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VOLUME I

VOLUME III (Secret)

VOLUME IV (Secret)
ERRATA TO REPORT
OF
ADMIRAL OF THE FLEET VISCOUNT JELLI COE OF SCAPA, G.C.B., O.M., G.C.V.O.,
ON
NAVAL MISSION TO THE COMMONWEALTH OF AUSTRALIA,
(MAY—AUGUST, 1919)

VOL. I. p. 2, para. (cl. (6)—for " and Radio Service," read " of Radio Service"

p. 15, para. 11, line 3—for " Europe" read " European Waters"

p. 16, table 1—insert footnote — " White population of South Africa numbers about one and a half million ".

p. 19, line 5—insert " 25 " after " (page -) ".

p. 20, note II, line 1—for " at calculated " read " are calculated ".

p. 28, notes under table IX, para. 2—reference should read " Table " A " of chap. III of
vol. III ".

p. 33, para. 12—for " page 51 " read " page 41 ".

p. 46, line 2—for " Minnows " read " Records and Correspondence ".

p. 66, table 1—insert footnote :— " White population of South Africa numbers about one and a half million ".

p. 16, line 2—insert " 25 " after " (page -) ".

p. 159, note II, line 1—for " at calculated " read " are calculated ".

p. 206, para. 6(b)—for " Appendix B " read " Enclosure 2 ".

VOL. II. p. 171, line 3—insert commas before and after " T.B.D. ".

p. 174, (3) Coal, line 2—" canned " auxiliaries " to read " auxiliaries ".

p. 174, line 2—for " II " read " III ".

p. 175, line 2—for " East Coast " read " E.C. ".

p. 189, line 28—for " IV " read " VI ".

p. 191, " Byschane " cl. (c)—for " " D " Destroyer Boom " read " T.B.D. Boom ".

p. 194, line 4—for " five " read " three ".

p. 197, table, col. 1—" delete the words " or Sydney " after " Port Stephens ".

p. 199, " Estimates " para. 1(a), line 3—for " estimate " read " estimate ".

p. 203, para. 3, line 9—for " were manned " read " were manned ".

p. 206, para. 4(b)—for " Appendix B " read " Enclosure 2 ".


p. 236, para. 26, line 4—for " Freemantle " read " Fremantle ".

p. 246, Part 1, para. 3, line 1—for " each place " read " most places ".

H.M.S. New Zealand.
20th August, 1919.

JELLI COE.
Admiral of the Fleet.
REPORT
OF
ADMIRAL OF THE FLEET
VISCOUNT JELLYCOE OF SCAPA
G.C.B., O.M., G.C.V.O.
ON NAVAL MISSION
TO THE
COMMONWEALTH OF AUSTRALIA
(MAY–AUGUST 1919)

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Are printed separately.
CHAPTER VI.
Docks and Docking Facilities in the East.

Table I of this chapter gives the dimensions of certain classes of modern British
warships. The large increase in the size of more modern ships is very marked
both in length and beam. Bulge protection gives beam dimensions hitherto
uncontemplated in ship construction. It is interesting to compare the "New
Zealand’s" dimensions with those of more modern ships with and without bulge
protection.

2. Table II shows the dimensions of docks, existing or projected, in and
adjacent to the Pacific.

The receiving capacities of the docks for the ships on Table I are shown.

It is significant that modern warships of the "Queen Elizabeth," "Royal
Sovereign," "Renown," and "Hood" classes cannot be accommodated in many
of the existing British docks.

Of the British docks projected, those at Esquimalt and Vancouver, B.C., in
Western Canada indicate foresight on the part of the Canadian Government, as the
docks will be able to accommodate any modern men-of-war. The situation in the
South Pacific, however, is not greatly relieved by this fact.

The list of foreign docks given shows the advantageous position in which the
Japanese and United States Governments are placed by their long-sighted policy.

3. Table III summarises the British docking facilities, and emphasises the
present unsatisfactory position which we hold in the Pacific.

4. Reference should be made to the chart of the Pacific Ocean, which
accompanies this chapter and shows at a glance the present and future docking
possibilities. The proposals in Volume III, Chapter I, for large docks in the
future at Fremantle, Bynoe, and Port Stephens, capable of taking the largest ships,
and located at practically equidistant points round the Australian coast, will, if
adopted, greatly improve the situation.

It is not considered, however, that this provision completely meets the
situation when operations are carried to the northward; there is very urgent
necessity for the establishment of a dock at Singapore large enough to take any
modern ship. Time is of importance, and may make it desirable to make use of a
floating dock.

The capability of the Cromarty Floating Dock is shown, and although it will
not accommodate the "Hood" at all, or the "Repulse" and "Renown," except
under special conditions, yet the remainder of the vessels on the list could be docked
in it.

5. The fitting when feasible of bulge protection to ships is of very great
value, in that the ship can endure attack from a large number of torpedoes before it
becomes necessary for her to leave the line, and before she is in danger of sinking.

6. In establishing Naval Bases too much emphasis cannot be laid upon the
need for leaving ample room for future expansion. Experience in the past has
51492—Vol. II.—A
almost invariably shown lack of foresight, both in reserving land for future development and in constructing docks and naval works on a sufficient scale to allow of large increase in the size of ships. The result has been thoroughly uneconomical, for when congestion and immediate requirements compel expansion, the price of land has probably greatly increased; it may be impracticable to enlarge the docks, and it may not be possible to construct new docks in positions most suitable with respect to the lay out of the yard.

Foresight is also required in determining necessary depths alongside wharfs, basins, locks, &c., as usually the depth in these cases can only be increased with difficulty and at great cost. In constructing Australia's Naval Bases the lessons of the past should not be overlooked.

7. I have read with great interest the recommendations made by the Dominions Royal Commission on the question of the harbours and waterways of the world. In that important report it is pointed out that hitherto harbour development has been due to disconnected individual improvement carried out without due regard to increase in the size and draught of ocean-going vessels, and in the absence of that co-ordinated action which is essential if Imperial interests in overseas communication are also considered. The report urges the enlargement and deepening of harbours to meet the requirements of the ships of the future on the various trade routes, as well as provision of docks of adequate dimensions uniformly throughout the route.

Correlated effort between the Harbour Engineer and the Naval Architect is called for in the future, and the advantages that large commercial docks may offer to the Imperial Navy are noticed.

There is much to be learned from the report, and if the recommendations made are carried into effect direct benefit to the Navy will result.

8. With regard to the sizes of docks for capital ships to be provided at the proposed naval bases, I recommend (allowing for reasonable expansion) that the dimensions given below be followed as far as the circumstances of the individual case permit.

<table>
<thead>
<tr>
<th>Clear Length</th>
<th>Breadth at Entrance</th>
<th>Depth at M.H.W.N. over Sill</th>
</tr>
</thead>
<tbody>
<tr>
<td>feet</td>
<td>feet</td>
<td>feet</td>
</tr>
<tr>
<td>1,100</td>
<td>230</td>
<td>40</td>
</tr>
</tbody>
</table>

The docks should be capable of being divided into two smaller docks by means of an intermediate caisson; and there should be no batter of the sides of the entrance, the breadth at the sill being in consequence the same as at Mean High Water Neaps.

Allowing for a width of 30 feet at the intermediate caisson, two ships could be docked together, when the necessity arises, as shown under:

- "Caledon" and "Danae" = 450 + 471 + 30 = 951
- "Caledon" and "Emerald" = 450 + 570 + 30 = 1,050
- "Caledon" and "Raleigh" = 450 + 605 + 30 = 1,085
- "Caledon" and "New Zealand" = 450 + 590 + 30 = 1,070
- Two "Caledons" = 450 + 450 + 30 = 930
- Two "Danaes" = 450 + 470 + 30 = 952

9. It will be noticed that in Volume III, Chapter I, the necessity for establishing a naval dockyard at Port Stephens in the place of that at Sydney has been mentioned—the existing dockyard located at Cockatoo and Garden Islands having reached the limit of expansion, and being, moreover, extremely expensive and uneconomical mainly on account of the island situation.

Before finally recommending that the naval dockyard should in future be at Port Stephens, due consideration was given to Sydney Harbour, which was inspected with a view to finding a new site, the Harbour Commissioners kindly giving their valuable assistance.

10. After making due allowance for reasonable commercial expansion, the sites remaining where a naval dockyard might be established at Sydney were found to present the following disabilities:

(a) Rose Bay.—A residential quarter and the centre of recreation. Land sites very expensive and the situation somewhat exposed to bombardment from seaward.

(b) North Shore and Middle Harbour.— Almost entirely steep-to, consequently the expense of making sufficient level ground would be prohibitive.

(c) Long Cove.—The available land on the western shore abreast of Rodd Island would need to be supplemented by the reclamation of Iron Cove and Iron Creek in order to give any dockyard frontage. A fairly long water frontage could thus be obtained but without turning room for Capital ships.

The site has other disadvantages, viz.:

(i) It does not lend itself to further development without very heavy cost.
(ii) There would be great expense in replacing the existing road and tramway bridge (which is 9 spans) by either a more modern structure with a large opening span, or alternatively, by a tunnel.
(iii) Very extensive dredging would be required to give an adequate approach channel to the site suggested for the Naval Dockyard and judging from the foreshore features along either side of Iron Cove and at Rodd Island it is probable that the larger proportion of the dredging would be in solid rock.

The site at Long Cove cannot therefore be recommended for a Naval Dockyard.

(d) The reclamation of Major's, Yaralla and Bray's Bays would provide a deep water frontage for a dockyard site; it is understood that the bars in the Parramatta River below these bays would not be especially difficult to dredge. The great expense involved however in establishing a dockyard here, the great distance of the site from the harbour entrance, and the position above the great commercial traffic and above a bridge renders the situation unsuitable.

11. With regard to Jervis Bay and Port Stephens the following points were noticed:

Jervis Bay

(a) The adjacent country is practically undeveloped, consequently there is much room for expansion both naval and commercial.

(b) The wide entrance to the bay would require to be shortened by an expensive line of breakwaters, which besides protecting the harbour from weather to some extent would assist in its protection from enemy attack.

(c) A township and railway communication would have to be established. The railway at Nowra is about 20 miles away.

(d) The iron-mining districts are remote.

(e) The harbour is 82 miles south of Sydney, so not well placed strategically.
do not hallucinate.

12. The advantages that Port Stephens offers from the naval point of view as compared with Jervis Bay are so great that commercial considerations should not be allowed to stand in the way of its development as a naval base for the better defence of the Commonwealth.

### TABLE I.

*(Enclosure to Chapter VI.)*

**DOCKING FACILITIES IN PACIFIC AND INDIAN OCEANS**

<table>
<thead>
<tr>
<th>Country</th>
<th>Dock</th>
<th>Receiving Capacity for Ships on List.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Melbourne</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sydney</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Canada W.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>British</td>
<td></td>
<td></td>
</tr>
<tr>
<td>China</td>
<td></td>
<td></td>
</tr>
<tr>
<td>India</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Indonesia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Japan</td>
<td></td>
<td></td>
</tr>
<tr>
<td>New Zealand</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Australia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Melbourne</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sydney</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Canada W.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>British</td>
<td></td>
<td></td>
</tr>
<tr>
<td>China</td>
<td></td>
<td></td>
</tr>
<tr>
<td>India</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Indonesia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Japan</td>
<td></td>
<td></td>
</tr>
<tr>
<td>New Zealand</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**TABLE II.**

*(Enclosure to Chapter VI.)*

<table>
<thead>
<tr>
<th>Place</th>
<th>Dock</th>
<th>Dimensions</th>
<th>Receiving Capacity for Ships on List.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Melbourne</td>
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<td></td>
</tr>
<tr>
<td>Sydney</td>
<td></td>
<td></td>
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<tr>
<td>Canada W.</td>
<td></td>
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<tr>
<td>British</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>China</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>India</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Indonesia</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Japan</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>New Zealand</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A.—Dimension (beam) is “over fenders.”

B.—It is assumed that the ships of the “Emerald” class are being fitted with bulges. The dimensions are an estimate for Type “D” Bulge, as in the “Raleigh.”

C.—The dimensions are an estimate for Type “B” Bulge, as in the “Royal Sovereign,” (= 12' 6”).

D.—The beam of the “Tiger” when bulged is an estimate framed on the dimensions of the “Renowned” and “Royal Sovereign.”

E.—The receiving capacities of the various docks shown on the appended lists have been taken on the basis that only vessels distinguished above as “E” are bulged. The dimensions on which the receiving capacities of the various docks in Table II are based, are underlined above.

F.—It should be noted that the maximum beam of the bulged ships is about midway between keel and load waterline.
### TABLE II—continued.

<table>
<thead>
<tr>
<th>Place</th>
<th>Dock.</th>
<th>Dimensions</th>
<th>Receiving Capacity for Ships on List.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Floor</td>
<td>Breadth</td>
<td>Depth</td>
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<tr>
<td></td>
<td>Head.</td>
<td></td>
<td>Sill.</td>
</tr>
<tr>
<td>French</td>
<td>Dry Dock</td>
<td>ft. in.</td>
<td>ft. in.</td>
</tr>
<tr>
<td>Diego Guarei</td>
<td>636</td>
<td>90</td>
<td>82</td>
</tr>
<tr>
<td>Saigon</td>
<td>517</td>
<td>107</td>
<td>62</td>
</tr>
<tr>
<td>Japanese</td>
<td>Hokodate</td>
<td>461</td>
<td>81</td>
</tr>
<tr>
<td>Kobe</td>
<td>Mitsubishi</td>
<td>500</td>
<td>75</td>
</tr>
<tr>
<td>Kure</td>
<td>No. 3.</td>
<td>650</td>
<td>136</td>
</tr>
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<td></td>
<td>No. 3.</td>
<td>645</td>
<td>134</td>
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<td>Maizuru</td>
<td>No. 4.</td>
<td>543</td>
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<td>No. 4.</td>
<td>750</td>
<td>105</td>
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<tr>
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<td>No. 1.</td>
<td>510</td>
<td>88</td>
</tr>
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<td></td>
<td>No. 5.</td>
<td>713</td>
<td>96</td>
</tr>
<tr>
<td>Osaka</td>
<td>Port Arthur</td>
<td>500</td>
<td>72</td>
</tr>
<tr>
<td>Sasebo</td>
<td>No. 3.</td>
<td>553</td>
<td>85</td>
</tr>
<tr>
<td></td>
<td>No. 5.</td>
<td>744</td>
<td>104</td>
</tr>
<tr>
<td>Uraga</td>
<td>No. 4.</td>
<td>388</td>
<td>84</td>
</tr>
<tr>
<td>Yokohama</td>
<td>No. 4.</td>
<td>476</td>
<td>84</td>
</tr>
<tr>
<td>Yokosuka</td>
<td>No. 4.</td>
<td>314</td>
<td>63</td>
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<tr>
<td>Mexico</td>
<td>Sabina Cruz</td>
<td>439</td>
<td>93</td>
</tr>
<tr>
<td></td>
<td>Proposed</td>
<td>574</td>
<td>91</td>
</tr>
<tr>
<td>American</td>
<td>Honolulu</td>
<td>632</td>
<td>79</td>
</tr>
<tr>
<td>Panama</td>
<td>No. 1.</td>
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<td>110</td>
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<td>Canal</td>
<td>No. 1.</td>
<td>618</td>
<td>74</td>
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<tr>
<td>Puget Sound</td>
<td>No. 2.</td>
<td>801</td>
<td>114</td>
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<tr>
<td>San Francisco</td>
<td>Hunter's Point</td>
<td>962</td>
<td>97</td>
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<td></td>
<td>Hunter's Point</td>
<td>714</td>
<td>86</td>
</tr>
<tr>
<td>Seattle</td>
<td>Floating, proposed</td>
<td>600</td>
<td>90</td>
</tr>
<tr>
<td>Cromarty Floating Dock</td>
<td>689</td>
<td>113</td>
<td>103</td>
</tr>
</tbody>
</table>

### TABLE III

(Enclosure to Chapter VI.)

<table>
<thead>
<tr>
<th>ANALYSIS OF DOCKING FACILITIES.</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Place</th>
<th>Dock.</th>
<th>Dimensions</th>
<th>Receiving Capacity for Ships on List.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Melbourne</td>
<td>Sydney</td>
<td>Canada W. Edgington</td>
<td>Canada W. Proprietary</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Melbourne</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sydney</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Canada W. Edgington</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Canada W. Proprietary</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calcutta</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hong Kong</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bombay</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colombo</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>New Zealand (existing)</td>
<td></td>
<td></td>
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<tr>
<td>New Zealand (proposed)</td>
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<tr>
<td>Singapore</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cromarty Floating Dock</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note.**—x indicates where ships can be docked. xx indicates where ships can be docked under certain circumstances.
CHAPTER VII.

Naval Air Requirements of Australia.

PART I. Operation of Aircraft—
(a) From a Base.
(b) From a Carrier.
(c) From a Man-of-War.
(d) Torpedo-carrying Aircraft.

PART II. Material—
New machines.
Aircraft Industry in Australia.
Plans of Air Stations.
Proposals for present requirements.
Air Stations.

PART III. Meteorology.
Civilian Flying.
Medical Aspect of Flying.

AIRCRAFT FOR THE NAVY.

Liaison Office.

Owing to the very rapid alteration and increased capabilities of matériel, it is not possible to lay down a definite and binding policy in this matter to cover a number of years. This new arm has not the same experience either as regards administration or matériel as have the two older services.

Hard and fast proposals for definite matériel would be obsolete in a very short time, and the naval air policy will require review from time to time in the light of experience gained. (See Chapter 16(b) re forecast of the future.)

2. As a first principle it is laid down that full advantage should be taken in every way possible of the experience gained by the Mother Country during and after the war. All the knowledge obtained on personnel, training, technical matters, administration, operations, &c., should be available for the Commonwealth, whose officers can sort out the results and apply them as necessary. From enquiries made in Melbourne, it appears that very little of the information which should be sent to Australia is being received.

3. The first requirement, therefore, is the establishment of a very efficient liaison office in London. Experienced Officers who can speak from the administrative, flying, and technical points of view are required.

The selection of personnel for this purpose needs very careful consideration, and it would be false economy not to get officers of high rank, if necessary, as on their opinions, if accepted, might depend the saving or injudicious spending of thousands of pounds.

4. This question of liaison work must be considered in conjunction with the Military and Civil sides of flying as well.

As a start it is recommended that two officers be appointed:—
(1) A Flying Officer.
(2) A Technical Officer, with engineering knowledge.

One of these should have had Naval experience.

PART I.—Operation of Aircraft.

(A). From a Base.

(B). From a Carrier.

(C). From a Man-of-War.

(D). Torpedo-Carrying Aircraft.

(A). From a Base.

Seaplane Flying Boat Bases may be either permanent or temporary. Experience to date has been confined almost entirely to permanent bases, though conditions approximating to temporary bases have often arisen where, for various reasons, sheds have not been erected.

2. Permanent Bases.—Up to the present, these possess the great advantage of being able to house machines, and to keep them in as good condition as possible. The drawbacks, of course, are expense, labour, and inability to move the Station, should any reason make this desirable.

The exact amount of the advantage gained by housing cannot be stated definitely, but an increase in efficiency of 30 per cent. in matériel compared to unhoused boats errs rather on the side of modesty. Indications point to the fact that the days when shed accommodation will be provided for small seaplanes only are rapidly approaching. Alterations in methods and details of construction will doubtless be made to meet the new conditions, so that the difference in efficiency between the two methods will decrease.

3. Temporary Bases.—These possess an advantage in the rapidity with which they can be established together with mobility, if desired. On the other hand they possess the disadvantage of having machines continually exposed.

Method of Establishment.—Temporary Bases.

Aircraft Carrier.

4. Undoubtedly the quickest way to do this is by means of the Aircraft Carrier, but owing to the large personnel involved, together with the expense of the ship and inability to carry anything but small aircraft, this method presents certain disadvantages.

Depot Ship.

5. The alternative method is by employing a small Depot Ship, with good repair and salvage facilities, &c., the aircraft being flown to their destination.

As far as is known there is no experience available to date in this direction, and proposals for this purpose must necessarily be of a tentative nature, although guidance in certain matters can be obtained from the Aircraft Carriers evolved during the war.

6. It is believed that the above proposal is being developed in England, and it is suggested that full inquiries be made by the Liaison Officer at the Air Ministry, any experience gained by the Home Country being communicated to Australia.

7. As part of such a scheme, the question of docking lighters, or the quick building of a small slipway, together with the provision of cranes for changing engines, &c., forms an integral part.

Roughly, the best line of development appears to be as follows:—

Obtain a ship of about 4,000 tons, speed more or less immaterial, say 10-12 knots, with accommodation for the Air Personnel, in addition to ship's company, necessary at the proposed base.
Included in her equipment should be stores and spares for machines, petrol and oil stores, an air compressor, good workshops, one or two powerful motor boats for towing, a strong derrick or crane with a high lift, engine-running bench, &c., and good refrigerating plant.

8. Experience is necessary before a decision is reached, whether docking lighters, or the construction of a small slipway should be attempted at the base. If docking lighters, not less than one per three boats should be provided.

The former are probably the simpler, but of course they will have to be towed across the open sea. On the other hand, keeping seaplanes ashore, whether housed or not, possesses advantages in facilitating the departure of patrols at specified times by enabling their engines to be run up, and stores, bombs, &c., to be transported to them easily.

Note.—It will not be possible to take machines required to operate from such bases in an erected state in the ships, so there are two alternatives:—

(a) To fly there if practicable.

(b) To be taken there in parts in some cargo ship, and to be erected on the spot.

9. It is therefore recommended that a ship of about 4,000 tons be procured for this purpose. The experience of the Admiralty as regards size and nature of Air Service workshops, petrol stores, bomb stores, &c., should be obtained, and she should be equipped to carry out the functions enumerated above. With the increasing size of boats it will be necessary for her to store planes complete of perhaps 100-150 feet long, under cover. This must not be overlooked. It may be preferable to have her converted in England for the Commonwealth under Admiralty supervision.

She should be ready by the middle of 1921.

(B. From a Carrier.

10. This method possesses the advantage of extreme mobility as a base and ability to keep any rendezvous at a given time, but has the disadvantage that only small aeroplanes or seaplanes can be carried. Whether aircraft carriers have a big future in naval work is not yet determined, as the future of the small machine is not at present settled. Undoubtedly they will have certain useful functions to perform in the way of reconnaissance and spotting.

(C. From a Man-of-War.

11. The present policy is to supply Capital Ships with one or more aeroplanes. Generally a division of four ships carries fighters and reconnaissance aeroplanes.

Light cruisers are also fitted to carry aeroplanes.

Owing to the lack of designs of suitable seaplanes, aeroplanes were used entirely during the late war. It is questionable, however, whether in peace time the rise to personnel by this method of operating is justifiable. The development of a small seaplane capable of flying off decks and turrets to fulfil the same functions would lessen the risks considerably. The Air Ministry should be asked to provide a suitable design of light seaplane for use from warships operating at long distances from the land in the Pacific.

12. Seaplanes, being capable of recovery complete, the question of supply, which is difficult when operating over large areas, is somewhat simplified. It must be clearly understood, however, that aeroplanes and seaplanes carried in ships will always have a comparatively small radius of action, and will not be able to fulfil the functions of those aircraft of greater size operating from bases.

Aircraft carried in ships suffer from exposure and deteriorate, so that their value is somewhat reduced.

13. It is therefore recommended that except at such times as ships are about to carry out exercises, &c., or are moving from one place to another, the aircraft and personnel should be ashore, where machines deteriorate less and where flying practice can be obtained by the pilots.

(D). Torpedo-carrying Aircraft.

14. Much progress has been made with this weapon latterly, and its development may be expected to proceed with other types.

It has been suggested as a serious rival to the submarine as a method of attacking convoys, and its possible use in this direction, together with counter measures, must not be overlooked.

At present, aeroplanes with small radius of action are used, but greatly increased radii up to, say, 400 to 600 miles out and back, may be expected in the next few years with still further developments later on.

The present method of operation is from an aircraft carrier, but with increased radius of action there is no reason why torpedo aircraft should not be operated from a shore base, if enemy ships are likely to pass within their effective radius of action.

15. Recommendations on this subject are contained in Chapter IV of Volume IV. It is considered important that experience with this type of aircraft should be obtained in Australia.

PART 2.—MATERIEL.

New Machines.

As before stated, the developments of big boats is proceeding apace, and the following are the probable performances of some of the new ones now under construction:—

1. A twin-engined 600 h.p. boat. Speed, 97 m.p.h. Carrying capacity, 5,000 lbs. for a 250 mile trip; 3,000 lbs. for a 500 mile trip; and 1,000 lbs. for a 750 mile trip—these being reckoned against a 30 m.p.h. wind.

2. A four 600 h.p. engined machine with better sea qualities than the preceding ones. Speed, 105—110 m.p.h. Carrying capacity, 8,000 lbs. for 250 miles; 4,000 lbs. for 500 miles; and an extreme range with crew only of about 500 miles—distances as before against a head wind.

3. 5,000 h.p. machine, with the object of having a very long range machine of great size so as to stand up to heavy weather. For a trip of 1,000 miles she should carry 10,000 lbs.; and the extreme range with a crew of ten should be about 1,600—1,800 miles. Anticipated speed, about 95 m.p.h.

Aircraft Industry in Australia.

2. This needs immediate and very careful attention. In the event of war, Australia will have to provide its own aircraft, and produce them in quantity. During the latter part of the war, the output of aeroplanes and seaplanes in England was about one per ten minutes, or, roughly, 4,000 per month. Quantity production had been closely studied and reduced to a fine art. As soon as a type of machine has been settled, say, for the next year or two years, a proportion of money should be set aside for the manufacture of jigs, gauges, &c., so that the production of these machines in quantity can be commenced with as little delay as possible in the event of hostilities arising.

3. The question of seasoning and supplies of timber, and the general suitability of timber available in Australia for aircraft construction, must be carefully considered. The opinion and report of an expert in timber is necessary for this purpose.
4. The question of the manufacture and production in quantity of engines, armament, instruments, and other fittings must also be treated in a similar manner.

5. Owing to the large space they occupy in shipping, if brought from England, it is thought that priority should be given to aircraft themselves, and after that to engines. It would be economical to get an expert with experience from England for this purpose.

**Arrangement of Air Stations.**

6. The boat-building industry needs very special consideration. It is a far more difficult constructional problem than aeroplane construction, and needs highly skilled labour. This branch of the Service would naturally not have the same interest for Military Officers in the event of Aircraft and Munitions Production being put under Military Control, and very special precautions are necessary to see that it is not excluded, in view of its exceedingly important for overall work.

7. Owing to the necessity of establishing stations quickly in war time, a large amount of space and material was wasted during the recent war. Stations were often built to accommodate, say, 150 men and a few machines, but the development of operations has involved the placing there of, perhaps, ten times the original amount. This has resulted in Stations growing up in a straggling manner, with a very uncommercial outlay, both as regards land and distance between important parts of the Station. There is, however, little, if any, need for a repetition of these mistakes in the future, and in considering the construction of a station, the following facts must be borne in mind and due allowance made:

(i) There should be ample room for the extension of quarters round the men's recreation rooms, galleys, &c. The same applies to officers' quarters.

(ii) Workshops should have room for expansion when necessary, ground being left available, and similar principles apply to all other buildings in the Station.

(iii) The men's quarters should be as near their work as possible. Much time has been wasted in some cases by having the quarters a mile away from the workshops and sheds.

(iv) The size of the machines may, and probably will, grow. Allowances must be made for this in accommodation and also in the size of aerodromes in the case of land machines operating with the fleet. It will probably be of little use to choose the small aerodrome surrounded by high approaches with grounds which cannot be readily acquired when necessary.

(v) In the case of a large station, a railway siding in the station is almost a sine qua non.

8. When a site for an Air Station has been selected, although the erection of a Station at that place may not be contemplated immediately, it is recommended that plans be prepared, allowance being made for expansion as above, and a schedule of material required made out. This will enable such a Station to be erected with a minimum delay in the event of its being required, before the programme under which it would be constructed materializes. Some form of option should be retained over the site selected.

**Handling of Machines.**

9. This is likely to be one of the big problems of the near future. If machines increase to a span of some 250 feet or more, it is unlikely that the expense of providing sheds for them will be justified, even if practical. Consequently they will have to be kept in the open. The problem becomes more acute in the case of flying boats or other sea craft, and it would appear that the time is not distant when the co-operation of the Docks and Harbour Boards will have to be asked. With flying boats, docking accommodation, to enable repairs to their bottoms to be made, will be necessary. Also the necessary hoisting facilities for changing engines, removing planes for re-covering, &c., will have to be provided. Unfortunately there is no experience to date in this matter which will serve as a guide in the future. It is recommended that in this direction the developments in England, where large flying boats will shortly be in use, be watched very carefully, and adopted as necessary.

10. In the case of temporary bases, alluded to previously, the provision of proper handling facilities may result in the difference between a unit being able to repair a machine and the sacrifice of a flying boat costing anything from £10,000 upwards. Removing planes for repair, changing engines and hull repairs are the principal problems.

**Proposals for present requirements.**

**Boats.**

11. It is necessary to adopt a type for immediate requirements, and the type of boat which is now available in quantity, and is recommended, is the F.5 Type-twin engine Rolls Royce 375 h.p. The machines have a range of about 800 miles, with crew, in a calm. Even if the type became obsolete for operational purposes in a few years, it would still be suitable for training.

It is possible that a number of these machines may be available as a gift.

**Ship Aeroplanes.**

12. It is recommended that the Panther type of two-seater be obtained for spotting and reconnaissance.

As regards fighters, it is believed that the “Camel” type is being superseded, and it is recommended that the type adopted in its place be procured.

**Torpedo Aircraft.**

13. The latest information is that the Sopwith “Cuckoo” is the standard torpedo machine. This type, with the “Viper” engine, is recommended, pending the development of an improved type.

**General.**

14. From time to time as necessary, and each year when considering the next year’s programme, the question of the re-equipment of a portion of the squadrons with machines of a later type must be considered. As a broad principle it is considered advisable to standardize as far as possible in material with the Mother Country for the following reasons:

(1) Supplies and spares will be available in greater quantities in case of emergency.

(2) Units sent from Home to assist in the event of war will find suitable spares in Australia.

**Air Stations.**

15. It is understood that a site has been requisitioned at Limeburner’s Creek, Port Phillip, and that the erection of a station there for seaplane training and patrol work, together with naval aeroplane work, will proceed. This should meet training requirements for the present, but in the event of war arrangements are required to remove the seaplane training elsewhere.

The question of other air stations in Australia is dealt with in Chapter III of Volume III and Chapter IV of Volume IV.

**PART 3.**

**Meteorology.**

This subject is of great and increasing importance to flying.

Meteorological Huts were established at nearly all Naval Air Stations, and the organisation of the whole Meteorological Service was under consideration after the signing of the Armistice.

The end aimed at is to be able to provide a pilot going on a long-distance flight with as exact information as possible of the weather conditions he will be likely to encounter during that flight.
2. It is not known what has been definitely settled, but one proposal on foot was that the Meteorological Office in England should be put under the Air Force, who would supply all other Services with such information as they desired. It is recommended that the decisions adopted in England be ascertained and applied as necessary in Australia, but, owing to its large size and scattered population, it cannot be expected that the Service will be as complete as the European one for some considerable time.

3. The establishment of a Meteorological Service for naval flying purposes must, of course, be closely associated with that for military and civilian purposes.

A few remarks on the effect of storms on flying are appended.

Some Remarks on Weather in Australasia as Affecting Flying.

In the few following remarks on storms which have been gathered from the various publications available, it is proposed to consider briefly some of the aspects of storms on flying.

The area under consideration lies between Australia on the south and west, latitude 7° N. to the northward, and Fiji on the east.

The storms to be considered are:

(a) Cyclones on the Queensland Coast and to the eastward.

(b) Cyclonic storms on the W. and N.W. coasts of Australia.

(c) The area covered by these, as far as Australian flying is concerned, is the Queensland Coast and the islands to the S.E. of the Solomons, including the New Hebrides.

Queensland Coast. The period of the storms is from December to early April. They usually strike the coast between 12° and 26° south, and for the last eight years their centres have passed 30 miles south of Cairns. They have been mostly experienced at Cardwell, Townsville, Bowen, the Northumberland Islands, and the neighbourhood of Sandy Cape. To the southward of the 26th parallel they break up into heavy gales. They may extend some distance inland, but their centres do not often pass the coast ranges, which appear to repel them, and they usually emerge from the coast between Broad Sound or Cape Moreton.

There are no records of any of these storms in the Solomons.

(b) West Australian Hurricanes. These are known locally as "willy-willies." They occur in connection with or are from the violent forms of cyclonic disturbances which originate over tropical seas, and are practically limited to the summer months, December to April inclusive.

These storms sometimes give the first indication of their approach in the extreme N.E. corner of Western Australia, and occasionally, it is believed, at Port Darwin. They travel at first in a S.W. direction, the centre keeping well out to sea. When they reach the latitude of about 20°, their course alters and they recurve and commence to travel in a S. or S.E. direction, striking the coast generally between Condon and Fortescue, and frequently bringing a "willy-willy" to wreck whatever happens to be in its way. They then travel inland, passing as a rule either over or to the eastward of the goldfields, whence they travel to the Southern Ocean.

The islands to the northward of Australia are in the monsoon region, and do not suffers from these cyclones. There is one case on record however of a typhoon occurring in the northern part of Borneo on the 31st October, 1904, which caused a great loss of property.

To consider the effect of these storms on flying:

(a) Aircraft in the air.

The effect is not known, and it is quite probable that present day machines would be unable to survive. On the other hand it is possible that a pilot may be able to see the storm coming and to run from it.

This is a point requiring investigation. In any case losses due to this cause can probably be accepted.

(b) Permanent buildings and machines on the ground or moored out.

This is a far more serious consideration, and due weight must be given to it when erecting air stations.

Unless the risk of a heavy pecuniary loss is taken, buildings must either not be erected at all, or allowances for these storms must be made in their construction. This will be an extensive item in the case of large aircraft sheds.

Machines moored outside.

Although a case has occurred of a flying-boat riding out a gale at her moorings, generally speaking, it may be anticipated that such machines will be wrecked, and presumably any shelter under whose lee they may be put, such as trees, houses, &c., in the case of aeroplanes, are liable to a similar fate.

It would, therefore, appear that machines must not be moored out in localities where these storms occur during such periods as they are likely to be met. It is further apparent that other meteorological conditions must also be closely studied in erecting structures for air purposes. For example, drainage for tropical rains must be provided where necessary. In the heavy Queensland rains, it is quite possible that any Bessoneau or other canvas hangars would be washed down with rain, smashing up their contents.

Aerial Survey.

4. There is, however, one other urgent duty to be performed, i.e., the aerial survey of the islands to the north and north-east of Australia. Nothing at present is known of the flying conditions there, and in the short time available during the visits to these islands it has not been possible to inspect thoroughly sites for air stations.

Before money is spent on such stations it is most necessary that the best site possible, consistent with naval requirements, be chosen, and that all sides of the question, such as water supply, possibilities of construction, &c., be thoroughly investigated. Again, flying directions analogous to sailing directions are now being prepared wherever flying is carried out, and it is most desirable that in the event of war such directions should be up to date for the Islands.

5. Certain of the work, such as photography, can be done only from the air. It is further possible that, on calm days, photography from the air may in some cases reveal shoals, coral reefs, &c., and give contours of known ones, thus being of assistance to the Hydrographer and the Navy generally. The islands of Australia would appear to offer as good an opportunity for testing this as anywhere.

6. Included in the survey party should be experts on the following (knowledge of these parts of the world is a desideratum in their particular work):

Works and buildings.
Surveying, both land and sea.
Metropolitan.
Tropical medicine.

The Type of Carrier most Suitable for this Work.

7. The smaller carriers, such as the "Nairana," "Pegasus," &c., probably have not the fuel supply necessary for the work, nor have they the large repair facilities required in the case of a crash. It must be remembered that such a carrier will be cut off from all supplies during the time she is away, and must, therefore, be as self-contained as possible.

It would appear that the "Argus" would fulfill the requirements as well as any vessel, provided that she can hoist in float-type seaplanes.

Recommendation.

8. It is, therefore, recommended that the British Admiralty be asked to carry out the survey in co-operation with the Navy Board, in the "Argus," or other carrier, the experts in works and buildings, land surveying, meteorology, tropical medicine, &c., being provided by the Commonwealth Government.
Civilian Flying.

9. It is impossible to dissociate altogether this aspect of flying from the consideration of the Services. It appears that Australia should offer as big a future for commercial work as any country, and the uses to which the personnel and material can be put in time of war must form part of any organisation for such a war.

Personnel.

10. Pilots accustomed to long-distance flights and accurate navigation lend themselves admirably to naval work.

Material.

11. The aeroplanes will probably be more useful to the Army or independent forces, but a proportion, especially if they fly much over sea, could doubtless be utilised for naval work. The functions of any commercial airships would in war time be almost entirely naval. The bases, aerodromes, depots, etc., would doubtless be of great use, and, provided that no undue hindrance is caused to the companies thereby, they should be established where their utility to the Services will be a maximum.

12. Owing to the uncertain state of affairs in this matter at present, definite proposals are not possible, but as companies become established it is recommended that as a stipulation for granting their licenses a proportion of the personnel be made to join an Air Reserve for the Navy, where they can do a proportion of naval training each year, say one month, consisting of gunnery, formation flying, signalling, recognition of ships, etc., etc.

The movements and proposals of the British Government in this direction might well be watched, and if necessary adapted to local conditions.

By judicious consideration of the above aspects, it is quite possible that large advantages to the Services may accrue, combined with considerable saving in the erection of buildings.

Medical Aspect of Flying.

13. This is a subject which received a very considerable amount of attention in England during the latter part of the war, and is an aspect of flying which must not be neglected.

Several well-known medical men specialised in the maladies peculiar to the air, and investigated the causes which rendered some men unsuitable as pilots.

The recommendation of one officer who had had experience of this work was that medical officers for this purpose should be trained young, and whilst under training should obtain the necessary flying experience.

Owing to the comparatively small number of medical men involved, it is possible that specialists in this subject might advantageously be shared by the Navy and Army. In any case, it is recommended that the reports and results available in England be obtained for Australia.
alone which may reasonably be expected is of the order of one million tons. I gather that the conditions are such that it should be possible to supply this oil fuel (free on board) at Daveaport, Tasmania, at about £4 per ton, which is considerably less than the present market price (£6 15s.).

I recommend that the development of this promising field should be pressed forward at once with a view to obtaining a source of supply for the fleet; the project being placed presumably under joint Imperial and Commonwealth control.

8. It would seem, however, that the largest supply of oil fuel required by a modern fleet is most likely to be found in the oil-bearing districts of New Guinea.

A considerable amount of geological surveying and prospection has already been carried out in Papua, and the general prospects are sufficiently favourable to justify greater and more expeditious efforts being made to develop the known areas and to test others.

The policy of working the field at this stage as a joint Imperial and Commonwealth proposition has many advantages; one disadvantage, probably, is that development will be slow. It is understood that the Prime Minister has recently had the subject of the development of the field personally under consideration, but whatever line of operation is instituted the policy should aim at freeing the Imperial Fleet without delay of its almost complete dependence upon foreign supplies of oil.

With regard to a proposal by Dr. Wade to use Orokolo Bay, in the Gulf of Papua, for the shipment of oil—a submarine pipe line from the tanks being run out into the Bay—it is considered that the advantages which would accrue by the adoption of this system are sufficient to recommend it for very careful consideration, particularly by sea men. Quite possibly there will be some days in the year when shipment of oil will be impracticable on account of the weather, but this occasional disadvantage should be accepted in view of the time and cost that will be occasioned if any of the other proposals for shipment are adopted. In my view, the Navy Department might with advantage cause observations to be made in the Bay.

9. As regards the recently acquired German New Guinea, it is only to be expected that the information available regarding the possibilities of oil supply are meagre, but, in view of the importance of the question Imperially, I would suggest that one of the first of the new responsibilities of the Commonwealth is to cause thorough investigations to be made, particularly in the neighbourhood of Eita pe (Berlin Harbour), about 100 miles to the eastward of the Dutch frontier.

10. A source of supply in New Guinea, particularly in view of the importance of the locality strategically, fully justifies outlay in prospecting. As soon as the Government has got the workings on a sound footing it would be well to consider the introduction of private enterprise under Government regulations and control. Objections in connection with native questions have been raised; I have, however, had the advantage of a discussion on this subject with the Administrator at Rabaul, and there does not appear to be much weight in these objections.

11. I have been asked to remark upon the question of the development of the oil-fields in Portuguese Timor. With Timor situated as it is, in a position off the northern coast of Australia, we cannot afford to let this possible source of oil supply fall into the hands of any potential enemy.

The reports which have been brought to my notice, however, do not indicate what may be the future possibilities of the field, and although a British company—the Timor Petroleum Concession, Ltd., of Sydney—holds a concession, the working of which has been suspended (I understand, from want of capital), it is in the absence of such information I am not in a position to recommend the Commonwealth Government to support the venture by a subsidy.

In view of the importance of the matter to Imperial interests, however, I venture to suggest that the Commonwealth Government should take all possible steps to ascertain what are the potentialities of the field, and act accordingly.

12. The wider use of oil fuel commercially around the Australasian littoral will directly benefit the naval aspect. It will be noticed in the table at the end of this chapter that large reserve stocks of fuel will require to be maintained for the use of the Imperial Fleet in war.

This reserve should be established without delay, and since at present the use of oil fuel commercially in Australia is not extensive, the large stock required must—at any rate, at this stage—be provided by the Government, and the more convenient procedure of contracting with oil companies to reserve specified quantities for naval purposes should be adopted when the occasion permits.

The periodical turnover of the Government stock might be effected by arranging to supply Government and commercial concerns as necessary, in addition to the peace time requirements of the Fleet.

There can be no doubt that many commercial advantages will follow any large development of the Imperial Oilfields, and these advantages will in turn benefit the naval side of the question—primarily by relieving the Government of the necessity of wholly providing its own stocks, and secondarily by ensuring an equable distribution of oil in the Southern Seas over and above the amounts for which the strategic requirements can legitimately call.

13. In the event of the unexpected failure to produce oil in sufficient quantities in our own territories, the reserves for the Imperial Fleet will have to be obtained from the Dutch East Indies, Borneo, or other oilfields, on the best terms that can be arranged.

Coal.

14. Turning to the question of coal for the Fleet, it must be remembered that it does not necessarily follow that a coal which is suitable for a merchant ship is acceptable to a man-of-war. Several Australian coals which find favour with the mercantile marine have been suggested as being fit for naval purposes, though actually not having the requisite constituents.

The conditions are so different that a few observations on the subject are desirable.

In a merchant ship the grate area for a given power is much larger than in a warship. For example, in the former the consumption of coal may be of the order of 8 lb. per square foot of grate area at full power, whereas in the latter about 32 lb. per square foot is used. Consequently, in the man-of-war ash accumulates four times as fast as in the merchant ship, so that a coal which produces a high percentage of ash will, in a man-of-war, cause choking of fires, heavy labour, and other disabilities, to which the merchant ship would be largely immune.

The merchant ship can afford ample boiler space and room for design favourable to the burning of inferior coals; but in the man-of-war boiler space is necessarily restricted, and boiler design cannot—owing to the function of the vessel—follow the special requirements of inferior coals.

In the Pacific especially, the man-of-war requires a very large radius of action, so that bunker space can ill be afforded for carrying a coal yielding a high proportion of ash.

The man-of-war requires to be able to develop full power quickly, and to maintain full speed for long periods. Consequently, a coal which does not lend itself to the forcing of the boilers and continued efficient firing is unsuitable.

Further, if ash in quantity has to be dealt with, it should be, as a rule, choker-forming; otherwise undue strain will be put upon personnel, especially in hot climates, and a considerable wastage of coal will occur.
Finally, besides being of as high calorific value as possible, the coal required by men-of-war should, for obvious reasons, be as smokeless as circumstances permit.

15. From records of trials of Australian coals placed before me, it appears that the maximum power that men-of-war on the station have been able to attain hitherto with continuous steaming is about 64% only. This is mainly due to the large proportion of ash obtained from the majority of Australian coals. For instance, with Welsh coal, the ash percentage is about 4.6%, and with Westport 2.36%; but with southern New South Wales coal it is 10.67%. These figures are the result of laboratory analysis, but it should be noted that usually in practice the ash residue is double or more than double these amounts.

16. Discussing generally the more likely fields, previous experience seems to show that the southern coalfields of New South Wales have been found more suitable for men-of-war than the northern fields of that State. Southern fields give a lower consumption per I.H.P., less smoke and less flame at the funnels, but apparently do not allow of being forced.

In Queensland there are some coals which approach an anthracitic character, and, as a rule, for steaming purposes, the more nearly a coal conforms to the anthracite the more suitable it is. The analyses of certain Queensland coals indicate that less smoke and less ash are to be expected than are obtained with the New South Wales coals.

Beyond these two possible sources there is no evidence of a suitable coal being obtainable other than from New Zealand. Yet, although holding premier place in Australasia, Westport coal has the disadvantage that it gives off large quantities of smoke. Generally the comparatively smokeless coals of Australasia are very high in ash.

17. It appears that very frequently the Australian coal supplied to ships on the station has not been obtained from separate mines, but has been mixed in various proportions by the coal agencies, as convenient. Such procedure is not likely to lead to good results, and it is considered that exhaustive trials are required with modern men-of-war at various speeds to test thoroughly the better coals.

18. To give effect to this, from the various better coal measures selected, those mines should be chosen which have the deepest seams of solid coal. This should eliminate the danger of dirt-bands in an otherwise good coal, causing a prohibitive amount of ash. Careful analysis of the coal should be taken on delivery, and attention should be given as far as possible to the particular conditions under which the coal will give the best results. Trial should not take place until sufficient experience has been gained on board in the handling. The mixing of two coals may be found to be desirable for good results, and this question also should be considered.

19. Of the several coals which justify trial, the following appear to be specially worthy:

The Sydney Metropolitan Colliery (Cremorne) Coal, cleaned.
The Excelsior Colliery Coal, New South Wales.
The Dawson River Coal-field, Queensland.
The Ipswich Coal, Queensland.
The Burrum Coal, Queensland.
The Blair Atholl Coal, Queensland.
The Mammoth Colliery Coal, Queensland.

20. If, as the result of the trials, which should take place without delay, a comparatively satisfactory coal is obtained, arrangements should be made to maintain the naval stocks by a specified proportion of the output of the selected mines.

Frequent analysis should be made to ensure that there is no falling off in standard, and that the coal conforms to specification on delivery. Great care should be taken in storage and handling to prevent deterioration, and the services of a Coal Inspector are required.

A source of coal supply in Queensland is especially to be desired, in view of the necessity of northern bases, and would justify additional facilities in railway connection if needed. Pending definite trials, however, stocks must be provided of Westport or Welsh coals.

The proposed method of distributing fuel supplies for the Pacific Fleet in war is dealt with in Chapter II, Volume IV, and a table at the end of this section shows the amount of fuel required to be stored at the various ports and naval bases ready for the use of the Fleet in time of war.

In calculating these reserves of coal and oil fuel required for the Far Eastern Fleet, allowance has been made for the accommodation made in Chapter Ia, that all future ships for service in these waters should be fitted to burn oil fuel.

21. In conclusion, I wish to urge that the importance of the question of fuel supplies for the Fleet demands speedy action, but more especially with regard to oil, on which, to a large extent, the security of the Pacific depends.

Enclosure to Chapter VIII, Section I.

PROPOSED AMOUNT OF FUEL AT EACH PORT.

<table>
<thead>
<tr>
<th>Place</th>
<th>Coal Tons</th>
<th>Oil Tons</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sydney</td>
<td>21,990</td>
<td>4,380</td>
<td></td>
</tr>
<tr>
<td>Newcastle</td>
<td>4,880</td>
<td>1,860</td>
<td></td>
</tr>
<tr>
<td>Port Stephens</td>
<td>30,920</td>
<td>71,472</td>
<td>This stock should be kept at Sydney until Port Stephens is ready to receive it, and is provided with facilities and sufficient defences.</td>
</tr>
<tr>
<td>Brisbane</td>
<td>13,461</td>
<td>25,200</td>
<td></td>
</tr>
<tr>
<td>Gladstone</td>
<td></td>
<td>9,000</td>
<td></td>
</tr>
<tr>
<td>Cairns</td>
<td></td>
<td>10,000</td>
<td></td>
</tr>
<tr>
<td>Harbour &quot;B&quot;</td>
<td></td>
<td>69,425</td>
<td></td>
</tr>
<tr>
<td>Hynoe</td>
<td>4,377</td>
<td>19,322</td>
<td></td>
</tr>
<tr>
<td>Siyu (Fiji)</td>
<td></td>
<td>31,418</td>
<td>86,887</td>
</tr>
<tr>
<td>Singapore</td>
<td>9,188</td>
<td>39,044</td>
<td></td>
</tr>
<tr>
<td>H. W. Cool</td>
<td>5,740</td>
<td>11,213</td>
<td></td>
</tr>
<tr>
<td>Cockburn Sound</td>
<td>16,512</td>
<td>47,144</td>
<td></td>
</tr>
<tr>
<td>Adelaide</td>
<td>1,269</td>
<td>3,729</td>
<td></td>
</tr>
<tr>
<td>Melbourne</td>
<td>9,658</td>
<td>6,240</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>146,684</td>
<td>452,430</td>
<td></td>
</tr>
</tbody>
</table>

It will be necessary to maintain a portion of this stock at Sydney if it is decided that the convoy route shall terminate at Sydney instead of Port Phillip.

A 6,000-ton tank is also proposed at this port for the use of the Fleet in Peace time.

22. To give effect to this, from the various better coal measures selected, those mines should be chosen which have the deepest seams of solid coal. This should eliminate the danger of dirt-bands in an otherwise good coal, causing a prohibitive amount of ash. Careful analysis of the coal should be taken on delivery, and attention should be given as far as possible to the particular conditions under which the coal will give the best results. Trial should not take place until sufficient experience has been gained on board in the handling. The mixing of two coals may be found to be desirable for good results, and this question also should be considered.

23. Of the several coals which justify trial, the following appear to be specially worthy:

The Sydney Metropolitan Colliery (Cremorne) Coal, cleaned.
The Excelsior Colliery Coal, New South Wales.
The Dawson River Coal-field, Queensland.
The Ipswich Coal, Queensland.
The Burrum Coal, Queensland.
The Blair Atholl Coal, Queensland.
The Mammoth Colliery Coal, Queensland.

20. If, as the result of the trials, which should take place without delay, a comparatively satisfactory coal is obtained, arrangements should be made to maintain the naval stocks by a specified proportion of the output of the selected mines.

Frequent analysis should be made to ensure that there is no falling off in standard, and that the coal conforms to specification on delivery. Great care should be taken in storage and handling to prevent deterioration, and the services of a Coal Inspector are required.

A source of coal supply in Queensland is especially to be desired, in view of the necessity of northern bases, and would justify additional facilities in railway connection if needed. Pending definite trials, however, stocks must be provided of Westport or Welsh coals.

The proposed method of distributing fuel supplies for the Pacific Fleet in war is dealt with in Chapter II, Volume IV, and a table at the end of this section shows the amount of fuel required to be stored at the various ports and naval bases ready for the use of the Fleet in time of war.

In calculating these reserves of coal and oil fuel required for the Far Eastern Fleet, allowance has been made for the accommodation made in Chapter Ia, that all future ships for service in these waters should be fitted to burn oil fuel.

21. In conclusion, I wish to urge that the importance of the question of fuel supplies for the Fleet demands speedy action, but more especially with regard to oil, on which, to a large extent, the security of the Pacific depends.
Section 2.—The Provision of Fleet Stores (including Victualling Stores).

It is recommended that the Navy Board should appoint a Committee immediately to carry out with all despatch a thorough investigation into the state of affairs as regards the manufacture and production of all Naval Stores.

2. Australia should, as far as possible, be self-contained in this matter, and, in the case of stores which cannot at present be manufactured in the Commonwealth, steps should be taken to endeavour to remedy this, reserves being meanwhile accumulated from the United Kingdom to meet the requirements of the Fleet as it grows.

3. In view of the great experience gained during the war, the advice of the Admiralty should be sought, including information with regard to the best methods of storage and distribution in war.

Section 3.—The Provision of Munitions.

It is obviously most desirable that Australia should be made as self-contained as possible, not only as regards food, stores, and fuel but also as regards the manufacture of all the necessary descriptions of Munitions of War.

This will not only entail the storage of fuel and reserve material required for war, and the setting up of munitions factories, but also the preparation of a very complete organisation of the industries and factories of the Commonwealth to enable munitions of war, including explosives and their constituents, to be manufactured on a large scale immediately after the outbreak of war, by private firms, in addition to the Armament Factories and firms. Munition Repair Factories will also be required throughout the country.

In connection with this problem, it should be noted that, after the outbreak of war, time is a most important factor.

2. It will be necessary for properly equipped Research Laboratories and Inspection and Production Staffs to be formed, manned by fully qualified officials who have the knowledge necessary to organise the Australian Industries and raw materials for use in war.

I am aware that this matter has been engaging the attention of the Commonwealth Government for some time, and have been supplied with reports by Mr. A. E. Leighton (General Manager, Commonwealth Arsenal) and others.

3. Commodore F. C. Dreyer, C.B., C.B.E., the Chief of my Staff, accompanied by Mr. Leighton, has visited the Cordite Factory at Maribyrnong, near Melbourne. Mr. Leighton very courteously explained the position of affairs as regards the manufacture of explosives and other munitions.

Commodore Dreyer, who was Director of Naval Ordnance at the Admiralty, 1917–18, informs me that no separate inspection of cordite or other explosives, or of their constituents during manufacture, is carried out in Australia.

This is a most serious omission, and I desire to call the attention of the Navy Board specially to the vital importance of setting up forthwith an Inspection Staff, directly under the D.O.T. and M., and entirely separate from all manufacturers of explosives and their constituents, to carry out thorough and rigid inspection in the manner in which it is carried out by the Chief Inspector of Naval Ordnance and his Staff, under the Director of Naval Ordnance at the Admiralty.

I strongly recommend that no explosives manufactured without such independent inspection should be allowed on board any ships of the Royal Australian Navy, and that any at present on board such ships should be disembarked forthwith. Further, that any such naval ammunition now existing, if stored on shore, should be placed clear of other ammunition so that in the event of its exploding the effect may be isolated as far as possible.

The best course will be to destroy it.

4. The Royal Navy has learnt by painful experience how absolutely necessary it is that no precaution should be neglected, however small, in connection with the manufacture, transport, and storage of explosives.

I desire to call the attention of the Navy Board to—

"C.B. 01429."

"Report of matters arising out of the loss of H.M.S. 'Vanguard.'"

and to emphasise the fact that the work of inspection can only be properly performed by fully qualified inspectors and staffs, as employed by the Admiralty. Inspection by the inspecting staff of the Ministry of Munitions was not so rigid for three main reasons:

(a) A huge output was essential.
(b) The ammunition was fired away quickly, i.e., keeping qualities were not so essential.
(c) The explosion of an ammunition dump on shore is not an accident of vital importance.

The case with the Navy is very different—the explosion of a cartridge in a ship's magazine is accompanied by the total loss of the ship and her officers and men.

In the case of Capital Ships such losses might spell disaster to the country.

I recommend that the copies of the Admiralty specifications for the manufacture and testing of explosives and their constituents should be obtained and rigidly adhered to.

5. With regard to the storage of explosives—

(i) On board ship:—The Admiralty Instructions are contained in—

C.B. 759.

"Naval Magazine Regulations, 1919."

in a pocket in the cover of which is a copy of "The Naval Cordite Regulations, 1917."

Both the above publications are kept up to date by amendments issued in C.I.O.'s and in Gunnery Issues of Monthly Orders.

(ii) On Shore.—The Instructions are contained in—

"Regulations for Magazines and care of War Materiel."

Attached is a brief general statement showing "The Requirements of a Naval Ordnance Depot."

A general report on the subject of Fire Risks in the Naval Ordnance Depots in England, made on 31st December, 1917, by a Fire Insurance Expert, after officially visiting these establishments is also appended.

6. It is recommended that the detailed Admiralty Instructions for the safeguarding of explosives while in transit by train, steamer, or other conveyance should be obtained and rigidly carried out.
GENERAL

The Requirements of a Naval Ordnance Depot.

Magazines.—The type depends largely on the climate, if moist a light roof should be fitted to allow easy escape of pressure in case of ignition. If climate is hot the magazine should be underground or well protected from the sun, the effects of ignition being accepted. The magazines should be cooled if possible, non-inflammable material being used for construction.

Size not more than 100 tons stowage, if possible—200 tons should not be exceeded—magazines should be at least 150 yards apart.

Traverses up to the height of the building are desirable, to localise effects of an explosion.

Floors should be asphalte or smooth concrete.

Shell Stores.—Non-inflammable material. Concrete floor. Shell Stores should be well away from Magazines and Traversed.

Note.—Magazines and Shell Stores should be underground, if possible, to guard them against attack from aircraft.

Miscellaneous Explosive Stores.—Stored according to the Classification and Magazine Regulations, and well clear of Magazine and Shell Stores.

Advisable to have a complete unclimbable fence or some such protection around the whole at a sufficient distance to prevent anything thrown reaching the Magazine or Shell Stores.

Guns, breech mechanisms, and non-inflammable ordnance stores to be kept well away from the explosives. Guns plugged and placed on skids in the open—remains under cover.

Fire Service.—Pipes with water at pressure throughout the Depot. Two hydrants at least to each building.

Lighting.—All connections and leads should be outside the Magazines and Shell Stores, if possible, actual lights being let into the walls with a protected glass front.

Lightning Conductors are a necessity.

Position of Depot.—Protected from bombardment; easy access to pier or wherever water transport can be arranged.

Well isolated from populated quarters—200 yards from nearest building.

Detailed instructions are given in the Regulations for Magazines and Care of War Material.

Torpedo, Factory and Range.

7. It is not considered that the requirements of the Royal Australian Navy, as at present constituted, warrant the establishment as yet of a Torpedo Factory in Australia.

8. It is, however, most desirable that a Torpedo Range, having a straight run of 20,000 yards and a depth of from 10 to 15 fathoms should be available for torpedo practices and for experimental work.

9. Port Phillip appears to be suitable for this purpose. The long range to which modern torpedoes run necessitates the acceptance, as in this case, of a certain amount of risk, due to a sea sometimes being set up in a reach of over 10 miles; on the other hand the depth of water is such that diving operations should be comparatively easy.

10. Later, when the size of the Royal Australian Navy justifies the establishment of its own torpedo factory, this factory should be established on the shores of Port Phillip, adjacent to the Torpedo Range.

Manufacture and Storage of Mining Material.—Main Australian Mine Depot.

11. The reserve of 10,000 mines, recommended in Volume III, Chapter II, should be stowed at a large depot to be erected near Sydney or Port Stephens, whichever is the future eastern base.

The lay-out of this depot should follow the lines of the latest English mine depots; and should have the fullest facilities for care and maintenance of 10,000 mines in reserve, and of one outfit of 1,000 mines ready for issue. Expansion on the outbreak of war should allow for the preparation for service of 50 mines per diem, working gradually up to 100.

12. It is recommended that a complete set of working drawings and specifications, and of the tools, jigs, and gauges necessary for the manufacture of all types of mines should be obtained by the Navy Board from the Admiralty for the use of the manager of the main Australian mine depot, in order that the manufacture of mining matériel in Australia may, in time of war, be put out to contract by any suitable firm in the country.

The manager of the mine depot should be responsible that this matériel is kept up to date.

Manufacture of mining matériel is well suited to such firms as manufacture motor-cars and their accessories, and, in time of war, no potential source of Australian supply can afford to be neglected.

Enclosure to Chapter VIII, Section 3, The Provision of Munitions.

FIRE RISKS IN NAVAL ORDNANCE DEPOTS.


The predominating feature of my inspection of the various depots has been to focus too trained insurance eye and mind upon features of fire hazard, after a personal experience extending close upon a period of forty years. The surveying of practically all kinds of buildings at the great workshops and factories of the Kingdom, a review of fires and their causes, and a close observation of the conditions prevailing which have led to disaster, and particularly the favourable features which, on the other hand, have secured immunity from fire loss, have prominently before me in this work. The keynote of safety seems to rest in careful management—a keen appreciation of order, cleanliness, and discipline.

Avoid overcrowding of buildings—whether workshops or stores—keep all passageways clear, and let there be good, free, well-ventilated, and clean air, and daylight.

Only too often during a busy period at public works has my attention been riveted to features of a temporary character—light timber buildings erected in juxtaposition to important and valuable plant—the temptation no doubt is great—which would be despised in normal times on the score of "safety first." Perhaps the outstanding points for anticipated trouble within the gates of the various magazine depots—having eliminated the possibility of variegated use of matches—may be summarised as follows:

Artificial lighting, heating, and spontaneous combustion. Where artificial light is used the general system of incandescent electric lighting is quite satisfactory, and the method of wiring, also lamps and outside switches are of an approved character. The original installation of lighting from the outside should be maintained wherever possible as there is a tendency to introduce inside wiring, which, no matter how well equipped originally, must have an ultimate bearing upon fire risk. Compliance with the I.E.E. Rules, which seem to be the case in general, should secure the desideratum.

Electric heaters, such as used for a glue kettle in the sewing-room at Chattenden, are required to be supported on insecure non-conducting bases, and isolated from work-clothes and all other combustible material. Rule 117 (a).

The use of candle light (in locked hand-lamps) at Marchwood suggests the inconvenience of lighting them within the area, and the temptation of infringement of regulations.

Heating of certain buildings by steam pipes involves a different method at each of the depots—some small-bore pipes with radiators and others up to 6-inch bore—cast-iron and or copper—but all overhead; and this system is to be commended where steam pipes are necessary. The arrangements existing at one depot, however, where the steam pipes enter the buildings below the floor level is to be deprecated. All heating apparatus should leave a clear floor-space underneath to avoid accumulation and accelerate sweeping.

"Spontaneous Combustion."—This "bug-bear" is a subject of such wide scope, whether considered with or without artificial heat, that the utmost care should be taken as to collection and removal of all sweepings. At no two depots did I find the system identical, and the varying contents of some of the dirt-bags, bags, or baskets, as the case presented itself on examination in numerous instances, were really astonishing.
Indeed, in some cases the materials seemed foreign to a magazine, but on inquiry a satisfactory answer was forthcoming. Hope ends, patches of greasy waste, and oily paper were among; the many combustibles collected. Standardisation might advantageously be adopted in this respect, and the "dirt tub" inside suggests itself to me as the most suitable for collection; but these should all be numbered and identified with the particular building to which each belongs. These tubs should be emptied daily into a metal receptacle fixed out-side the building—preferably raised above the ground-level, with a lid on the top and a hinged bottom door for ready closure. It will be apparent that my suggestion of keeping a tub to its respective building will not only create a better appreciation of the risk, but also prevent an undesirable mixture of residues.

The remarks in the foregoing "general report" are confined to the magazines and laboratories, and before leaving these buildings it may be noted that great care should be taken with regard to the oiling of overhead cranes, and avoidance of friction on wooden beams by the ropes thereof. In buildings where non-explosives are kept, metal receptacles inside for temporary deposit of refuse should be adopted.

The situation of the Northern Depot, with a direct south aspect, at once arrested my attention to many of the buildings on the show level sheltered by a 50 ft. headland, and reminded me of a great naval ordnance works fire loss on the Tyne in 1849, which created some suspicion on the action of the sea's rays being the cause. A scrutiny was made of all exposed windows, particularly along the magazines and laboratory sections, where concentrated sunbeams might play steadily upon the contents. It is not necessary for me to explain how a "burning glass" may be formed. Waggons on the main trolley-ways, whether inside or outside the buildings, should not be left overnight to impede the fireman's progress of dealing with any outbreak of fire.

The "Fire Instructions," and fire extinguishing equipment of the various depots should be standardised.

The police patrol comprises the fire brigade at each depot, and it occurs to me to suggest that the police should be organised for a weekly report on the conditions prevailing as to common features of fire risk, as suggested in the accompanying draft form. At present no systematic inspection is made on the lines of my survey, and consequently the Officer-in-Charge of each depot has no means of dealing with "defects" that might be brought to his notice in this manner in lieu of a personal visit which seems impossible in these times.

My experience with regard to the spread of fire once a building is alight was quite recently amplified in this city where burning embers were carried by a high wind and ignited the window frame of the Royal Technical School at a distance of 250 yards. For this reason stress is laid upon the outside buildings being equally well looked after, and in the inspection report form the salient features of insecurity are embodied.

A question was put to me at "Bull Point" as to what my objection was to a heap of iron-rust lying near woodwork of an important building—Major Cooper Key answered for me—Oxidation. There was no need to go farther at the time, but I now wish to record that other substances observed at the various depots and coming within this category of liability to ignite from so-called "spontaneous combustion," are as follows:—Coal, charcoal, lamp black, vegetable black, oily waste and cloths, old ropes, damp gunny-bags, rubbish heaps of all kinds, and felt, such as tarred roofing felt. Hair felt often used as a non-conductor is very liable to take fire. Oiled cloth or garments should be hung not piled. Sawdust and chippings of wood would burst into flame at once if a drop of sulphuric acid were to come into contact with the mixture, and many other combinations of salts give similar results. Sawdust impregnated with very little animal or vegetable oil or grease is considered a certain incendiary.

An invariable rule with iron which had remained a considerable time under water when reduced to fine grama or an impalpable powder to become red hot and ignite any combustible substance with which it comes into contact. This was accidentally found to be the case by a chemist when scraping from a gun some corroded metal which ignited the paper containing it and set fire to his pocket.

This interesting subject is dealt with in a paper by Thomas Inman, M.D. (Lond.), of Liverpool, read before the Literary and Philosophical Society, 8th January, 1855, and published independently "that its interest might spread beyond the limits of the Society." Many other writers have since treated the scientific aspect of this subject.

Glasgow, 31st December, 1917.

Fire Prevention.

Suggested form for periodical inspection of all buildings at the Depôt, to be filled up and handed to the Officer-in-Charge.

1. Are all the passages kept clear for the proper inspection of the corners of the building?
2. Where artificial light is used were there any circumstances which in your opinion might be conducive to fire risk?
3. Where artificial heat is used, are all wood cases or woodwork clear of the steam pipes or radiators for at least 2 ft. 6 in., and electrical fixtures securely fitted?
4. Did you notice any accumulation of splinter wood, old ropes, waste, or other dirt in the corners or grit upon any portion of the floors? And were the spaces beneath work benches and tables clear of all material?
5. Were any windows broken or any gland openings or apertures liable in your opinion to concentrate the sun's rays unduly upon any of the contents?

Signed................................................
Member of Police and Fire Brigade.
CHAPTER IX.

A.—TYPES OF SHIPS FOR THE ROYAL AUSTRALIAN NAVY.

All new vessels, men-of-war, or auxiliaries constructed in future for the Far Eastern Fleet, should, as far as possible, be fitted to burn oil fuel only.

It must be borne in mind in connection with their designs that they will be required to operate in the Tropics.

It is difficult to advise definitely as to the characteristics of vessels of each type which should be built, except as far as the next few years are concerned.

Capital Ships.

New vessels, in addition to being of the most powerful and up-to-date type, should have as large a radius of action as possible.

Light Cruisers.

New vessels, in addition to being of the most powerful and up-to-date type, should have as large a radius of action as possible.

Those used for convoy work should have a very large radius of action, this being more important for them than very high speed, and each should carry a fighting aeroplane or seaplane.

The German "Graudenz" class, of a displacement of 4,842 tons, is credited in C.B. 01500 (2) "War Vessels and Aircraft (British and Foreign)," Part II, April, 1919, with a radius of action of 7,900 miles at 10 knots, and a maximum speed of 27'5 knots, with an armament of seven 6'9, two 22-pdr. anti-aircraft, two machine guns, two torpedo tubes. A vessel having such characteristics would be suitable either for convoy work, or work with the fleet.

Flotilla Leaders.

Improved "Shakespeare" type with specially large radius of action.

T.B.D.s.

Improved "W" class, with 4'7 inch guns and specially large radius of action.

T.B.D. Depot Ships.

To be specially designed with large radius of action and large cold storage capacity.

Submarines.

"L" class, fitted with refrigerating plant.

Submarine Depot Ship.

To be specially designed with large radius of action and large cold storage capacity.

Aircraft Carrier.

In Chapter 7 it is recommended that an existing Royal Naval Aircraft Carrier be utilised in Australian waters. The experience thus gained should enable the most suitable type to be determined.

Aircraft Depot Ship.

In Chapter 7 it is recommended that a ship of about 4,000 tons be procured as a tender to a flying boat base where sheds are not practicable.

Fleet Repair Ship.

Design to be worked out in consultation with Admiralty. A radius of action of about 5,000 miles is required.

Mine-layer.

Should be similar in type to the U.S.S. "Romeo," carrying 500 to 1,000 mines, with a speed of 14 knots and a radius of action of about 5,000 miles.

Mine-sweeper.

a. Fleet-sweeper of "Arabis" type.

b. Local defence sweeper, a trawler with latest Admiralty improvements for vessel of this type included.

In Chapter I, vol. I, the question of the value of the Capital Ship has been investigated. It is now desirable to mention the principal weapons which are held in some quarters to threaten its existence. The subject is dealt with under the following headings:

(B.) Future possibilities of the use of aircraft against Capital Ships and Submarines.

(C.) Directions in which improvements in the Submarine as a weapon may be expected.

(D.) Anti-submarine Devices and Operations.


B.—FUTURE POSSIBILITIES OF THE USE OF AIRCRAFT AGAINST SHIPS AND SUBMARINES.

(From the point of view of the Air Schools.)

In considering the above problem, it is necessary to give a short review of some of the factors from which an estimate can be formed. A very large amount of speculation cannot be avoided, and estimates may eventually prove to be erroneous in some respects.

Construction.

Seaplanes have advanced since the war from about 2 to 6 tons, and one weighing 16 tons (1,800 h.p.) was recently built. There are now under construction by various firms boats weighing 50 tons (5,000 h.p.). These may reasonably be expected to fly, although perhaps a good many alterations will be necessary owing to lack of experience on the part of designing firms. It is believed that in America a design of boat with 20,000 h.p. is being attempted, though no details of this are known at present.

Speed will probably increase with size, and with the better stream-line form obtained in the boat design, it is not impossible that within ten to fifteen years large boats, say 600 tons, of 150-200 knots will be in the air.

The above few remarks show that finality in design is very far from being reached at present; in fact, it may be said to be still quite in its infancy.

Armament.

Bombs with a striking velocity of about 1,600 f.s. from a height of 15,000 feet can easily be designed and manufactured up to any weight. A 3,000 lb. bomb was the heaviest bomb under manufacture during the war, though this was never used. Several 1,400 lb. bombs were dropped. The accuracy of trained bombers towards the conclusion of hostilities was about 50 per cent. of shots within 2 degrees, using an unstabilized sight, and within 1 degree for a stabilized sight at a fixed target. With progress, improvement on these figures may reasonably be anticipated. Targets moving on a steady course and speed will present no difficulties. With improved sighting arrangements it should be possible to get 50 per cent within 2 degrees, at fixed or steadily moving targets, within 3 years.
Guns.

12-pounders are being mounted, but the larger machines will be capable of carrying considerably heavier weapons for anti-submarine work, though the use of guns against capital ships does not seem of practical utility at present, except to sweep the bridges with machine-gun fire. 12-pounder self-loading guns have been designed.

Torpedoes.

The use of these has been confined lately to small aeroplanes of about 300 h.p. The present idea favours the attack by several machines at short range (about 2000 yards). The use of several torpedoes at long range from a large boat will have to be considered. The platform for aiming is certainly considerably steadier than that provided by a small ship in a very slight sea.

Directional Wireless.

This is making very big strides, and a logical conclusion will probably be the bombing of certain objectives through clouds, &c., obtaining an exact position from this method. As a corollary navigational methods will improve, and reconnaissance reports should indicate the position of hostile ships with great accuracy.

Flying and General Remarks.

Night flying presents no difficulties nowadays.

Fog flying and finding the way under all weather conditions have not been studied as closely as they might, but these will be very essential for peace and commercial flying, and solutions to many problems may be expected before the next war.

In air combats large numbers of machines will take part, and eventually aerial battles will resemble in some respects naval engagements.

The technicalities of aircraft gunnery ballistic problems at high altitudes, &c., &c., were receiving attention at the time of the signing of the armistice.

The size of guns and range of engagement will increase.

At present the great drawback to seaplanes is their inability to rise from the water when any sea is running, although landings can be made in much heavier seas. How far this will be overcome in the future remains to be seen.

It is conceivable, though unlikely in the writer's opinion, that with increased reliability aeroplanes alone will be used.

Submarine Attack.

The primary difficulty in carrying out a successful attack is the inability to see the exact spot where a bomb dropped should fall. The visibility of a submarine beneath the water varies a great deal with the conditions. In the North Sea as a rule a submarine cannot be seen when submerged, and the indications of its whereabouts are given either by bubbles or by an oil streak. In the Mediterranean, on the other hand, submarines have been seen up to depths of 50 feet and more. Experiments have been carried out with colour filters with a view to seeing them under unfavourable conditions, but such experiments are far from complete, and it is perhaps not inconceivable to imagine that a method can be evolved whereby a submarine can be accurately located under practically all conditions when submerged. With the advance in size of machines, the destructive radius of the bombs used will likewise increase.

Hydrophones.

Experiments were carried out in this direction, but at the conclusion of hostilities, as far as is known, they were seldom, if ever, used, and one great objection to their use was the inability of a seaplane to rise from the sea except under the best conditions, after coming down to use its hydrophone.
The value of high surface speed to a submarine has been frequently demonstrated throughout the war.

Apart from the advantage of being able to move quickly from one area to another on receipt of necessary information, high surface speed enables a submarine, under good conditions of visibility, to get in the path of advance of an approaching enemy, and so in the best position from which to commence the attack. It also enables the submarine to avoid slow patrol craft without being forced to dive, thereby possibly saving valuable time and unnecessary work for personnel and wear of material.

2. Endurance Submerged.

All the later types of submarines can remain submerged throughout the hours of daylight (say, about eighteen hours) provided the battery is nearly fully charged at the commencement of the dive at a slow speed, and at very slow speeds endurance submerged can be considerably increased.

With improvements in battery capacities, which may be expected in the future, the submerged endurance is likely to be considerably increased. This is naturally of great value to the submarine, particularly when being hunted by numerous surface craft.

3. High Under Water Speed.

This is not a necessity, and great advances in this direction are not expected to take place in the general service submarine, but high under water speed (15 knots) has been and can be obtained in submarines built for special purposes. The majority of the German submarines possess a full speed of probably not more than 8 or 9 knots submerged, and this speed can only be maintained for one or two hours.

4. Habitability.

The British submarines are greatly in advance of others in this important direction, and much can be done to improve further the living spaces at present provided for the crews, both in spaciousness and for better ventilation when in harbour. It is thought larger crews will be carried in future.

5. The use of Submarines in future Wars.

It is not probable that there will be universal prohibition against the building of submarines in the future.

No doubt rules will be incorporated in future Conventions to the effect that submarines can only legitimately act against commerce in war provided that they place in safety all persons and relevant papers before destroying a prize, and that ships' boats cannot be considered a place of safety.

In order to enforce the humane use of submarines it is obvious that complete arrangements must exist for coping with their improper use.

D—ANTISUBMARINE DEVICES AND OPERATIONS.

(From the anti-submarine point of view.)

Submarine operations and their offensive power will, at any rate during the next decade, be rendered largely ineffective by the following offensive and defensive methods.

(a) By fast Patrol Craft, fitted with several detection devices of recent discovery, the development of which has been very much opened up during the latter part of the war. Also by the use of "killing" apparatus, such as guns, bomb bowlers, torpedoes, depth charges, explosive paravanes, &c.; and by the employment of wireless telegraphy and radio telephony to facilitate hunting.

(b) By similar position finding apparatus, &c., operated from shore stations; the information obtained being used to direct the hunting craft.

(c) By powerful aircraft operating round the coastline and carrying a number of heavy delay action bombs.

(d) By minefields frequently laid off the enemy submarine bases and by intensive mine barrages, located in home waters and at points where traffic is most congested, and consequent submarine activity most profitable.

(e) By some types of decoy craft.

(f) By torpedo net and submarine net defences, and booms at the defended ports.

(g) By the shifting of navigational marks.

(h) By bulges to the larger men-of-war.

(i) By high speed and zig-zagging of ships.

(j) By activity in the dress-up and secrecy as to results, thus affecting morale.

(k) By the destruction of advanced submarine bases and parent ships.

(l) By the inherent disadvantages of the submarine:—

(i) Low submerged speed unless radius of action is sacrificed. (Because high submerged speed means large battery power and large motors, i.e., great weight and space.)

(ii) Small armament and small quantity of ammunition compared with the large tonnage and large radius of action.

(iii) Morale is affected by harassing attacks.

(iv) Great discomfort, including temperature and continued strain.

(v) At times, difficulty of navigation.

(vi) The necessity of using oil, which at times reveals the submarine's presence.

(vii) Inaccuracy of torpedo fire at single ships unless at short range.

(viii) Limited field of vision, both vertical and horizontal, when at periscope depth.

(ix) Certainty of being prohibited from entering neutral ports.

E—THE CAPITAL SHIPS OF THE PRINCIPAL NAVAL POWERS.

The information in the attached tables has been extracted from C.H. 01500 (2). War Vessels and Aircraft (British and Foreign), April, 1919.

UNITED STATES—CAPITAL SHIPS.

Purchases to 1916 the United States had Capital Ships of Dreadnought types, built and building, as follows:—

<table>
<thead>
<tr>
<th>Programme</th>
<th>Tonnage</th>
<th>Speed in Knots</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;Tennessee&quot;</td>
<td>1915</td>
<td>32,000</td>
</tr>
<tr>
<td>&quot;California&quot;</td>
<td>1916</td>
<td>32,000</td>
</tr>
<tr>
<td>&quot;Idaho&quot;</td>
<td>1915</td>
<td>32,000</td>
</tr>
<tr>
<td>&quot;New Mexico&quot;</td>
<td>1914</td>
<td>32,000</td>
</tr>
<tr>
<td>&quot;Mississippi&quot;</td>
<td>1913</td>
<td>31,400</td>
</tr>
<tr>
<td>&quot;Arizona&quot;</td>
<td>1912</td>
<td>31,400</td>
</tr>
<tr>
<td>&quot;Pennsylvania&quot;</td>
<td>1912</td>
<td>31,400</td>
</tr>
<tr>
<td>&quot;Missouri&quot;</td>
<td>1911</td>
<td>27,000</td>
</tr>
<tr>
<td>&quot;South Dakota&quot;</td>
<td>1911</td>
<td>37,500</td>
</tr>
<tr>
<td>&quot;Texas&quot;</td>
<td>1910</td>
<td>27,000</td>
</tr>
<tr>
<td>&quot;New York&quot;</td>
<td>1910</td>
<td>37,000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Programme</th>
<th>Tonnage</th>
<th>Speed in Knots</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;Arkansas&quot;</td>
<td>1909</td>
<td>26,000</td>
</tr>
<tr>
<td>&quot;North Dakota&quot;</td>
<td>1907</td>
<td>20,000</td>
</tr>
<tr>
<td>&quot;Delaware&quot;</td>
<td>1906</td>
<td>20,000</td>
</tr>
<tr>
<td>&quot;South Carolina&quot;</td>
<td>1906</td>
<td>16,000</td>
</tr>
<tr>
<td>&quot;Michigan&quot;</td>
<td>1905</td>
<td>16,000</td>
</tr>
</tbody>
</table>

On 29th August, 1916, Congress approved a three-year programme of Naval Construction, the whole of which was to be commenced by July, 1919.

Suitable appropriations of money were made in 1916, 1917, and 1918 to carry out the successive stages of this programme, which in Capital Ships provided for—

10 Battleships,

6 Battle Cruisers.

51492 Vol. II.—D
Of these only 4 Battleships have yet been laid down, namely—

**Battleships.**

<table>
<thead>
<tr>
<th>Name</th>
<th>Programme Year</th>
<th>Tonnage</th>
<th>Speed in knots</th>
<th>Main Armament.</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;Colorado&quot;</td>
<td>1916</td>
<td>32,600</td>
<td>23</td>
<td>8 16-in. guns.</td>
</tr>
<tr>
<td>&quot;Maryland&quot;</td>
<td>1916</td>
<td>32,600</td>
<td>23</td>
<td>8 16-in. guns.</td>
</tr>
<tr>
<td>&quot;Washington&quot;</td>
<td>1916</td>
<td>32,600</td>
<td>23</td>
<td>8 16-in. guns.</td>
</tr>
<tr>
<td>&quot;West Virginia&quot;</td>
<td>1916</td>
<td>32,600</td>
<td>23</td>
<td>8 16-in. guns.</td>
</tr>
</tbody>
</table>

It has been decided that the six remaining Battleships of this programme shall be of the following type—:

**Battleships.**

<table>
<thead>
<tr>
<th>Name</th>
<th>Programme Year</th>
<th>Tonnage</th>
<th>Speed in knots</th>
<th>Main Armament.</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;Ranger&quot;</td>
<td>1916</td>
<td>35,250</td>
<td>35</td>
<td>8 16-in. guns.</td>
</tr>
<tr>
<td>&quot;宪法&quot;</td>
<td>1916</td>
<td>35,250</td>
<td>35</td>
<td>8 16-in. guns.</td>
</tr>
</tbody>
</table>

The designs previously agreed to for the six Battle Cruisers have recently been cancelled, owing to insufficiency of armour. New designs are understood to be in preparation for them.

The previously accepted designs were—:

**Battle Cruisers.**

<table>
<thead>
<tr>
<th>Name</th>
<th>Programme Year</th>
<th>Tonnage</th>
<th>Speed in knots</th>
<th>Main Armament.</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;Ranger&quot;</td>
<td>1916</td>
<td>35,250</td>
<td>35</td>
<td>8 16-in. guns.</td>
</tr>
<tr>
<td>&quot;宪法&quot;</td>
<td>1916</td>
<td>35,250</td>
<td>35</td>
<td>8 16-in. guns.</td>
</tr>
</tbody>
</table>

All these, including the sixth (unnamed), were appropriated to various yards.

On completion of the above programmes, the United States will have 35 Dreadnoughts, of which 27 will be Super-Dreadnoughts, i.e., carrying turret guns of larger calibre than 12 in., while six Battleships—will be of more than 40,000 tons displacement.

In October, 1913, a further programme of—:

10 Battleships. 9 Battle Cruisers, 18

was proposed and adopted. According to the most recent press reports, these 16 capital ships will, however, not be proceeded with.

**JAPANESE CAPITAL SHIPS.**

**Battleships—Built and Building.**

<table>
<thead>
<tr>
<th>Name</th>
<th>Programme Year</th>
<th>Tonnage</th>
<th>Speed in knots</th>
<th>Main Armament.</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;Kaga&quot;</td>
<td>1912-13</td>
<td>32,600</td>
<td>23</td>
<td>8 16-in. guns.</td>
</tr>
<tr>
<td>&quot;Tosa&quot;</td>
<td>1912-13</td>
<td>32,600</td>
<td>23</td>
<td>8 16-in. guns.</td>
</tr>
<tr>
<td>&quot;Nagato&quot;</td>
<td>1912-13</td>
<td>32,600</td>
<td>23</td>
<td>8 16-in. guns.</td>
</tr>
<tr>
<td>&quot;Musashi&quot;</td>
<td>1912-13</td>
<td>32,600</td>
<td>23</td>
<td>8 16-in. guns.</td>
</tr>
<tr>
<td>&quot;Hyo&quot;</td>
<td>1912-13</td>
<td>32,600</td>
<td>23</td>
<td>8 16-in. guns.</td>
</tr>
<tr>
<td>&quot;Tone&quot;</td>
<td>1912-13</td>
<td>32,600</td>
<td>23</td>
<td>8 16-in. guns.</td>
</tr>
<tr>
<td>&quot;Yamashiro&quot;</td>
<td>1912-13</td>
<td>32,600</td>
<td>23</td>
<td>8 16-in. guns.</td>
</tr>
<tr>
<td>&quot;Kinshu&quot;</td>
<td>1912-13</td>
<td>32,600</td>
<td>23</td>
<td>8 16-in. guns.</td>
</tr>
</tbody>
</table>

When the above are completed Japan will possess thirteen Dreadnoughts, of which twelve will be Super-Dreadnoughts, i.e., carrying turret guns of larger calibre than 12 in., and also three Second-class Battle Cruisers inferior to the British "Indomitable."
**Battle Cruisers—Built.**

<table>
<thead>
<tr>
<th>Name</th>
<th>Programme Year</th>
<th>Tonnage</th>
<th>Speed in knots</th>
<th>Main Armament</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;Hood&quot;</td>
<td>1916-17</td>
<td>41,200</td>
<td>31</td>
<td>8 15 in. guns</td>
</tr>
<tr>
<td>&quot;Repulse&quot;</td>
<td>1914-15</td>
<td>26,500</td>
<td>30</td>
<td>6 15 in. guns</td>
</tr>
<tr>
<td>&quot;Renown&quot;</td>
<td>1914-15</td>
<td>26,500</td>
<td>30</td>
<td>6 15 in. guns</td>
</tr>
<tr>
<td>&quot;Tiger&quot;</td>
<td>1911-12</td>
<td>28,000</td>
<td>27</td>
<td>8 15 in. guns</td>
</tr>
<tr>
<td>&quot;Lion&quot;</td>
<td>1909-10</td>
<td>26,250</td>
<td>25</td>
<td>8 15 in. guns</td>
</tr>
<tr>
<td>&quot;Princess Royal&quot;</td>
<td>1909-10</td>
<td>26,250</td>
<td>25</td>
<td>8 15 in. guns</td>
</tr>
</tbody>
</table>

**2nd Class Battle Cruisers—Built.**

<table>
<thead>
<tr>
<th>Name</th>
<th>Programme Year</th>
<th>Tonnage</th>
<th>Speed in knots</th>
<th>Main Armament</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;Australia&quot;*</td>
<td>1911</td>
<td>18,900</td>
<td>24</td>
<td>8 12 in. guns</td>
</tr>
<tr>
<td>&quot;New Zealand&quot;</td>
<td>1911</td>
<td>18,900</td>
<td>24</td>
<td>8 12 in. guns</td>
</tr>
<tr>
<td>&quot;Indomptible&quot;</td>
<td>1905-6</td>
<td>17,250</td>
<td>23</td>
<td>8 12 in. guns</td>
</tr>
</tbody>
</table>

*Royal Australian Navy.

Thus the British Fleet consists of 43 Dreadnoughts, of which 29 are "Super-Dreadnoughts, i.e., carrying turret guns of larger calibre than 12 in.

†These four 12 in. gun ships can only be classed as second-class Battle Cruisers.

**France—Capital Ships.**

<table>
<thead>
<tr>
<th>Name</th>
<th>Programme Year</th>
<th>Tonnage</th>
<th>Speed in knots</th>
<th>Main Armament</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;Lyon&quot;</td>
<td>1915</td>
<td>29,000</td>
<td>21-5</td>
<td>16 13-4 in. guns</td>
</tr>
<tr>
<td>&quot;Lille&quot;</td>
<td>1915</td>
<td>29,000</td>
<td>21-5</td>
<td>16 13-4 in. guns</td>
</tr>
<tr>
<td>&quot;Tourville&quot;</td>
<td>1915</td>
<td>29,000</td>
<td>21-5</td>
<td>16 13-4 in. guns</td>
</tr>
<tr>
<td>&quot;Normandie&quot;</td>
<td>1913</td>
<td>21,530</td>
<td>21-5</td>
<td>12 13-4 in. guns</td>
</tr>
<tr>
<td>&quot;Laomedon&quot;</td>
<td>1913</td>
<td>21,530</td>
<td>21-5</td>
<td>12 13-4 in. guns</td>
</tr>
<tr>
<td>&quot;Plantef&quot;</td>
<td>1913</td>
<td>21,530</td>
<td>21-5</td>
<td>12 13-4 in. guns</td>
</tr>
<tr>
<td>&quot;Gasconet&quot;</td>
<td>1913</td>
<td>21,530</td>
<td>21-5</td>
<td>12 13-4 in. guns</td>
</tr>
<tr>
<td>&quot;Bérénice&quot;</td>
<td>1913</td>
<td>21,530</td>
<td>21-5</td>
<td>12 13-4 in. guns</td>
</tr>
<tr>
<td>&quot;Loire&quot;</td>
<td>1912</td>
<td>23,177</td>
<td>20-0</td>
<td>10 13-4 in. guns</td>
</tr>
<tr>
<td>&quot;BreTAGRE&quot;</td>
<td>1912</td>
<td>25,177</td>
<td>20-0</td>
<td>10 13-4 in. guns</td>
</tr>
<tr>
<td>&quot;Provence&quot;</td>
<td>1912</td>
<td>25,177</td>
<td>20-0</td>
<td>10 13-4 in. guns</td>
</tr>
<tr>
<td>&quot;France&quot;</td>
<td>1911</td>
<td>23,095</td>
<td>20-0</td>
<td>12 12 in. guns</td>
</tr>
<tr>
<td>&quot;Paris&quot;</td>
<td>1911</td>
<td>23,095</td>
<td>20-0</td>
<td>12 12 in. guns</td>
</tr>
<tr>
<td>&quot;Courbet&quot;</td>
<td>1911</td>
<td>23,095</td>
<td>20-0</td>
<td>12 12 in. guns</td>
</tr>
<tr>
<td>&quot;Jean Bart&quot;</td>
<td>1911</td>
<td>23,095</td>
<td>20-0</td>
<td>12 12 in. guns</td>
</tr>
</tbody>
</table>

*Projected. †Work suspended. All of these five ships except the Bérenice have been launched.

If all the above ships are completed, France will possess sixteen Dreadnoughts, of which twelve will be Super-Dreadnoughts, i.e., carrying turret guns of larger calibre than 12 in.