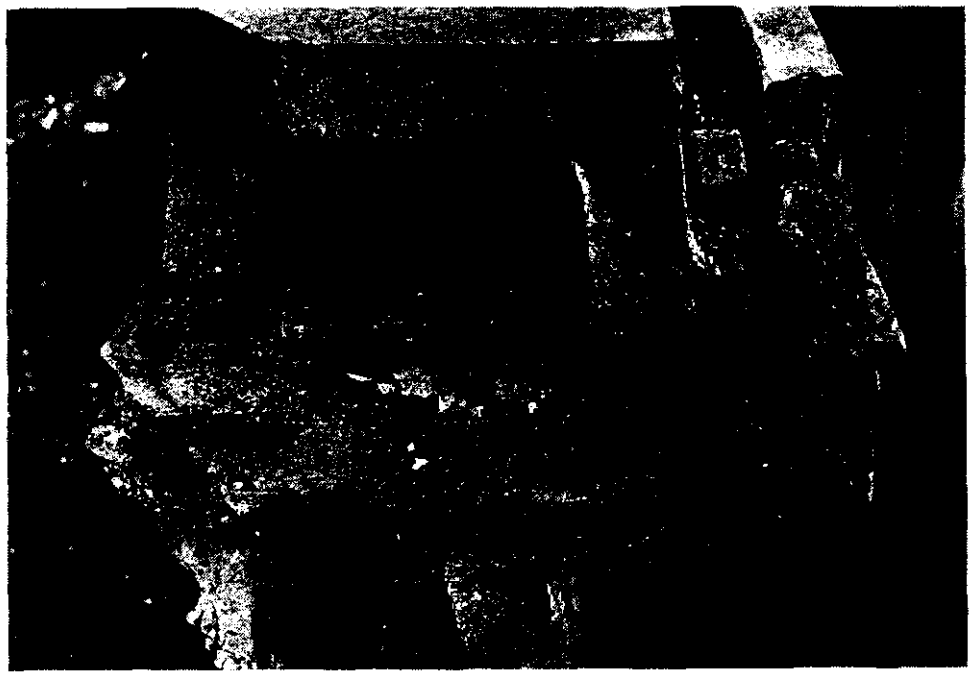


FIG. 3.—" A " TURRET ROLLER PATH

and the small arms magazine were flooded as a precaution. The only 6 in ammunition left available was that in the hoists of ' X ' and ' Y ' turrets.

At 0910 the forward engine-room had an urgent call for more water for fighting fires forward. At that time the ship had the simple convergent nozzle branch-pipes which give only a jet and are most wasteful of water. The fire-main was de-isolated at 64 and 117 stations till finally there were seven pumps on the firemain forward of 136, the forward bulkhead of the after engine-room. The inefficient fire-fighting equipment resulted in much water collecting on the forward mess decks. These were packed with soldiers and with all the paraphernalia which they have to carry in war. In addition they had smuggled on board many cats and dogs and four women. The gear and animals were distributed round the mess decks. The women were put in the Admiral's cabin, whence they emerged at Alexandria, intact.

At about 1040 a lull in the bombing and a pause in the blackouts tempted the Commander (E) to go forward and see if all the fires were out. At the top of the forward engine-room hatch he met the Senior Engineer who had come up from the after engine-room with the same idea, so the Commander (E) went below again.

Second Hit

The attacks were then renewed. Wave succeeded wave until finally a formation of eleven Ju 87s dived on *Orion* pressing home the attack with fierce determination. At 1050 a 1,000 pound bomb hit the bridge and went down through seven decks and two bulkheads till it met the 80 lb. armour deckhead of the 4 in H.A. magazine which formed the platform deck in the lower steering position. The armour was holed and plates bent down 6 feet, squashing flat some of the 4 in projectiles which fortunately did not detonate. The detonation of the bomb was complete and the blast effect, horizontally and upwards, very severe, wrecking all compartments between 53 and 77 bulkheads from the hold to the upper deck. Splinters penetrated 35 bulkhead and 77 bulkhead was blown away between platform and lower decks. The 6 in transmitting station (T.S.), 4 in H.A. magazine, high angle control position

FIG. 4.—RESULT OF NEAR MISS CLOSE TO S.O. PROPELLER

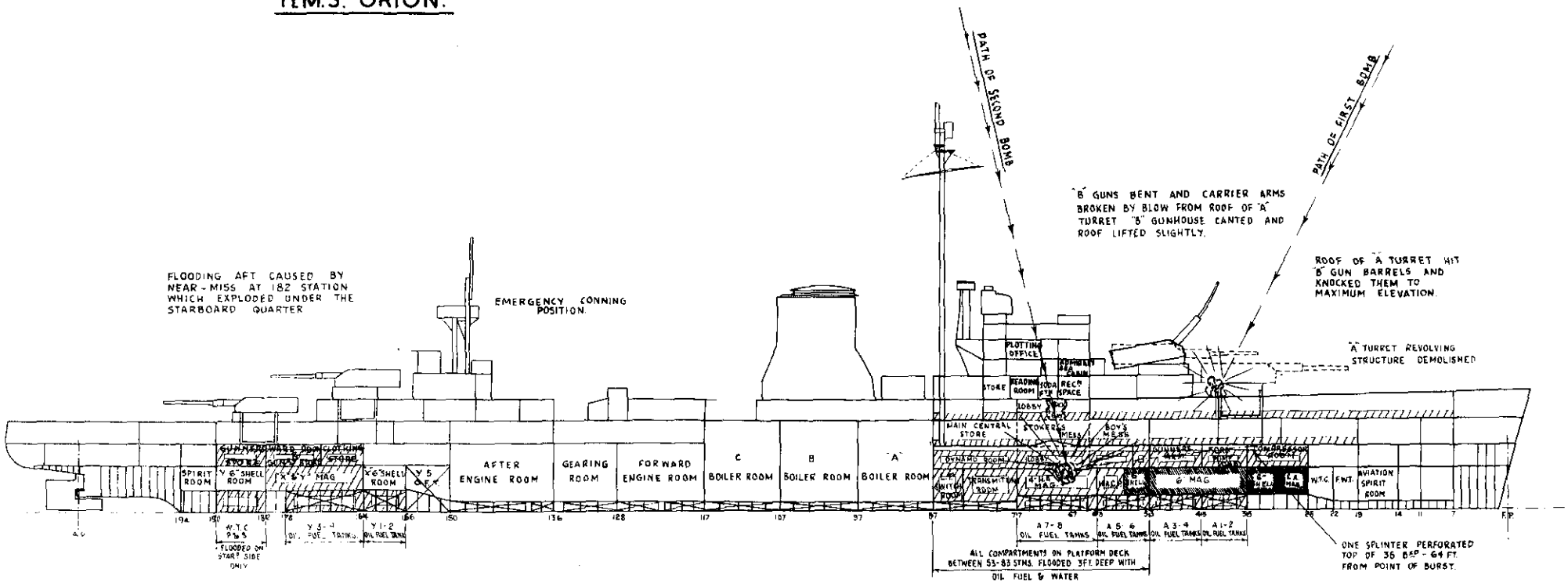
(H.A.C.P.), and No. 1 low power (L.P.) switch room and gyro compass room flooded completely, though some men escaped from the T.S. and L.P. switch room. The forward dynamo room, L.S.P., telephone exchange, auxiliary wireless telegraphy (Aux.W.T.) office, chart and chronometer room, refrigerating machinery and cold and cool rooms, main flour store, provision room, and electrical equipment compartment port and starboard were completely wrecked, everyone in them being killed, and the compartments flooded up to the new waterline. The main switchboard and No. 2 L.P. switch room flooded slowly.

The damage-control headquarters (D.C.H.Q.) was in the L.S.P. lobby and stationed there was not only the First Lieutenant (taking the Commander's place) but the Damage Control Officer (D.C.O.) (Lieut. (E) A. L. C. J. Spearman, R.N.) and most of the pumping and flooding party. The stokers' and boys' messdecks were packed with soldiers and the bomb killed over 200 men and badly wounded rather more than that. The Senior Engineer (Lieut. Cdr. (E) J. H. Pears, R.N.) and the Officer of No. 2 fire party (Lieut. (E) D. O. B. Taylor, R.N.) were also killed. Sub. Lt. (E) D. Bradshaw, R.N., in charge of No. 1 fire party was badly gassed by cordite fumes and nearly died that night from their delayed action. That left the Commander (E) and two Warrant Mechanicians.

In case of the loss of the D.C.H.Q. and also to enable the Commander (E) to advise the D.C.O., a flooding board was kept in the F.E.R., and the charge of damage-control naturally reverted to the Commander (E) as soon as the second bomb hit.

Conditions were hardly ideal for taking charge ; all telephones had failed with the loss of the exchange and L.P. switch rooms, and no sound-powered telephones were fitted. One S.P.O. and two stokers of the double bottom (D.B.) party remained, but they were too busy finding good oil to burn to do any counter-flooding or pumping. The engine rooms were in darkness except for light from Oldham's lamps, all ventilation had failed, and the port outer shaft was the only one driving the ship. The ship had a heel of 11° to starboard. There was enough smoke in the engine rooms to make the men

H.M.S. ORION.



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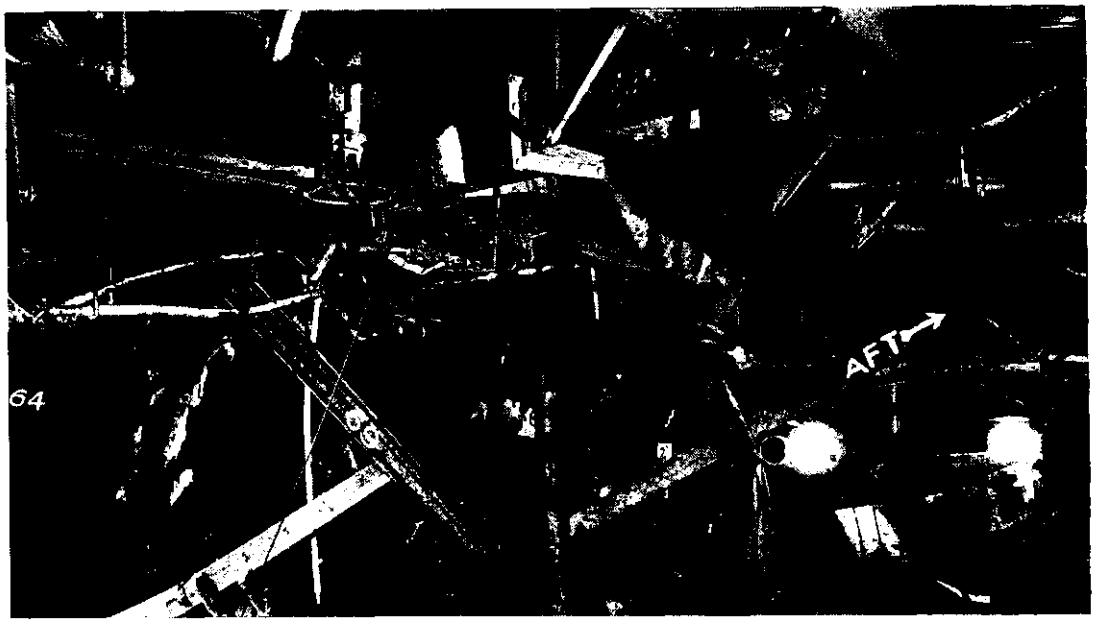

FIG. 5.—STOKERS' MESS DECK AFTER SECOND BOMB HIT

cough but not enough to make much difference to visibility. The steering gear was out of action and *Orion* had turned round and headed for Crete. Rear-Admiral Rawlings confessed later that at that moment he felt a trifle depressed.

'A' boiler room's crew had to evacuate, being unable to breathe in the smoke which the fans drew from the fires forward. The S.P.O. reported to the Commander (E) and was told to go down again and flash up as soon as the smoke cleared. He did so an hour later. Meanwhile, the Commander (E) shut 'A' main bulkhead valve, to preserve what steam pressure remained in the boilers, but allowed the A.E.R. turbines to trail, thinking it better to risk damage through over-heating than to cross-connect the units while still being bombed. (No shaft locking gear nor withdrawable turbine couplings were fitted at that time.) The electric lubricating oil pump, supplied with power from the turbo-generator of another unit had started automatically and was taking care of the bearings. Fire and bilge pumps were put on the condensers to try to keep them cool.

The starboard outer shaft was trailing merely because of a blackout in 'C' boiler room but there was enough steam to keep No. 3 T.G. running.

All electric power failed, however, because the supply breakers of No. 3 and 4 T.Gs. came off under shock, although they were gagged. The electrical parties were well trained and some lighting and ventilation were restored within three minutes which seemed as many hours to those in the engine rooms, as the temperature was rising quickly. The ring main had been cut, but No. 3 and 4 T.Gs. were feeding No. 5, 6, 7 and 8 sections of the ring main with all breakers open. Shortly afterwards the switchboard was abandoned owing to the intense heat and the turbo-generators were put into local control. 'A,' 'B' and 'C' boiler rooms and emergency lighting forward were later fed by the centre line emergency cable from No. 3 turbo-generator.

A Warrant Mechanician was sent to connect up the mechanical steering wheel and restart the steering motors, but found that the leading stoker watch-keeper had already done so, and the Navigating Officer was arranging a chain of messengers from the after conning position in the mainmast to the tiller flat. The soldiers joined in this game which resulted in the orders becoming somewhat confused. The Evershed order repeater and telephone were useless

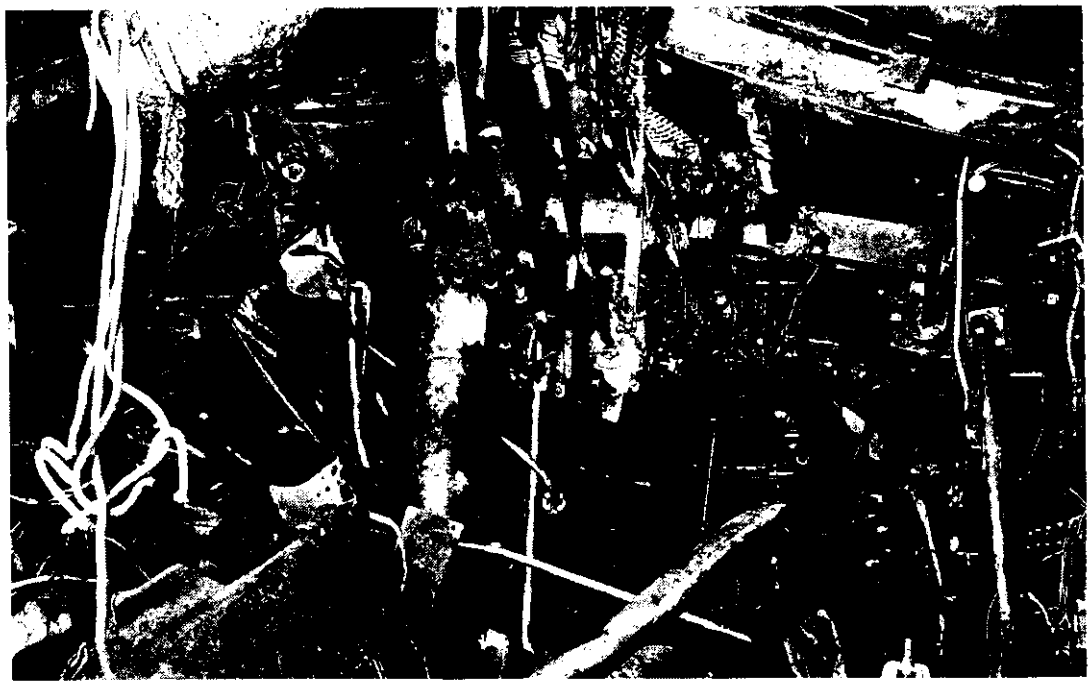

FIG. 6.—PLATFORM DECK LOOKING TOWARDS DYNAMO ROOM AFTER SECOND BOMB HIT

because of the destruction of the low-power supply, but later a field telephone was rigged. Engine orders were supposed to be passed by voice pipe to the A.E.R., thence by telegraph to the F.E.R., but the Bridge was most patient and did not trouble the Engine Room at all after about 1108 when the Commander (E) sent a message that till further orders he intended to disregard telegraphs (a form of speech only as the telegraph shafting between wheelhouse and the F.E.R. passed through the L.S.P. and had been destroyed with it). Soon afterwards he received a thoughtful message from the Commander, " Shall I fire the starboard torpedoes to reduce the list and topweight ? " to which the answer was a grateful " Please."

The heel by that time was about 12½° starboard and the ship came back about ½°. Pumping out the starboard after fresh water tank and the Gunner's store aft, which had been flooded from the sea, reduced the heel to 11½°. Later, when bombing had ceased, a Chief Engine Room Artificer was sent round asking the soldiers all to crowd to the port side and this human ballast took off another 1° or so.

The soldiers helped in the 4 in supply parties and luckily had removed most of the ammunition before the 4 in magazine was hit. They augmented the close range fire of the ship's Oerlikons and pom-poms with their Bren and Lewis guns, as long as the dive bombing continued. They helped the parties rescuing wounded on the messdecks. Others formed a chain to pass buckets of water up from the sea for fire-fighting. Their conduct in such unfamiliar and unpleasant conditions was admirable, particularly when given a job to do.

By 1150 all fires were extinguished. An hour later the inner shafts were working again on steam from ' A ' boiler-room and all shafts were doing 224 r.p.m. giving a speed of 25 knots.

More and more tanks were found to be leaking and blackouts continued till 1500 the sprayers in ' B ' boiler-room could no longer be kept alight. Two Fulmars had been sighted. The ship was a long way from Scarpanto and further bombing was not likely to be intense. Main steam and feed water of

' A ' and ' B ' units were cross-connected and ' B ' boilers shut down. Speed was now 21 knots.

By 1630 the one tank which had been entirely reliable and easy to use at all times through its unit suction (A10) was empty, ' A ' boilers had little to burn and the port outer and both inner shafts had to slow down considerably.

The main steam and feed water systems of all three units were cross-connected, ' A ' boilers were shut down and ' A ' bulkhead valve was shut. All shafts were doing 180 r.p.m. supplied by ' C ' boilers steaming on the stand-by oil fuel tanks, which were the double-bottom tanks under the boiler-rooms. The speed of the ship was about 18 knots.

The Drunken Beacon off Alexandria was sighted at 2000 but by that time so little oil fit to burn remained that the Commander (E) told the Commander that he could not guarantee that the engines would not stop at any moment and the Commander decided to wait for tugs rather than risk blocking the channel if the engines failed.

The rest of the squadron went into harbour.

Orion came alongside No. 14 quay at Alexandria at 2330 on 29th May with two rounds of main armament remaining and about ten tons of uncontaminated fuel to spare.

LESSONS LEARNED

Determination

The greatest single factor in saving the *Orion*, under the good providence of God, was the Admiral's determination to get her back to harbour and his faith that she would reach it. He remarked afterwards :

" There was only one thing got us back, Chief, that was ' Guts.' "

The best of material preparations is little use unless the will to win is there. The knowledge that survivors from *Fiji* and *Gloucester* had been machine-gunned in the water a few days before provided perhaps an additional incentive to greater efforts to save the ship. The need for physical toughness as well as moral courage was felt below when the ventilation failed. Exacting games and sports are very rightly encouraged in the Navy to develop endurance and the will to win despite fatigue and adverse circumstances.

Ship-Knowledge and Training

Knowledge of the ship and of her machinery was generally good as she had been in commission over three years, though most of the original ratings had gradually been relieved. After the second bomb most of No. 1 and 2 fire and repair parties were casualties, dead, wounded, gassed or badly shocked, and it was lucky that many of No. 3 party were quite conversant with the whole ship. Training in machinery and electrical damage-control had been thorough, but there had been virtually no leak-stopping or fire-fighting training as schools for practising these arts did not exist when *Orion* left home.

Fire-Fighting

The old branch pipes used far too much water, and resulted in free surface on messdecks and flats. It proved impossible to pump out the water from the sponge formed by the soldiers' gear and bodies. In such an operation, the soldiers' gear should be tightly packed into one space as low in the ship as possible. Many gas casualties from cordite fumes amongst the fire parties would have been avoided by the use of breathing apparatus.

Care of Wounded

Many soldiers were badly burnt by flash, as they were in tropical rig.

The doctors were both in the Sick Bay tending wounded when the second bomb blew them up to the deck head. The shock impaired their efficiency greatly. They should have remained dispersed and had some of the wounded sent to the after dressing station to be tended. After the second bomb, over 250 wounded were lying about on the upper deck and they added greatly to the difficulty of getting about the ship. All the fresh water (F.W.) pumps had been put out of action by flooding, and the F.W. tanks contaminated. The ready-use stocks of water ran out, and the sufferings of the wounded were increased by lack of water, which was a pity as some could have been obtained direct from the evaporators by sending down to the after engine-room.

Machinery

The behaviour of the machinery was almost perfect. When near misses shook the ship, as a terrier a rat, all the machines ran on sweetly. The inner turbines were unharmed by trailing without a vacuum.

' B ' boilers primed heavily during one of the early blackouts, the water level having no doubt been allowed to get too high while the water was being cleared from the sprayers, but no harm seems to have come of this.

The unit system was invaluable. It was proved that even if the engines of two shafts have got to be in the same room, it is still well worth separating the pipe systems into two units. The modern cruiser with its two machinery units only is retrograde wasting so many of the advantages of a four shaft ship. *Orion's* three units saved her, though she had only two engine rooms. The unit system made diagnosis from the F.E.R. very simple, and made it possible to keep at least one shaft turning even at the worst crisis. Viewed as an exercise in the operation of machinery it was an intensely interesting day.

The lack of steam-driven fans was felt in the engine rooms when the electric supply failed. Had the turbo-generator watchkeepers and electrical damage-control parties not been well-trained the ship might have been lost because the engine-room crews would have died of heat. There was no thought of evacuation. Emergency Diesel generators might have been able to close the gap in electric supply. One Diesel forward would have been very useful after Nos. 1 and 2 turbo-generators had been wrecked. During a heeling exercise carried out just before the war, it was found that at 7° of heel the turbo-generators on the high side of the ship threw all their lubricating oil out through the breathing pipes on the drain tanks, in about five minutes.

It was quite simple to alter the breathing pipes to stop this. Had it not been done, the bearings of No. 4 turbo-generator would have run when the ship heeled. Its failure might well have caused the loss of the ship, as the steam supply to the remaining generator (No. 3) was, at that moment, most uncertain, with ' C ' boiler room indulging in a blackout.

Breathing apparatus would have saved the evacuation of ' A ' boiler-room because of smoke and would have enabled the inner shaft to be left running at the worst time.

Fuel Problems

The principal trouble throughout was water getting into the oil fuel tanks as various parts of the hull were damaged by near misses. With frequent changes of tanks and with water in the oil fuel suction main line, diagnosis became rather difficult. The second bomb destroyed or split the inboard bulkheads of A5, 6, 7 and 8 oil fuel tanks. The suction valves to A7 and 8 were open when the explosion occurred, the valve spindles were broken inside the tanks and the valves could not be shut. The flooding of these two tanks with water

prevented the supply of oil fuel from A1, 2, 3 and 4. Of the big tanks abaft the engine room, Y5 alone was tight after the near miss on the starboard quarter. The other tanks remaining were the double-bottom tanks under the boiler-rooms and engine-rooms (B1 to 12 and X1 to 18) many of which were leaking, and A9 and 10. Trouble was always experienced in steaming fast on the D.B. tanks as the fuel pumps, of the gear type, very soon lost suction. Also there was no way of ensuring that the tanks were free from water except by pumping from the residue suction, a lengthy business involving connecting and disconnecting hoses on 30 tanks. The oil from the D.B. tanks was usually pumped over into deep tanks at night, when air attack was unlikely. Many of the D.B. tanks had been emptied during the previous night and many others were leaking as a result of near misses.

The unit oil fuel tanks, from which the oil fuel pumps of each unit had a private and separate suction (originally fitted in *Orion* but done away with when the reserve feed tanks were brought inboard) would have been most valuable on this occasion. The one remaining unit suction from A10 oil fuel tank kept ' A ' boilers going at a critical moment.

The fuel suction line formed a ring round the ship, but the ring was incomplete, a gap being left on the port side of ' B ' boiler room.

This meant that with all boilers on main line suction, one boiler room had to suck from forward and two from aft or *vice versa*. Thus the oil fuel suctions were split into two units, not three.

Much of the trouble caused by water in the fuel has been overcome by fitting ships with service and settling tanks, but care should be taken that the unit division is applied to these, and also to the transfer pumps and their suctions. Each unit must be completely separate, from the original fuel tank to the tips of the propeller.

Stability

The free surface caused by water from fire-fighting operations was entirely unchecked by dwarf bulkheads or sills as none were fitted. It extended from 7 to 87 bulkheads on upper and lower decks, though some of it was able to drain away through the damaged decks of the sick bay and stokers' mess. Owing to damaged bulkheads and flooding from the sea through sea-cocks the whole section of the ship between 53 and 87 bulkheads was flooded up to the water-line and formed one large free surface across the whole beam of the ship. Smaller free surfaces existed aft between 164 and 190 bulkheads in the gunners' store, wardroom store, clothing and issue room, and compressor room and pump lobby.

The soldiers and their gear represented 120 tons of topweight, added at about upper deck level.

The result was that the ship was lolling and much of the $11\frac{1}{2}°$ heel remaining after firing the torpedoes and pumping out the gunners' store and starboard fresh water tank was due to negative stability in the upright position. The Commander (E) was not aware of this at the time, partly owing to the absence of damage reports (hardly surprising in view of the casualties and lack of means of communication) but also because the stability curves of the ship were safely locked away in the Ship's Book. Had means of counter-flooding been readily available he would probably have used them, not realizing that the heel was due to free surfaces, and perhaps put the ship over to an even bigger angle of heel to port. It is essential that both the Commander (E) and the Damage Control Officer be well versed in the stability characteristics of their ship and have copies of the stability curves and typical examples of damage with them

at their action stations and have some idea of the metacentric height when ordering counter-flooding action.

Dispersal

Too many key personnel were grouped in the L.S.P. and lobby. The L.S.P. Lobby was chosen for the D.C.H.Q. as seeming to be one of the safest places in the ship, though it was realized that the platform deck was rather low for it because of the danger of flooding.

The reasons for the Senior Engineer's action station in the A.E.R. were not only to enable him to take charge of 'A' unit but also to put him at a safe distance from the Commander (E) in the F.E.R. and he should not have been allowed to go forward and be in the same compartment as the D.C.O. and Section Officer of No. 2 fire and repair party.

Communication

When the second bomb destroyed the telephone exchange and telegraphs and flooded Nos. 1 and 2 L.P. switch rooms all means of internal communication failed, except for the telegraphs between engine-rooms and boiler-rooms and a voice-pipe between the two engine-rooms. It was extremely difficult for a messenger to find his way in darkness along the crowded and sloping gangways and mess decks, and his progress was slow. Insufficient messengers had been provided in the forward engine-room to allow for control entirely by messenger and the lack was exaggerated by the fact that it might take twenty minutes for a man to deliver a message to the bridge and return.

The Commander (E) paid brief visits to the bridge when the situation down below allowed, but he could insist on his right of gangway, had a torch, and knew all possible routes, so was much quicker than a messenger.

He did not have a clear picture of the extent of the damage for some hours, owing to lack of communications. For example, at about 1300 when 'A' boilers were steaming again, he sent a Warrant Mechanician to restart No. 1 and 2 turbo-generators, which had been blasted and flooded by the bomb two hours earlier.

His ignorance is not so surprising when compared with what happened on the bridge. The Flag Lieutenant was talking down a voice-pipe to the plot, trying to conjure up some fighter support, when his conversation was interrupted by smoke belching up the voice-pipe. He stepped backwards and was prevented only by the Admiral's outstretched arm from stepping down the hole in the deck made by the second bomb, which had passed through less than a yard behind him while he was speaking.

The sound-powered telephone has now overcome most of the difficulties and it is difficult to see how, with the sided telephones now being fitted in new construction, communications can be entirely disrupted, short of cutting the ship in halves.

Conclusion

Had *Orion* had better fire-fighting equipment, dwarf bulkheads, small portable pumps and oil fuel service tanks she would have steamed back from Crete with very little trouble at all. As it was for hours, that seemed like days to those on board, it was touch and go and, if one more thing had gone wrong she would have been a stationary target. That would have been her end and that of the 1,500 men (and 4 women) still alive on board her.