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NORWAY: COAST REPORT

PART II THE COAST, PORTS, AND COAST DEFENSES

SECTION 1 KRISTIANIA FJORD

JUNE, 1917

OFFICE OF NAVAL INTELLIGENCE



FEBRUARY, 1918

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ROGER WELLES,
Captain, U. S. Navy, Director of Naval Intelligence.

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By *C. P. Fuller*

NORWAY: COAST REPORT.

PART II.

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SECTION 1.

KRISTIANIA FJORD.

JUNE, 1917.

The information contained in this book should be verified
and supplemented whenever an opportunity offers.

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THE KRISTIANIA FJORD.

(See Chart 2 and Admiralty Charts, Nos. 2330, 3158, 3159, 1974, 1039, 3160.)

GENERAL REMARKS.

From its principal entrance between Little Faerder and Torbiörnskier, Kristiania fjord extends nearly due N. for 55 miles to Kristiania, the capital of Norway. Varying in breadth from 13 miles at the entrance to two-thirds of a mile at Dröbak, the fjord is deep throughout in the main channel, and, on the whole, free from dangers. The shores are mountainous. The rounded islands and hills covered with fir and pine trees which characterise the scenery in the lower reaches, give place to steeper declivities northward of Dröbak, and bolder hills in the background.

Ice abounds during the winter months; the more important channels are kept open by ice-breakers.

Railway lines skirt both shores from the mouth of the fjord to Kristiania.

A number of towns are situated on the shores of the fjord and its numerous tributary fjords and inlets, which branch in all directions from the main channel.

All the small islands at the entrance to the fjord are connected by telephone.

The channel of approach to Kristiania is defended by the Dröbak fortifications, which are described in detail on pages 13 to 18.

COAST FROM THE NORWEGIAN-SWEDISH BOUNDARY TO KRISTIANIA.

The boundary between Norway and Sweden is shown on Chart 2. It follows up the middle of Sækken Channel, and strikes the coast opposite the entrance to Svinesund; it then continues up the center of that fjord and down the center of Idefjord to its head, when it bends somewhat southwards before turning northwards.

Of the various approaches to Svinesund from the sea, Lauersvælgen, the channel between Kirkeö and Lauer is that which is most used, but this channel is narrow and intricate. The eastern approach is through Sækken, the entrances to which lie between the island of Heia and the shoals off the Koster Islands. Both these channels have deep water, and the anchorages in the vicinity are fairly numerous.

FREDRIKSHALD.

(See Plate 1 and Admiralty Chart 3160.)

Ships of deep draft can approach Fredrikshald through Svinesund, but the navigation is difficult. There are two good harbors in which vessels can be moored, of which the outer harbor, which is inclosed by the islands of Bratö, Sauö, and Kuskier, can accommodate large vessels. The inner harbor, east of Sauö, is available for medium-sized ships.

THE COMMERCIAL PORT.

Quayage.

The quayage accommodation consists of Langebryggen (stone), 711 feet in length, with 10 to 20 feet depth alongside; Langebryggen (wood), 289 feet in length, with 14 to 18 feet depth alongside; Outer Railway Quay, 1,530 feet in length, with 10 to 16 feet depth alongside; Inner Railway Quay, 780 feet in length, with 15 to 17 feet alongside; and Mölbryggen (wood), 1,405 feet in length, with 15 to 18 feet depth alongside. Railway sidings are laid on to the quays in the Outer Harbor. All the quays are situated to the eastward of the entrance of the Tistedals Elv.

Lifting Appliances.

There is no information of any cranes or other lifting gear.

Repairing Facilities.

There is an iron factory at which small repairs to hull and machinery can be carried out.

Patent Slips.

There are three patent slips owned by "Brevigs Mekaniske Verksted," whose works are situated in the Indre Havn. The largest is worked electrically and is 120 feet in length, with a cradle 160 feet long, capable of lifting a steamer of 400 tons. The two smaller are worked by steam, and the lengths of cradles respectively are 90 feet and 50 feet, the former able to lift a ship of 100 tons, and the latter of 80 tons.

Coal and Coaling Facilities.

The total import of coal into Fredrikshald in 1913 was 41,248 tons. About 2,000 tons are usually kept in stock, and coaling can be carried out either alongside a wharf with a depth of water of 17 to 18 feet alongside, or from lighters.

Trade and Shipping.

The principal industries are connected with dressed timber and granite, and there are numerous factories and sawmills above the town, which are operated by the rapid stream of the Tistedals Elv. A British Vice-Consul is resident in the town. The principal imports are coal and foodstuffs. About 400 vessels enter the port annually.

THE TOWN.

Fredrikshald, an ancient Norwegian frontier town, is one of the centers of the timber traffic of Eastern Norway and the adjoining parts of Sweden. The town is situated on both banks of the Tistedal river, and on the south bank on a hill is situated the disused fortress of Fredrikssten. The town had a population of about 12,000 inhabitants in 1914. In addition to the railway bridge close to the mouth of the river, two other bridges cross the river, affording communication between the two parts of the town. On the north shore and to the west of the town rises an isolated hill, called Rødsberget, and around the town the country is hilly. Extensions are going on to the north and east of the town on the north shore of the river. A system of canalisation has been undertaken in the more rapid portions of the lower river to ensure more convenient handling of the timber when floated down. The Customs House is situated at the eastern end of Langbryggen wharf, and south of the main square (Torv); other public buildings are the Raadhus (town hall), on the north side of the square, the post office at the eastern end of Kristian-August street, and the telegraph office on the west side of Wiels Platz, both the latter are in the northern town. There are several good hotels and electric light is used universally. The Power Station is on the north bank of the river and to the east of the town, and the gasworks are close to the Ebenezer Infirmary also in the eastern suburb.

COMMUNICATIONS.

By Steamer.

Steamers run to Strömstad once or twice daily, also to Kristiania daily, *viâ* Hankö; from Tistedalen on the river, 2 miles above Fredrikshald, a steamer communicates three times weekly with Skullerud, the journey being made up the river through a system of lakes and canals, called collectively the Fredrikshald Canal in which there are numerous locks.

By Railway. (See Map 1.)

Fredrikshald is on the main southern line from Kristiania and Sarpsborg to Møllerud on Lake Venern, whence it communicates with Gothenburg or Stockholm. The line crosses the frontier at Kornsjö (20 miles) into Sweden. There is a tunnel at Tistedalen, and several others between that place and the frontier, and the line which at first follows the river valley branches south-east from Tistedalen through thick woodland. The railway crosses the Tistedals Elv close to the mouth, and the station is on the south bank of the river.

By Road. (See Plate 6 facing page 26.)

Fredrikshald is great road center, and the majority are good though narrow. A main road runs S.E. to Enningdalen (10½ miles), where it bifurcates, one branch communicating with Strömstad (28 miles), and the other crossing the Swedish frontier at Kornsjö (20 miles). The most direct route to the frontier is by road due east to Holmegil (14½ miles), where it joins the Swedish system. At Hauglund (10½ miles) on this latter road a road branches north parallel with the frontier and with branches on either side of the lake district to Örje (26 miles), where it meets a road connecting the Glommen Valley with the frontier. A road parallel to this one runs due north from Fredrikshald to Mysen (33 miles) on the Glommen-Örje road. There is also communication by a network of roads with Sarpsborg and Fredrikstad, and a road crosses the narrow part of Svinesund at the village of that name, and continues to Strömstad.

By Telegraph and Telephone.

Telegraph and telephone lines cross the Svinesund into Sweden, and Fredrikshald is in direct communication by both with the main systems of both Norway and Sweden. There is apparently no communication northwards either by telegraph or telephone, except *viâ* Sarpsborg.

MILITARY DETAILS.

Fredrikshald being within the neutral zone, all formerly existing land and sea defences in the vicinity have been dismantled since 1905. In Brand Battery, situated immediately to the west of the Fortress of Fredrikssten, are mounted a few old guns for saluting purposes.

COAST FROM FREDRIKSHALD TO THE RIVER GLOMMEN.

The coast northwards as far as the mouth of the Glommen is considerably indented, and Single Fjord runs some way inland, but is of no special importance. There is a barrier of islands protecting the inner channel and affording various means of access to the open sea, and anchorages are fairly numerous.

FREDRIKSTAD.

(See Plate 2 and Admiralty Chart 3160.)

The immediate approaches to Fredrikstad are by way of the two entrances to the Glommen, the Östre Elven from the south and south-west, and the Vestre Elven from the west and north. These branches run respectively east and west of Kragerö. That portion of the river between Isegran and Graesvikfloen is shallow, but up to these points large vessels may ascend both branches. Of the several channels of approach between the islands by which Östre Elven is approached the Löbe Channel between Asmalö and Kirkeö is the deepest and widest.

THE COMMERCIAL PORT.

The port is of considerable importance owing to its situation at the mouth of the Glommen, on which the timber of the Österdal, the most richly wooded district in Norway, is floated down to the sea. At Fredrikstad the river is deep and broad, but the depth of water alongside the quays is not great, so that large vessels must load in the river in an average depth of 23 feet of water. The height and depth of water at Fredrikstad depends largely on the amount of flood in the River Glommen, which can fluctuate very considerably. The river is crossed in various places by steam ferries, connecting up different portions of the town.

Quayage.

There are ballast quays in both the Östre and Vestre Elven, of which the depth alongside the latter is 15½ feet. A new Customs quay has been erected with a depth alongside of 20 feet. A new quay has also been built at the factory De-no-Fa; it is dredged to 28 feet, and is 656 feet long. The height of the quays above normal water level is from 6 to 8 feet. It is proposed to bring the railway to the quays at the S. end of the town; there is already a branch running to the quays N.E. of the town.

At all the sawmills and other factories on the river between Fredrikstad and Sarpsborg there are small quays, but these are as a rule poorly equipped with cranes, &c.

Harbor Improvements.

At Vaterland, the southern suburb of Fredrikstad, new quays are under construction. They were to have been completed in 1916, and it was stated would have a depth alongside of 27 feet.

Lifting Appliances.

There are no floating or harbor cranes belonging to the port, and as nearly all the loading and discharging is done in the river, the quays hardly require them. There are a number of cranes of various sizes, however, at the shipbuilding yards (see under "Private Shipbuilding Yards"), of which the "Fredrikstad Mekaniske Verksted" owns one capable of lifting 150 tons.

Shipbuilding Capabilities.

These are discussed under "Private Shipbuilding Yards."

Repairing Facilities.

Repairs to hull and machinery can be undertaken by the various shipbuilding yards.

Docks.

There is a floating dock belonging to the "Fredrikstads Mekaniske Verksted."

Patent Slips.

There are in all six patent slips, three belonging to the "Fredrikstads Mekaniske Verksted," and three to the "Glommens Mekaniske Verksted."

Harbor Craft.

A considerable number of lighters are always at hand, and there are several tugs.

Coal and Coaling Facilities.

The import of coal in 1913 was 51,632 tons; about 10,000 tons is usually kept in stock. There is a coaling wharf with a depth alongside of 15 feet, but coaling is usually performed from lighters, of which there are several available of 50, 60, and 100 tons respectively.

Trade and Shipping.

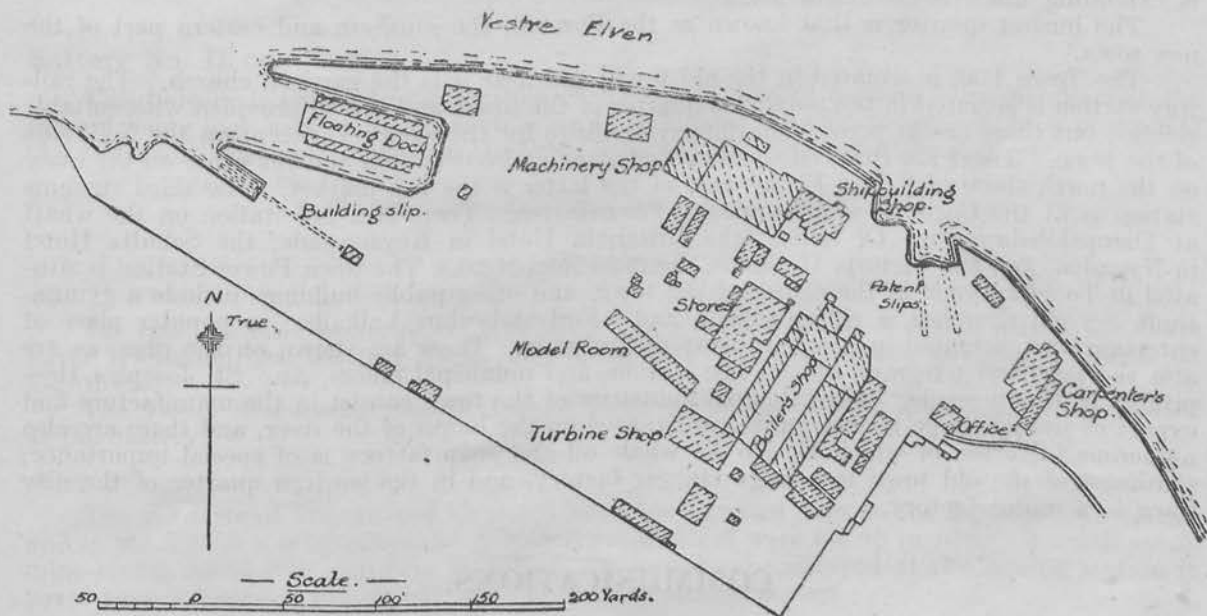
Shipbuilding and the dressing and preparation of timber are the principal industries, and in addition to timber, bricks and granite are exported. The chief imports are coal and general merchandise. A British Vice-Consul is resident. There is very considerable trade, and during 1913, 28 British vessels of a tonnage of 30,113 tons cleared the port.

PRIVATE SHIPBUILDING YARDS.

Fredrikstads Mekaniske Verksted. (See plan below.)

This shipbuilding yard, which is situated on the south bank of the Vestre Elven, and opposite to the Town, is of considerable importance, and sometimes carries out building for the Norwegian Government. The torpedo boats "Kvik" and "Dristig," and later the "Kjaek" and "Hvas" were constructed at this yard. Of late years, this firm has been specialising in a vessel now known as the "Fredrikstad Type," and at present they are able to build steamers up to 4,500 tons dead weight. Up to 1915 the total number of ships turned out had been 77, of which the largest had a gross tonnage of 2,000 tons, but in 1915 considerable activity was reported, and one of the old slips was being lengthened. In March 1916 it was reported that the yard had received orders for 34 ships, the largest of which was to be of 4,500 tons dead weight, and the management is now (1916) contemplating making extensive alterations and additions, as it is hoped later to be able to construct ships up to 7,000 tons. These extensions, which are being carried out to the west of the present yard, are expected to be completed about the end of 1918. It is further proposed to build a new floating dock for the use of the works, and which it is hoped to complete by the end of 1917; this dock will be capable of dealing with the largest Norwegian men-of-war, or a vessel between 10,000 and 12,000 tons. These works are connected with the shipbuilding yard at Revig, which constructs the hulls and sends the new vessels in tow to Fredrikstad for fitting out (see Section 2); the firm is also amalgamated with Messrs. Jensen and Dahl, shipbuilders, Kristiania.

The number of employes varies in accordance with the amount of work in hand from 1,000 to 1,500. Engines up to 1,200 H.P., and boilers of large size are built; the firm also constructs large water turbines, and it is believed that it will shortly begin to construct its own steam turbines.



FREDRIKSTADS MEKANISKE VERKSTED.

Building Slips.

There are four building slips, which are 60 feet, 210 feet, 240 feet, and 300 feet in length respectively; one of these is believed to have been lengthened recently.

Floating Dock.

There is a floating dock, 212 feet in length, and capable of taking a vessel 285 feet long. The lifting power is 1,850 tons. A new floating dock is proposed. See above.

Lifting Appliances.

The works are well equipped with cranes, one of which is capable of lifting 150 tons. There are also various smaller cranes lifting between 10 and 25 tons, and the building slips are also well fitted out with cranes and gantries. In the workshops there are a few travelling cranes.

Patent Slips.

The company operates three patent slips, the lengths of cradles being respectively 88 feet, 78 feet, and 59 feet. They are worked electrically.

Glommen's Mekaniske Verksted.

These works are situated opposite to the Nygaardsbryggen on the western shore of the Vestre Elven. The yard is only capable of building very small craft, such as tugs, lighters, &c., and only the smaller class of repairs can be executed. The number of employees in 1916 was about 300 workmen.

There is one crane to lift between 15 and 20 tons, and one or two smaller portable cranes are also installed.

The works own three patent slips, which are worked by electricity, and the lengths of the cradles are 90 feet, 70 feet, and 41 feet respectively.

Other Works.

The "Fredrikstads Armatur Fabrik" build small steamers, and execute small repairs. There are three building slips, 60 feet, 70 feet, and 100 feet in length respectively. Engines and boilers are also constructed. The number of employees in 1906 was 70 men. The exact position of this yard is not known.

The "Nobbetorp Mekaniske Verksted" is a small yard, situated on the left bank of the Glommen above Fredrikstad.

THE TOWN.

The town of Fredrikstad is situated at the southern point of Glemminge, an island formed by two arms of the River Glommen. The old town, together with the Fortress of Kongssten and its environments, is situated to the S.E. of the main town, and on the opposite side of the river. Opposite the town on the south shore of the Vestre Elven are numerous shipbuilding yards, factories, &c. The large soap and whale oil factory of De No Fa lies to the south of the old town and on the eastern shore of the Østre Elven; it has its own wharves. The population of the town in 1914 was 15,662 inhabitants, but it is probably increasing, as the town is extending towards the northeast.

The busiest quarter is that known as the Forstad, the southern and eastern part of the new town.

The Town Hall is situated in the old town, and near it is the garrison church. The railway station is situated in the northeast quarter of the town, and is well provided with suitable sidings, but there are at present no railway facilities for the wharves, except on the N.E. side of the town. There are three customs stations, one at Fredrikssten and the other on the quay on the north shore of Vestre Elven; east of the latter is the fish market. The third customs station is at the Customs wharf opposite Fredrikssten. There is a fire station on the wharf at Dampskibsbryggen. Of hotels, the Britannia Hotel in Keyersgade, the Schultz Hotel in Nygaden, and the Victoria Hotel are the most important. The town Power Station is situated in Torbjørnsgade in the center of the town, and other public buildings include a gymnasium, several churches, a riding school, and "Forlystelseshus Valhalla," a popular place of entertainment, situated in a square west of Torsgade. These are shown on the plan, as are also the post and telegraph offices, fire station, and municipal offices, &c. St. Joseph's Hospital is in Ridehusgade. The principal industries of the town consist in the manufacture and export of timber; large timber yards are situated on the banks of the river, and there are also numerous factories, of which De No Fa whale oil and soap factory is of special importance; southeast of the old town is a large vinegar factory, and in the western quarter of the new town is a motor factory.

COMMUNICATIONS.**By Steamer.**

There is frequent communication by steamer with London, Hull, Dutch, and German ports, and other Norwegian ports. Daily communication also with Kristiania and Sarpsborg.

By Railway. (See Map. 1.)

There is railway communication with Kristiania, *via* Moss; the line crosses the western arm of the River Glommen over the Kjølberg Bridge at Onsö (4 miles). The railway also runs along the west bank of the main stream to Sarpsborg (6½ miles).

By Road. (*See Plate 6.*)

There is a network of roads radiating from Fredrikstad. Main roads lead to Moss (19 miles), *viâ* the bridge at Onsö, up both banks of the Glommen to Sarpsborg, and eastward to Fredrikshald (20½ miles).

By Telegraph and Telephone.

There is telegraphic and telephonic communication, *viâ* Sarpsborg with Strömstad (Sweden) and Fredrikshald, also with Moss and Kristiania. There is also a direct telephone service, independent of Sarpsborg, *viâ* the road, to Moss. A cable, maintaining telegraphic and telephonic communication, leaves the peninsula south of Fredrikstad in the neighborhood of Homleskjaer for the islands of Hvaler, whence the telephone cable continues from Gravningsundet to the Swedish coast just north of Dynekilen.

By River.

Above Fredrikstad, the Glommen is navigable to vessels drawing 15 feet to 17 feet for about 6 miles up to Sandesund, where there is a quay for the river steamers. The strength of the current, which is considerable especially in the spring, makes navigation difficult.

MILITARY DETAILS.

At the time of the 1905 crisis, the Swedish plan of attack is stated to have been to effect a landing on the S. E. shore of Kragerö, then cross the channel at Hutholm and seize the railway north of Fredrikstad.

COAST DEFENSES.

The defenses of Fredrikstad consist of Q. F. batteries which, supported by coast defence gunboats, protect the mine fields laid in Östre and Vestre Elven. The batteries were constructed about 1904, the cost (9,500*L.*) being defrayed by the sale of the old fortress of Fredriksten, which was disclassified in 1903. A telephone connects Alshus and Hutholm, and there is telephonic communication with the islands (*see* "Communications").

No searchlights have been reported to be in these positions, which are known respectively as the Östre Elven Position (Battery No. I) and the Vestre Elven Position (Battery No. II).

Battery No. I on Chart 2.

This battery is situated near Alshus, and is plainly visible from the channel. The emplacements are hewn out of the rock, and the whole work is enclosed by a wire fence. A magazine and small barrack building are at a short distance on the north side.

In 1907 the armament consisted of:—

2—65 mm. (10-pdr.) or 57 mm. (6-pdr.) Q. F. guns.

Battery No. II on Chart 2.

This battery is situated near Hutholm. The guns can not be seen from the channel, the ground being high and rocky. An observer in 1907 saw what he thought to be a portion of the work, but whether this was on Hutholm (islet) or Kragerö is not clear.

The armament consists of:—

2—65 mm. (10-pdr.) or 57 mm. (6-pdr.) Q. F. guns.

SUBMARINE DEFENSES.

The coast defense batteries are used to defend the mine fields, of which that in the Östre Elven is situated near Battery No. I. The firing station is at the point just south of Kalleröd Lighthouse.

The Vestre Elven mine field is close to Battery No. II, and the firing station is situated at the battery.

Mine Store.

The old forts of Isegran and Cicignon have been turned over to the Mining Department, and in the former a mine store and mining establishment were set up in 1902. A small steam mine-laying vessel was seen here in 1907. The personnel employed at the mining station in peace time is stated to consist of 3 officers and 150 mining ratings.

Barracks and Military Establishments.

There are artillery barracks and stables for artillery horses near the cemetery to the north of Kongssten Fortress; inside Fredriksten Fortress itself there are artillery barracks on the north face, engineer barracks on the east face, and large infantry barracks situated in the central square. On the south side of the fortress is the arsenal, and to the east of it the Military Hospital.

SARPSBORG.

(See Plate 3 and Admiralty Chart 3160.)

The eastern entrance to Fredrikstad is available to Sandesund, the port of Sarpsborg, and affords up to 21 feet of water. Dredging operations are proceeding to enable vessels to go up drawing 22 to 24 feet of water during the winter.

The Commercial Port.

There is a very considerable extent of quayage, most of which has railway facilities. Vessels, if boomed out from the quayside, can at most of the loading places at Sandesund be safely loaded to a draft of from 1 to 6 feet in excess of the available depths quoted below.

The height between the surface of the water and the quays is normally 6 to 8 feet, but depends upon the flood in the river.

The following table gives particulars of the various quays:—

Name.	Length in Feet.	Depth alongside in Feet.	Cranes.	Remarks.
<i>Public Quays.</i>				
Tolbodbryggen.....	82	10	.....	Under construction; 90 feet completed in May, 1915. Depth alongside to be increased to 16 feet. In communication with railway. Do.
Dampskibsbryggen.....	285	15 to 18	.....	
New Quay.....	125	8	.....	
Övre Alvim Brygge I.....	700	17 to 20	.....	
Övre Alvim Brygge II.....	640	6 to 13	.....	
Nedre Alvim Brygge.....	489	14	.....	
Sandesund Brygge.....	393	10	.....	
<i>Private Quays.</i>				
Mellös Brygge.....	1,378	15 to 18	4 electric, 2 steam.	Two of the electric cranes are used for discharging bales of pulp from storehouses.
New Quay.....	?	18	.....	Under construction.
New Pier (wood).....	450	18	.....	For discharge of pulp from Russia.
Hafslund Brygge.....	262	10	1 electric..	Crane discharges about 50 tons per hour.
Hafslund Brygge.....	656	18 to 20		
New Quay.....	1,100	20 to 23	.....	Dredging in progress to 20 to 23 feet, and one new electric crane to be provided.
Greåker Cellulosefabrik.....	623	18	.....	Vessels must be boomed out.
Brödr Andersen's Brygge.....	290	15 to 20	.....	
Yven Paperfabrik.....	.....	14	.....	

The new quay at Mellös Brygge has been completed to a width of about 328 feet, and dredging is in progress, so that there may be 18 feet alongside.

The new quay at Hafslund Brygge has been completed, and at high water vessels drawing 20 to 23 feet can go alongside; about 300 feet of this quay has an available depth of 12 to 14 feet. Progress is being made on the reconstruction of the older part of the quay.

The harbor authorities possess no cranes, but at the "Kellner" Company's wharves there are two cranes capable of lifting 2 to 3 tons (fitted with grabs), also two "Coles" traveling cranes, one of 10 tons and the other of 5 tons, as well as other traveling electric cranes for loading vessels. The "Usines" Company have two cranes, one of 10 tons and the other of 15 tons. An additional electric crane is to be provided on the new quay at Hafslund Brygge. (See "Table of Quays.")

There are apparently no facilities for coaling ships at Sandesund. The port imports a large quantity of coal, the import in 1913 being 133,229 tons. A silo, said to hold about 4,000 tons, has been erected to deal with coal.

The Town.

The principal industries of Sarpsborg and Sandesund consist of saw, cellulose, and paper mills; carbide, electric power, and engineering works, and its principal export is timber.

In 1914 the population consisted of about 11,500 inhabitants, and the town is gradually increasing in size. It is situated on the right bank of the Glommen about 1½ miles above Sandesund. To the north of the town the river forms the lake of Glengshölen, and to the S. E. is the great waterfall, called the Sarpsfos, over which is the suspension bridge, which carries the railway. The falls are utilised for a number of saw mills, and celluloid and other factories, most of which are at Hafslund on the opposite bank. A little to the south of the bridge there is an electric power station, which serves factories all down the river as far as

Fredrikstad. A tramway runs from the fall past Borregaard to Sandesund. On the east bank of the river there is a salmon ladder, and a flume for the passage of sawn timber. At Sundlökken, opposite Sandesund, there are important zinc factories.

The suburb of Borregaard is situated amongst hills between Sandesund and Sarpsborg.

There are some gasworks, which probably supply the town, a short distance north of the factories at Hafslund.

Communications.

By Railway. (See Map 1.)

Sarpsborg is a junction of three railways, one following the Glommen to Fredrikstad at its mouth; the second runs northward up the valley of the Glommen to Mysen (25 miles), Askim (32 miles), and Kristiania (65 miles). At Askim are important nickel mines and the great Glommen electric power station, which supplies Kristiania and other towns with electricity. The third railway runs to Fredrikshald (16½ miles), and Sweden.

By Road. (See Plate 6).

Sarpsborg is a great road centre; there is communication to Fredrikstad, Moss, Mysen, Fredrikshald, and other towns, and a road runs up the valley of the Glommen.

By Telegraph.

The town is a main center for the telegraph and telephone system, which runs direct from Kristiania *via* Moss to Sarpsborg, Frederikshald, and Southern Sweden. A main telephone system also proceeds from Sarpsborg *via* Mysen to Kristiania.

Military Details.

A new fort (No. III on Chart 2) for land defense was completed in 1910 in the Sarpsborg district. This fort is reported to be situated about one mile N. of Sarpsborg. A second fort (No. IV on Chart 2) has been recently constructed in this locality also for land defense. The fort is situated about one mile west of Fort No. III. A permanent garrison manned these two forts in 1916, and this service was to be continuous, the men being relieved every six months. The armaments of the forts is not known, but they have probably been constructed to protect the passage of the Glommen by the railway.

COAST FROM RIVER GLOMMEN TO MOSS.

There is an inner channel extending northwards within the islets and rocks between Torgauten Lighthouse and Smaastangen, but it is narrow and winding, and the most usual course from Fredrikstad or Fredrikshald is to steer out of the approach channels into the clear fairway leading up the Kristiania Fjord.

Krogstad Leret is an anchorage often used by men-of-war; it has depths of from 7 to 12 fathoms.

There are also several other anchorages in the fjords, &c., on this coast, and are described in the Pilot.

Moss. (See Chart 2.)

The town and harbor of Moss are situated on the east side of the canal which cuts through the isthmus between Jæløen and the mainland. The depth of water in the canal, which is approached from the southward through Verle Bay, is from 17 to 18 feet, but large vessels as a rule prefer to go round the north of the island and to approach the harbor through Mosse Sund, which is available for the entrance of vessels of any draught.

The Commercial Port.

The total quayage in the harbor amounts to 1,500 feet with a depth alongside from 17 to 26 feet, and ships can load or discharge alongside.

There is a crane on the quay to lift 30 tons, and two floating cranes of 30 and 60 tons respectively.

There are two shipbuilding companies of importance, "Moss Jernstøberi og Mekaniske Verksted," which builds steel ships up to 340 tons, and it is reported that they may be asked to build submarines. The other shipyard belongs to the "Moss Vaerft Aktieselskabet," which has built steamers up to 1,100 tons. Considerable repairs to hull and machinery can be carried out at either of the above-mentioned works. The new company of "Fougner's Staal-Beton-Skibsbygning" has just (1916) been started at Moss for the construction of concrete lighters and ships. The company has an order for various lighters and for a steamer of 3,000 tons, also for a floating dock of 6,000 tons lifting capacity, on order for the Russian Government.

There are two floating docks, which can be used either separately or together. Details are given in the dock book, but when used together they are about 250 feet long, and will lift a steamer of 1,200 to 1,300 net registered tonnage. The two docks are owned by the "Moss Vaerft Aktieselskabet," which it is believed has ordered another floating dock in Danzig for delivery at Moss.

The "Moss Vaerft Aktieselskabet" owns two patent slips worked by steam. They are respectively 230 feet and 150 feet long, and the lengths of cradles are 130 and 70 feet; the larger will take a ship of 650 tons, and the smaller one of 300 tons. The "Moss Mekaniske Verksted" also owns two patent slips; these are respectively 278 feet and 165 feet in length,

the cradles being 134 feet and 79 feet long; the larger will take a vessel up to 1,200 tons, and the smaller up to 210 tons. Both are operated by steam.

The salvage steamer "Troll," belonging to the "Norsk Bjergnings Kompagni," is stationed at Moss.

About 1,000 tons of coal are kept in stock. The import of coal in 1913 was 38,029 tons. Coaling is performed either from lighters or alongside.

The Town.

The town of Moss, which is a busy trading center, had a population in 1914 of about 9,000 inhabitants. It is the capital of the Amt of Smaalenene and the residence of the Amt mand. The railway station is on the south side of the town. A bridge crosses to Jaelöen, where there are several villas, this being a favorite summer resort for the population of Kristiania. There are two or three good hotels, and a British vice-consul resides in the town.

Communications.

Steamers communicate with Kristiania several times daily, the voyage taking three to four hours. There is also a service four times a day to Horten on the opposite side of the fjord.

There is direct communication by railway with Kristiania (37 miles) and south-east to Fredrikstad (21 miles). (See Map 1.)

Three main roads leave Moss, one northwards along the coast to Soon (8 miles), Dröbak (16½ miles), and Kristiania; one N. E. to Vaaler (9 miles), where it distributes various branches inland; and the third southward along the railway to Fredrikstad. There are various offshoots from each of these main roads. (See Plate 6.)

Moss is situated on the main trunk telegraph and telephone lines between Kristiania, Sarpsborg, Fredrikshald, and the Swedish frontier. There is an independent telephone line running from Moss to Frederikstad, avoiding Sarpsborg.

Military Details.

Land defense works have been constructed near Moss, in connection with the defense of the E. shore of Kristiania Fjord. A battery on the "Onerod property," on Jaelöen, was reported in 1902, as well as the construction of another on Björnaas. It is also believed that two works exist just in rear of Moss, as shown on Plate 6.

All these works are merely prepared positions, without armament in peace time.

Soon.

To the north-east of the entrance to Mosse Sund is situated the small town of Soon, which is a fashionable bathing resort. There is good anchorage in the bay in from 8 to 14 fathoms; the principal export is timber.

This port is considered as suitable for carrying out a landing for the purpose of attacking the Dröbak defenses on the land side. It is believed that two works forming part of the *interior line* of land defense works (see page 17) have been constructed on each side of the entrance to the bay. They are probably without any armament in peace time, and are of the same general description as other works in this line. (See Plate 6.)

In August 1916 it was authoritatively reported that Messrs. Fred Olsen were about to construct three oil tanks at Soon for use of their motor ships.

COAST FROM SOON TO DRÖBAK.

North of Soon the Kristiania Fjord narrows down to a width of a little over a mile, which is caused by the long peninsula, known as Hurum landet, which bounds it on the western side. This width continues for about 6 miles northwards as far as Dröbak, where the fjord is somewhat obstructed by islands and gradually widens as it approaches Kristiania. These islands, of which the fortified areas on Kaholm and Haaöen are described later under 'Coast Defenses' of Dröbak, are separated from the mainland by navigable channels, of which the usual course taken by large vessels is on the east side; the western channel is impeded by a submerged breakwater, though there is an opening for vessels on the eastern side.

Dröbak.

Dröbak is situated on the eastern mainland and at the northern extremity of the narrow part of the fjord. There is a quay 60 feet long with 15 feet alongside, and also the steamer quay which is 200 feet in length and from 14 to 18 feet alongside. Dröbak, with a population in 1914 of about 2,000 inhabitants, carries on considerable trade in timber and ice. In winter when the upper part of the fjord is blocked by ice, navigation frequently remains open up to Dröbak, where goods for Kristiania are discharged.

Communications. (See Plate 6.)

There is ample means of communication by road with the neighborhood and with Kristiania, but no railway nearer than Aas (6 miles). There is frequent communication by

steamer with Kristiania, Moss, Svelvik on the western side of the fjord, and steamers call on their way from Kristiania to Bergen. There is communication by telegraph and telephone to join the main systems at Aas; there is also direct telephonic communication with Kristiania, and a telephone cable crosses to Fort Oscarsborg, on South Kaholm Island.

THE DEFENSES AT DRÖBAK.

(See Chart 2.)

NAVAL DETAILS.

In 1897, a site was purchased at Husvik for a naval laying-up harbor; moorings were laid down and stores for ammunition built at a cost of 1,000%. A few existing buildings were likewise converted to naval use. Nine years later it was decided to reduce the number of laying-up harbors, and Husvik was closed, the ammunition store being removed to the dock-yard at Karljohansvaern.

The coast defense war vessels attached to the Dröbak defenses have now their headquarters at Karljohansvaern, but it is understood that in war time coast defense vessels are used to supplement the land defenses.

A Norwegian naval officer has stated that the depth of water in the channel off Dröbak is greater than shown on the chart.

MILITARY DETAILS.

Northward of Dröbak, Kristiania Fjord divides into two branches, which flow east and west of Haaö. The regular channel to Kristiania is eastward of Kaholm, the Askholms, and Storgrund. The approach to the channel west of Haaö, which is known as Vest Fjord, is blocked by a submerged breakwater between Foergested and Kaholm. A gap is left marked by two poles between Smaaskier and S. Kaholm, but passage through it is dangerous, owing to the strong and irregular currents.

The submerged breakwater, or fairage, mentioned above, was examined in 1909. The depth over it is 7 feet at L. W. O. S. In the middle of the opening (200 feet wide), nearly midway between S. Kaholm and N. Smaaskier, there is a depth of 5 fathoms at L. W. O. S.

The question of modernizing the fortress of Oscarsborg was under consideration in 1913.

COAST DEFENSES.

It was proposed in 1900 to construct extensive barracks at Husvik at a cost of 17,000%. This was never carried out, it being subsequently decided that the existing barracks on S. Kaholm, together with certain private dwelling houses in and about Husvik, would suffice to meet requirements.

It was proposed in 1899 to erect a power and light station to supply the torpedo battery, but this has never been done. The power is now supplied from Husvik.

A plan was adopted in 1900 for laying wire entanglement and fencing around all Norwegian coast batteries. The former is laid in belts 17 feet wide and surrounds each separate work; the latter is laid round the entire site, and is chiefly intended to keep off the public. 9,500% was voted for this purpose at all defended localities.

In 1907, two old gunboats, painted grey, were lying alongside Bergholmen and Haaö. It should be ascertained, if possible, what vessels would be stationed at Dröbak in war time to assist in the defense of the forts.

It is believed that the main telephone exchange is in Oscarsborg. Mention occurred in the 1907 estimates of a captive balloon brought to Oscarsborg from Fredriksten. There is at least one steamboat belonging to the defenses; it is manned by men of the Coast Artillery. It is believed that no recent alterations have taken place in the principal armaments of the Dröbak defenses.

SEA DEFENSES ON THE DRÖBAK SIDE.

Veisvingen Battery (No. V on Chart 2).

This earth battery is scraped out of the slope of the hill. The face of the work stretching from S.E. to N.W., is about 80 yards in length. Traverses separate the guns, approximately 15 yards apart. In the rear of each traverse is a position for a range-finder (? or machine gun). The guns are all fitted with loading derricks.

At the east end of the work a magazine has been built behind a thick parapet, tipped with stone, and from 25 feet to 30 feet in thickness. The entrance is to the north. Three orographs

have been provided, but there is no wire entanglement round the battery, though a barbed wire fence prevents intrusion of nondesirables. A road leads direct through the wood to Vindfangerbugten to the north of the defenses.

It has been observed that the fold of the ground below the work renders the channel dead water for a distance of 1,500 yards from the east shore; owing to the dark background, the fort is difficult to distinguish from seaward.

The armament was verified in 1909, when it consisted of—

- | | |
|---------------------------------|--------------------------|
| 1—27 cm. (10.6-inch) M.L. gun | } taken from Oscarsborg. |
| 3—22.6 cm. (8.6-inch) M.L. guns | |

It has been stated that there are also machine guns and light Q.F. guns, but none have ever been seen.

Kopaas Battery (No. VI on Chart 2).

The three guns are mounted on the rock in the open, at the height of 120 feet, 90 feet, and 50 feet, respectively, above the sea level. The rock has been scraped away near the two lower guns to permit of increased depression, thus to command the channel close in. The guns are in line from the S.E. corner of S. Kaholm.

In 1900 the guns were painted the color of the ground, but were still distinguishable from the channel.

The magazines are under the gun positions.

The 1899 Estimates stated that one orograph had been provided, but that, "owing to the position of the guns," it was necessary to purchase two more (cost 55*l.* each). This was done.

In 1900, 450*l.* was allowed for "arrangements for protecting the range-finders," understood to be the orographs mentioned above.

The armament was verified in 1909, at which date it consisted of—

- 3—15 cm. (5.9-inch) L/47 Q.F. Armstrong guns, with shields.

Battery No. VII on Chart 2.

This small Q.F. battery (open in rear) is situated 30 feet above the sea at the Point, almost in line with the guns of Kopaas Battery. It is close to a small white house, and stands nearly in front of the observation station, mentioned in "Submarine Defenses," page 17. Midway between this battery and Kopaas Battery is a small iron-faced parapet, possibly intended for two small Q.F. guns, but no armament was seen there either in 1907 or 1909.

The guns in this battery are mounted on traveling platforms running on rails and, when not in position, are entirely concealed behind a cement wall. The armament, which was verified in 1909, consisted at that date of—

- 2—57 mm. (6-pdr.) Q. F. guns, with light removable shields.

WORKS ON S. KAHOLM (FORT OSCARSBORG).

The works on S. Kaholm are known collectively as Fort Oscarsborg. They consist of two earth batteries, two masonry casemates (disused), an old stone work, and an old masonry citadel (*rédut*). As they have not been visited for some years, the following description of the works can not be considered quite reliable.

The barrack which closes Vestfiord (mentioned on page 13) projects from the S.E. corner of S. Kaholm.

A new "laboratory" building (cost 550*l.*) was added in 1900, the former one being very exposed. The use of the so-called laboratories, common to all Norwegian defenses, has not been ascertained, but it is probably for examining shell.

There is a small coal and firewood store and a fire-engine house, and the old gunpowder tower has been converted into a clothing store.

The boat harbor is situated at the north end of the island, where there is also a conspicuous building, the use of which is not apparent. The gap between North and South Kaholm is spanned by a bridge. There is a floating crane belonging to Oscarsborg. It is understood that the barracks can only accommodate 90 men, a portion of the garrison of Oscarsborg being accommodated at Husvik; a permanent garrison now mans the guns, and serves continuously for six months.

"Hoved" (Main) Battery (No. VIII on Chart 2 and Plate 4.)

This battery has been described as built "upon the glacis of the old *rédut*." It faces S and S. E. The guns are mounted "*en barbette*" at a height of 45 feet above the water. The thickness of the parapet is 35 feet, and of the traverses 30 feet. An interspace of 66 feet separates the guns.

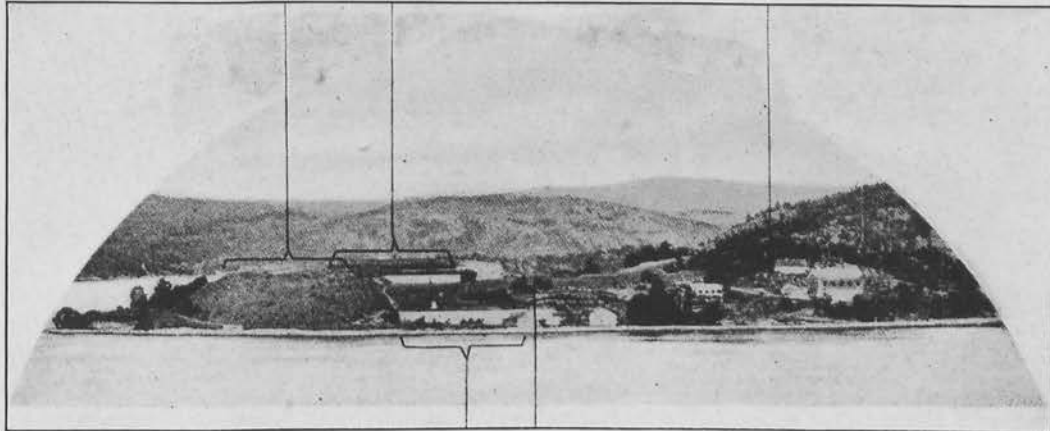
A well protected position for the battery commander is built at the extreme east end of the work.

DEFENCES OF DROBAK (KRISTIANIA FIORD).

FORT OSCARSBORG.

No. VIII. Old Redoubt.

No. X.

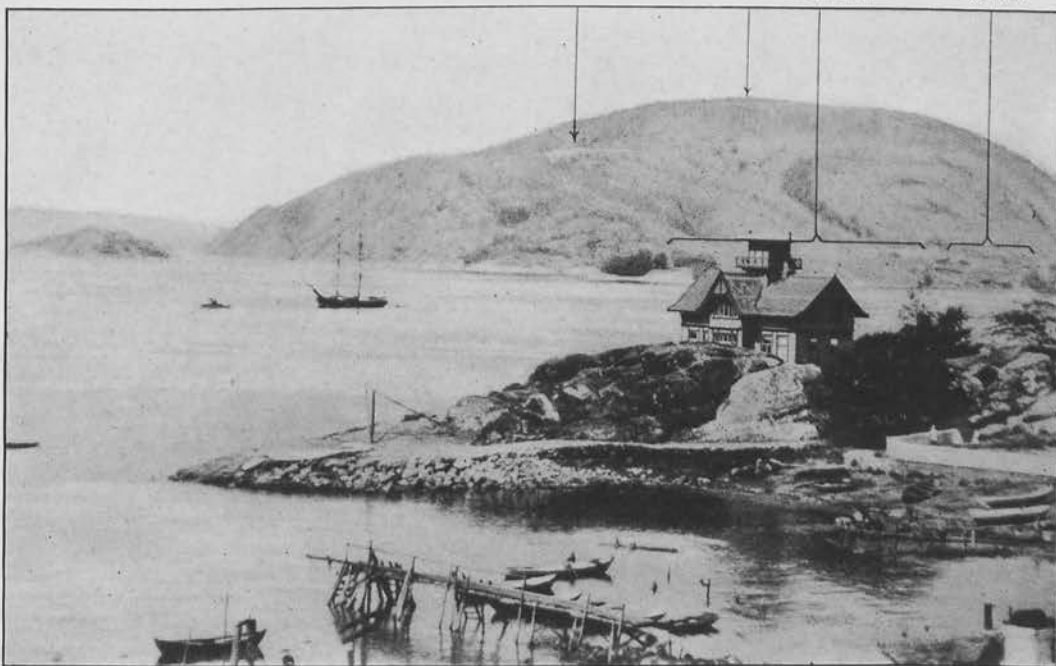


Casemate. No. IX
View from Eastward.

No. XII

No. XIII. No. VIII.

No. IX.



←-Dröbak.

View from S.E.

No. XII No. XIII. No. VIII Old Redoubt. No. IX.



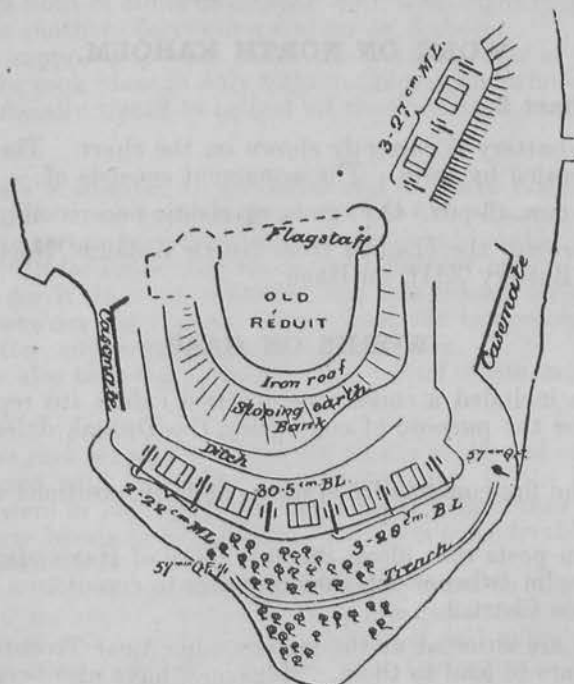
←-Dröbak.

View from S,S.E.

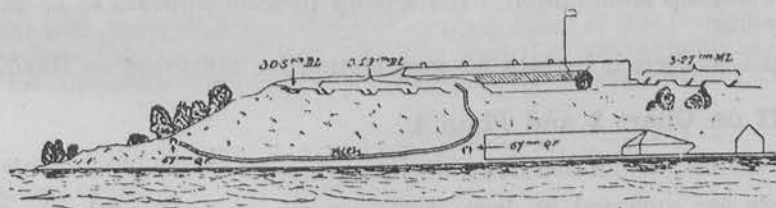
In 1900 it was reported that a depression range-finder had been mounted on each traverse between the B.L. guns. In the same year's Estimates, 1,000*l.* was allowed for providing "arrangements for protecting the range-finders in 'Hoved' and 'East' batteries." These range-finders are probably orographs.

Telescopic sights were purchased for the B.L. guns in 1906.

In 1909, an observer reported a deep ditch between the heavy gun positions and the masonry fort in rear. The latter is the old *réduit*, and the ditch is the moat belonging to it.



A trench or covered way, 4 feet wide and 12 feet deep, runs round the southern face of the island, below the main parapet, about 20 yards from the shore, and terminates at each end in a small battery mounting one 57 mm. gun. The battery at the western end was entered



VIEW FROM EASTWARD.

in 1909. It is entirely walled-in and cemented in front. The gun is mounted on a travelling platform on rails, and when not in position is entirely concealed; it fires out of a port at the western end of the battery, and commands the channel south of the island. In the trench close by is an ammunition hoist leading down to the magazines, which are apparently beneath the trench.

The battery at the east end was not entered, but as it is not covered in like the other one, the gun is visible, and commands the channel E. and N.E. of the island.

The armament was seen and identified in 1909, when (from east to west) it consisted of:—

- 3—28 cm. (11-inch) B.L. L/40, Krupp guns.
- 1—30.5 cm. (12-inch) B.L. L/25, Krupp gun.
- 2—22 cm. (8.6-inch) M.L. guns.
- 2—57 mm. (6 pdr.) Q.F. guns.

The 30.5 cm. gun is much shorter than the 28 cm. guns, but its shield is almost similar, *i. e.* large and spherical, and about 1½ inches thick; the M.L. guns have light shields only. The B.L. guns have a loading derrick.

East Battery (No. IX on Chart 2 and Plate 4).

This work practically adjoins No. VIII. The guns are mounted behind a grass-covered parapet, and are separated by traverses.

The arc of fire of one of the three guns permits it to command the channel as far south as the submerged breakwater; the other two guns do not fire much S. of E.

The guns are mounted at a slightly lower elevation than the ones in No. VIII.

See under battery No. VIII., for protection provided for the R.F. 's.

This battery was visited in 1909, when the armament consisted of:—

3—27 cm. (10.6-inch) M.L. guns, without shields, with davits fitted at the muzzle. The guns were then painted dark grey.

Battery No. X on Chart 2, and Plate 4.

In 1910, a battery was observed at the position shown and armed with six light Q.F. guns and provided with an elevated iron position-finder supported on iron trestles.

WORK ON NORTH KAHOLM.

Battery No. XI on Chart 2.

The position of this battery is correctly shown on the chart. The guns are 30 feet above the water, and well concealed by trees. The armament consists of:—

2—57 mm. (6-pdr.) Q.F. guns, on elastic non-recoil mountings.

A telegraph cable crosses the channel from North Kaholm, North of Battery XI., to a point 600 yards East of Battery XIII. on Haaö.

WORKS ON HAAÖ.

The 1900 Estimates included a small vote for two cables (to replace old ones) between S. Kaholm and Haaö, for the purpose of controlling the Dröbak defences from a position on the latter.

In the same year the fire-commander stations at both positions were connected by telephone.

A telephone cable on posts runs along the east shore of Haaö island from a point abreast the north end of N. Kaholm (whence the cable appears to come) to a house near the position marked Tronstadodden on Chart 2.

The four magazines are situated at the water's edge, near Tronstadbugten, with a jetty close by. No road appears to lead to them. Magazines have also been built at batteries Nos. XII. and XIII. In 1916, searchlights were reported to be stationed on the island.

A large building can be seen from the channel among the trees in the rear of No. XIII., but its use is not apparent.

A road zigzags up the east side of the island to Battery No. XIII., and close by is a rack railway for conveying up ammunition. It leads up to what appears to be bomb-proof case-mates, on the sky-line.

It is reported that there is barrack accommodation for 2,000 men on Haaö.

Battery No. XII on Chart 2 and Plate 4.

This work is situated about 350 feet above the water.

The howitzers are mounted in deep emplacements, and can probably *not* be used for direct fire.

The shields show up prominently from S.

The armament consists of—

4—28 cm. (11-inch) B.L.L/14 Whitworth howitzers, with shields.

7,000*l.* was expended between 1890–95 upon constructing this work, and 25,000*l.* upon armament and ammunition.

“Top Battery” (No. XIII on Chart 2 and Plate 4).

This earth battery, easily distinguishable from south, is situated above No. XII., at a height of 656 feet above sea level. It commands a large portion of the ground behind Dröbak. The guns are converted 16.7 cm. M.L.'s, and in 1899 a sum of 2,700*l.* was voted for purchasing new mountings to replace the old wooden ones.

The armament consists of—

10—12 cm. (4.7-inch) (converted 16.7 M.L.) B.L. L/36 guns.

450*l.* was voted in 1899 for laying belts of wire entanglement 17 feet wide round this battery.

Money was voted for one orograph in 1900; till then none had been provided.

Battery near Noeset Point (No. XIV on Chart 2).

This battery is intended to protect the minefields. The work was seen in 1909, and it was found that the ground is cut away below the embrasures to enable the guns to be depressed.

The armament consisted at that date of:—

4—57 mm. (6-pdr.) Q.F. guns.

SUBMARINE DEFENSES.*Minefields. (See Chart 2.)*

In 1897, since when there has been no information, the minefields were stated to consist of seven lines of observation and E.C. mines, extending from the church at Dröbak to Husvik Point.

An observation station stands in close proximity to the two 57 mm. guns belonging to Battery No. VII. It is built of stone or cement, with wide sight embrasures.

There is said to be another observation station on Kaholm.

A firing station is supposed to exist inside the tunnel in rear of the citadel on S. Kaholm.

Minelaying practice took place in July 1913 in the neighbourhood of Dröbak.

A minefield was officially stated to be laid off the Oscarsborg defenses during the war.

Torpedo Battery.

The torpedo battery is situated on the south end of North Kaholm.

It is considered that it can be distinguished from the channel, although it has not been identified with absolute certainty. What appears to be it is visible on a S.E. bearing. A sum of 890*l.* was voted in 1910 for improving the torpedo battery here.

It has three tubes for Whitehead torpedoes, and was erected about 1898 at a cost of 14,000*l.* On the high ground between the torpedo battery and the bridge connecting North and South Kaholm is an iron shelter, supposed to be the firing station.

Torpedo tubes are also believed to exist on the Island of Storskjaer, opposite Dröbak.

Mining Establishment.

All the faces of the rock which are climbable on the south and east extremity of the island of Bergholm, are covered with barbed wire entanglement. In the indentation midway along the south shore there were in 1911 three gunboats fitted with cranes, the funnels being marked with one, two, and three bands respectively. There is a considerable supply of coal stored on the west side of the indentation.

In 1911, at the west side of the island, two mining launches were seen hauled up and reels of cable were laying on the shore. There is a long low mine store at the west extremity of the island at the entrance of which could be seen spherical and cylindrical mines which had the appearance of having been recently removed from the water. There are two small fixed cranes and a travelling crane on the wharf.

Boom Defense.

If booms exist for the defense of this locality it is probable that they are stowed in sections somewhere near, probably on the islands of Kaholm or Bergholm, though no signs of any large baulks of timber could be seen in the vicinity in July 1913. An Englishman who knows this part of the fiord well states that he has never seen anything in this connection.

It is understood that two booms do exist, but that they are probably stowed away in peace time, and are intended to be laid in war time in the positions marked on Chart 2.

Cable Store.

A cable store is known to exist on Bergholm. In 1908 the sum of 100*l.* was voted for various alterations to it.

SEARCHLIGHTS.

Three searchlights only have been mentioned in the Estimates. They were all seen in 1907, on the Dröbak side. One was mounted at the Point opposite S. Kaholm, just below No. VII.; a rail track leads from it N. of the Point. A second is situated at the Point about one mile N. of Dröbak town; a rail track connects with a door in the rock. The third is at the point just S.W. of the church, mounted in a pit.

In 1900 it was reported that the existing installation (which is understood to be situated near the church at Husvik), could work all three searchlights.

The position of all three searchlights was verified in 1909; none were seen at this date on South Kaholm.

LAND DEFENSES ON THE DRÖBAK SIDE.

(See Chart 2 and Plate 6.)

The following works are intended to secure the sea defenses from attack from the land side.

Infantry Parapet.

From the east of Veisvingen Battery (No. V. on Chart 2), an infantry parapet follows the contour of the hill to the Seierstein Redoubt, and continues beyond the redoubt for a

KRISTIANIA.

(See Plate 5 and Admiralty Chart 1974.)

The actual entrances to Kristiania Harbor are known as the Skibsløb, or ship channel, between Hægholm and Lindø and the Vestre Løb, or west channel, between Kobbervaglen and Dynen lighthouses. The Skibsløb is generally used by merchant ships, but the Vestre Løb which is more roomy and less winding is the more usual approach channel for men-of-war and other large ships.

The port is situated about 55 miles from the entrance to Kristiania Fjord and the harbor is bounded by the mainland on the north and north-east, by the Ladegaard Peninsula on the west, and by numerous islands on the south-east and south. Of the three bights on the north side, known respectively as Biörviken, Piperviken and Frognerkilen, the last named is not much used by shipping, whereas Piperviken is the usual anchorage for men-of-war.

Bundeffjord, which extends for some miles southward of Kristiania, and on the eastern side of the Nesod Peninsula is not much used except by small ships, though it is deep and mostly clear of dangers.

THE COMMERCIAL HARBOR.

(See Plate 5.)

Quayage.

The following table gives the most important quays, working from E. to W.:—

Name.	Length in Feet.	Cranes.	Remarks.
Coaling wharf.....	721	.....	North of Kongshavn.
Grønlibryggen.....	1,968	One 3-ton electric.....	Depth alongside, 27½ feet. Rail-way sidings.
Bispebryggen.....	606	.....	.....
Tolboddbryggen (customs).....	462	.....	Customs quay and offices.
Langbryggen.....	744	One 6-ton, two 3-ton, electric, also floating cranes.	.....
Revierbryggen.....	577	One 3-ton electric.....	Grain elevator.
Fæstningsbryggen.....	728	One 20-ton fixed hand crane.....	.....
Ustikker I.....	308	.....	Mail steamers, Xnia—Bergen.
“ II.....	1,289	One fixed 20-ton at end, one 6-ton, two 5-ton, three 3-ton, all electric.	Wilson Liners' Berth.
“ III.....	918	.....	Grain elevator.
Fish harbor.....	754	.....	.....
Vippetangbryggen.....	1,246	One 6-ton, one 3-ton, electric.....	Depth of water alongside: N. end 29 feet, S. end 19 feet.
Akershusbryggen.....	1,689	.....	.....
Filipstadbryggen.....	.....	One 3-ton fixed crane.....	Under construction.

At the north end of Oslo Harbor lies the Eastern Railway station terminus fronted by various quays, floating pontoons, and sheds. The quays from the Eastern Railway station as far as the Vippetangbryggen are built of stone, rising about 6 feet above normal water level, and are well lit by electricity. They are connected by a goods railway, with sidings, running from the Eastern Railway station, round the base of the obsolete fortress of Akershus, to Piperviken Harbor and the Western Railway terminus. A driving road runs alongside the railway track and close to the water's edge; this road is called the “Strandveien.” At the north end of Piperviken Harbor, flanked on the east by a wooden quay and on the west by a stone quay, are the landing stairs used by launches from men-of-war, yachts, &c. Stone quays extend westwards past the Western Railway terminus to the Akers Engineering Works (see page 21). The Filipstad Bay quays, at present under construction, are further west. A wooden pier in Hjortnæs Bay is the starting point of a ferry to the Bygdø Peninsula. The total length of quayage at Kristiania is about 28,000 feet with a depth of water alongside varying from 10 to 30 feet; there is practically no rise and fall of tide. There are ample mooring facilities to rings on the quay walls and the harbors are well buoyed.

Harbor Improvements.

In 1915 the harbor authorities of Kristiania invited a general international competition for designs for the extension of the port with the object of further development with the plant already existing. It was proposed to establish a free port. Competitive drafts were to be lodged with the harbor board by November 1915; it is not known what result there has been. The filling up of Filipstad Bay for affording additional quayage has been going on for some time and the shore front is being pushed out between the railway and the water from

Filipstad Bay to Skarpsno in front of the grounds of the British Legation.

The following account has been published of harbor extensions in 1913:—

- (1) Grönlien quay extended about 100 yards. About 130 yards more to be constructed by the end of 1915. Railway tracks are being laid as work proceeds, and electric coal discharging machinery, capable of discharging 1,000 tons per diem, is being erected.
- (2) Vippetangen quay: about 100 yards more completed. The depth alongside will be sufficient for the largest vessels.
- (3) The new pier in Piperviken was expected to be ready for use by the end of 1913, but some delay has occurred owing to the pier settling. The dimensions are given as about 120 yards long on the north side and about 85 yards on the south side with 16 feet depth alongside.
- (4) The filling up of Filipstad Bay has proceeded satisfactorily, leaving a space for a boat harbor. It is intended to erect a support wall along the west side of the filling affording a good quay and yards for discharging coal.
- (5) The Skarpsno quay with depth alongside for torpedo boats has been enlarged to afford discharging space for 10 sand boats. Further small extensions are contemplated.
- (6) A hitch has occurred in the dredging of the Akers River owing to the fear of land slips.
- (7) A considerable extension is projected in Oslo Harbor by filling out the quay off the Sörengen planing mills which have recently changed hands. The new purchasers, an agricultural cooperative association, are said to intend to erect discharging machinery, cranes and new warehouses.

The municipal authorities, in a yearly trade retrospect, state that the harbor funds are too low to enable the extension, necessary to cope with the traffic, to be carried out with the desired rapidity, and that the question of discovering new sources of revenue for the harbor has, therefore, become an acute one.

Lifting Appliances.

At Langbryggen there are two floating cranes; one of these is steam of 40 tons and the other a hand crane of 2 tons. There is also a steam dredger and floating grab. Other cranes consisting of two 20-ton cranes, three 6-ton, two 5-ton, nine 3-ton cranes are shown in the "Table of Quays" giving their respective positions. In addition, the "Akers Yard" owns a steam crane on shore lifting about 60 tons and the "Nyland Yard" another lifting about 50 tons; there are also smaller cranes in these yards. There is also a 15-ton railway crane by the roadside under the Akershus bastion.

Repairing Facilities.

These are discussed under "Private Shipbuilding Yards" (*see* page 21).

Docks.

The "Akers' Shipbuilding Yard" owns two dry docks, one of which is believed to be still under construction (1916), and one floating dock. The "Nyland's Shipbuilding Yard" owns three floating docks. Full particulars are given in the Dock Book, *see also* under "Private Shipbuilding Yards" (page 21).

Patent Slips.

There are no patent slips.

Salvage Appliances.

The "Norsk Bjergningskompagni" is a salvage company which has its headquarters at Kristiania; it owns a fleet of salvage vessels which are based on the various parts around the coast. There are branch offices in Bergen and Trondhjem. There are also two icebreakers which are constantly employed during the winter.

Harbor Craft.

In 1912 there were six tugs of gross tonnage varying from 12 tons to 56 tons. In addition there was one tug specially detailed for work with the dredgers, of which there were two. There were also three water boats, one of which was moter propelled, for supplying ships at anchor with water.

Coal and Coaling Facilities.

The import of coal into Kristiania during 1913 was 599,365 tons. Permission was granted during that year for a private firm to erect modern coal discharging machinery on their coal wharf at Bispebryggen quay; plans were at the same time discussed for the erection by the railway authorities of similar machinery on Grönlein quay, including a concrete receiver to take 7,200 tons of coal, and served by two travelling electric grabs, which were to be capable of together discharging 1,000 tons a day. There is a large coaling wharf just north of Kongshavn fitted out with coal transporters and also wharves in Biörviken and Frognerkilen

bights, and in the Akers River. In 1910, 12,200 tons of coal were in stock. Coaling is performed alongside or from lighters, the coal being put on board in baskets. In 1907 there were 20 lighters of from 50 to 150 tons, 2 of 70 tons, and 25 of 40 tons.

Water Supply.

This is excellent for drinking purposes and not too hard.

It comes from lakes (principally Lakes Maridal and Sognsvand) to the north of Kristiania. It is laid on to nearly all quays and can be obtained by hose to the ship. The three water tanks mentioned under "Harbor Craft" supply vessels at anchor. The water can be used for all purposes without filtering, and is very pure.

Liquid Fuel.

Nothing is known of any supply depôt for liquid fuel.

There is a large petroleum store on the Steilene Islands in the approach to Kristiania; there is also a petroleum and benzine clearing house on the east bank of the Akers River.

Trade and Shipping.

The principal exports from Kristiania are wood pulp, cellulose, and timber, and the chief imports are foodstuffs and manufactured goods. In 1913, 1,982 (240 sailing vessels of 54,366 tons) vessels of 1,426,682 aggregate tonnage entered the port; of these 167 were British steamers of 195,877 tons. According to the Norwegian Veritas Register for 1912, Kristiania owned about 390 steamers of a total of 370,000 tons, and sailing vessels of a total of 56,000 tons. A British consul resides in the town.

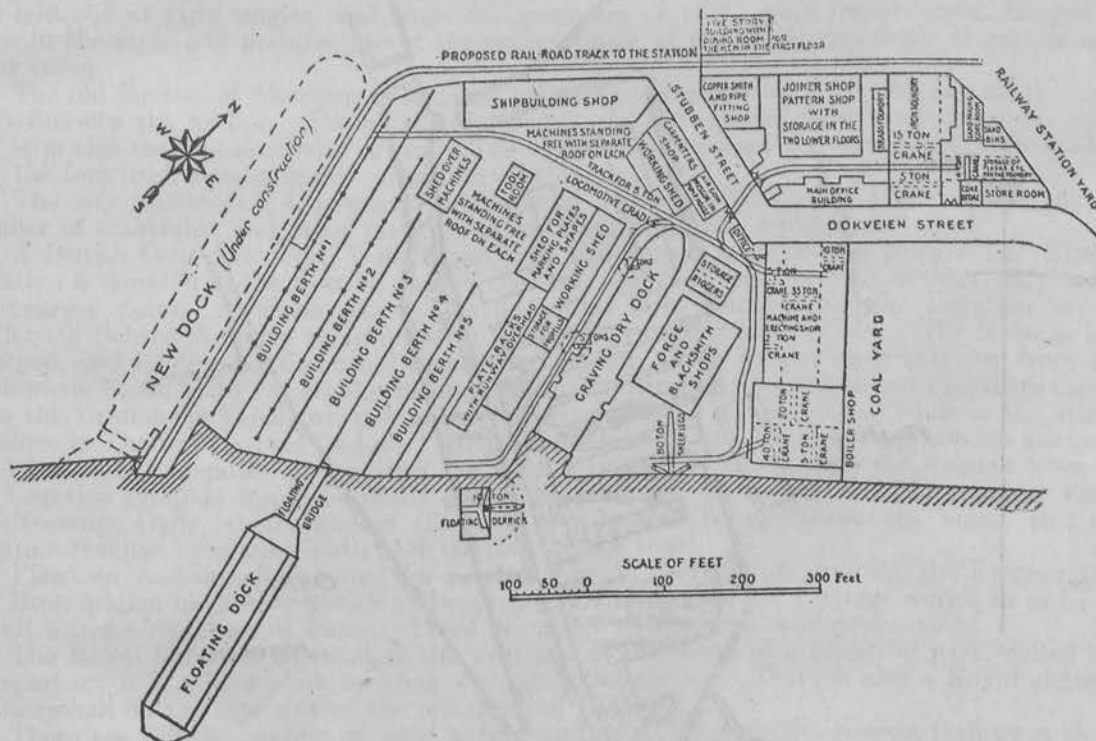
PRIVATE SHIPBUILDING YARDS.

Akers Mekaniske Verksted (see Plan below).

This yard, which is the largest in Norway, is situated on the west side of Piperviken, and carries out the construction principally of steamers and motor ships of large size, and occasionally tenders for men-of-war.

Engines and boilers of all kinds are constructed, and special machinery for the construction of motors has been installed. This yard recently concluded a contract with Messrs. Burmeister and Wain of Copenhagen for the sole right to build Diesel motors in Norway. In 1913 the yard was considerably increased, the engineering department doubled in size, and a new smithery erected; at the same time the number of hands employed was increased to about 2,000. In March, 1916, the firm had orders for 15 vessels, two of which were to be of 6,400 tons dead weight each; some of these were already under construction at that date.

The total water front of the works is about 280 yards.



PLAN OF AKERS MEKANISKE VERKSTED.)

Lifting Appliances.

The yard possesses one crane of 2 tons, one of 3 tons, one of 4 tons, four of 5 tons, one of 10 tons, one of 15 tons, one of 20 tons, one of 35 tons, and one of 40 tons lifting capacity. Also one shears of 80 tons lifting power, and a floating derrick of 10 tons.

Docks.

Akers dry dock, which is situated in the centre of the yard, is 281 feet in length, 46 feet 3 inches in breadth at the entrance, and 13 feet 9 inches in depth over the sill. It is provided on the dock side with one 3-ton and one 5-ton crane.

A strip of land, immediately adjoining the south-west side of the works, and known as Tyveholmen, has been acquired from the Government, and on it a new dry dock is under construction; the floor of the new dock is to be about 600 feet in length, and the dock will ultimately be at the disposal of the naval authorities in time of war, or on mobilization, otherwise it will be available for merchant shipping.

The Company also owns a floating dock, which was acquired in 1909; it is 240 feet 4½ inches in length over all, 56 feet in breadth, and 15 feet deep. It will take vessels up to 300 feet in length, and will lift 2,700 tons.

Building Slips.

There are five building slips on the south side of the yard; they are of various lengths from 200 to 400 feet long.

Various Shops.

The situation of the various shops is as shown on the plan. The older ones have nearly all been replaced by up-to-date buildings fitted with modern machinery.

A new foundry was completed in 1906, and equipped with electric cranes, and a new machine shop was constructed during 1907, and is 300 feet long and 100 feet broad. Nearly all the machines are of new pattern, and the machine shop is conveniently situated, well-formed and equipped with electric travellers.

Nyland's Mekaniske Verksted.

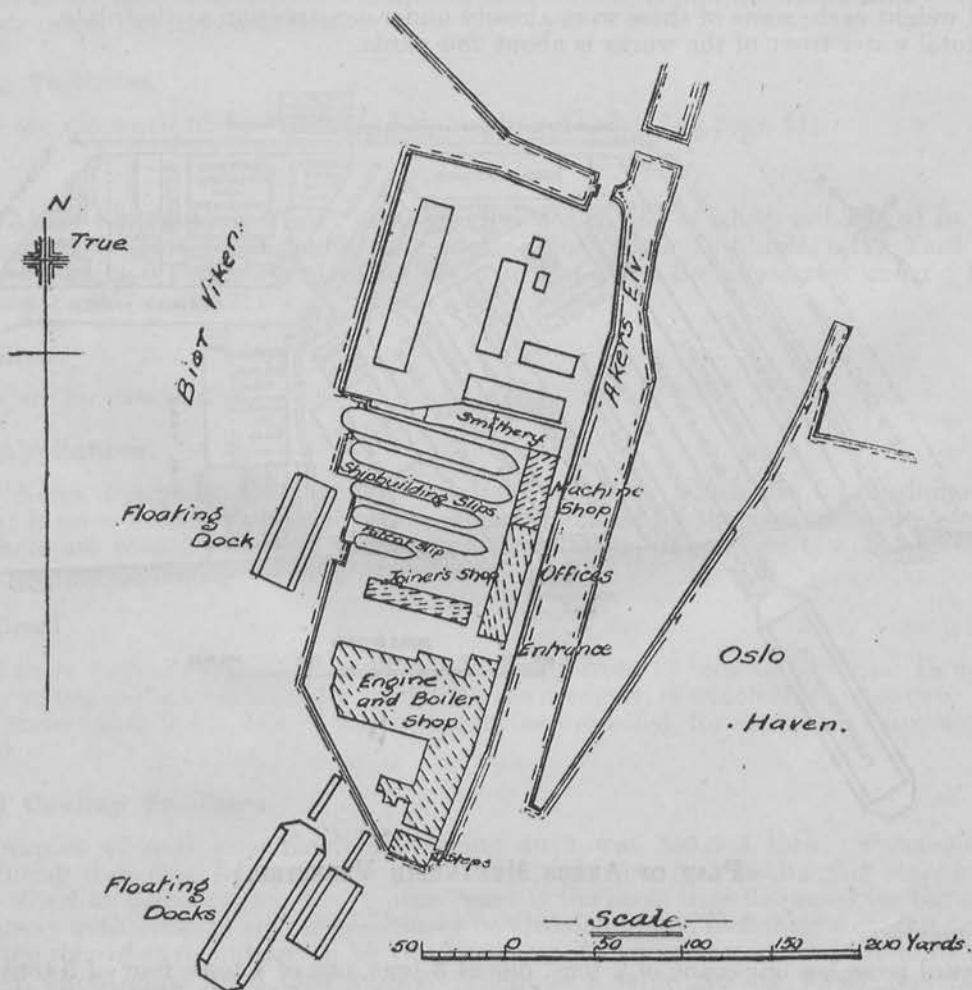
This yard is situated at the mouth of the Akers Elv. It was last visited in 1907, since which date improvements have taken place and the quayage lengthened to about 1,400 feet in all. The yard, however, is very cramped, and incapable of further extension. In 1907 the employes numbered about 800. In 1916, the firm had an order for nine steamers, some of which were already laid down; the largest of these was a vessel of 4,500 tons dead weight.

Docks.

The firm has no dry dock, but owns three floating docks (see Dock Book). The largest is 320 feet in length, 61 feet in width, and 18½ to 19 feet in depth, and capable of raising a ship of 4,500 tons.

Patent Slip.

The firm owns one patent slip of which no details are known, but it is believed to be quite small.



NYLAND'S SHIPBUILDING YARD.

Building Slips.

There are four building slips, of which the largest can take a ship up to 4,500 tons dead weight, and the two smallest up to 2,800 tons.

Lifting Appliances.

There is a 45-ton crane, and a floating sheers of a lifting capacity up to 20 tons.

Various Shops.

The engine building shop was considerably extended in 1905 and an electric traveller added. The other shops are shown on Plan above. The largest forgings and castings are obtained elsewhere.

Thunes Mekaniske Verksted.

The works belonging to this company are in the city near the National Theatre in Stortingsgaden. The firm is one of the largest and most reliable engineering works in Norway, and contracts for the Norwegian State Railways and other Government departments. Their manufactures cover a wide range, including locomotives, high speed steam engines, water turbines, mining machinery, and machinery for wood pulp and paper mills. They were recently agents for Messrs. Babcock and Wilcox's boilers and, in 1916 it was reported that the works were to be enlarged to deal with a contract for supplying the motors for 6 submarines which are to be laid down by the Norwegian Government.

Other Works.

Engines and boilers are constructed also by the following firms:—

Kvaerners Brug, Myreds Mekaniska Verksted, Olsen and Borge.

It is reported in the Press that a new company has just been formed at Killigen, near Kristiania, for the construction of concrete vessels.

THE TOWN.

(See Plate 5.)

Kristiania, the capital of Norway and seat of the Government, is beautifully situated at the foot of pine clad hills, at the north end of Kristiania Fjord, and on the Akers Elv, a small river falling into it. After the fire of 1624, Christian IV. of Denmark founded the modern city, but it has suffered from numerous fires since that date. The town has considerable trade, and in and near the city are numerous engine works and other factories, shipbuilding yards, breweries, cotton and paper mills, &c.

The principal street is the Karl Johans Gade, which extends from the Eastern railway station (Øst Banegaard) to the Palace at the western end of the city. The streets are broad and laid out at right angles, and since the great fire of 1858, great improvement has taken place in the style and architecture of the houses, most of which are now built of granite and other stone.

The old fortress of Akershus is situated on a slight eminence at the south side of the city, and overlooks the harbor. The regalia of Norway and the national records are preserved here, and it is also used as a convict prison. The ramparts have been converted into promenades, and the fort itself now assumes no military value.

The city possesses a University, a National Picture Gallery, an Observatory, and a number of charitable and other institutions amongst its public buildings.

A British Consul-General, Vice-Consul, and Pro-Consul reside in the town. The British Legation is situated in the western part of the city, near Skarpsno Railway Station; at present the nearest points at which parties can be landed from launches for the Legation are at Skilleback (where the ferry steamers start for Bygdø), or at Skarpsno pier. The latter is less cramped, and landing parties could reach the Legation either by the front entrance from the Drammens Veien, or by the stable entrance reached by turning up a side street (Tostrups Gade) from the Drammens Veien, whence a flight of wooden steps (on the right) leads to the stable entrance in Thomas Heftyes Gade. Tostrups Gade is steep and narrow, with wooden villas on the left and the Legation grounds on the right. In case of emergency, the wooden fence of the Legation grounds would be easily scaled, or removed, at the corner of Drammens Veien and Tostrups Gade, at the end of the high granite wall facing Drammens Veien, and the Legation reached by a steep path past the lawn tennis court.

Plans are occasionally mooted for cutting through the isthmus dividing the Frognerkilen and Bestumkilen bays near Sköien railway station and the railway carriage works, in order to permit a free circulation of water. There are many public parks and promenades.

The Royal Palace is situated at the west end of the town, in a beautiful park, called the Slotsparken; it is a long plain building with an Ionic portico. There is also a Royal château at Oscarshall on the east side of the peninsula of Bygdø.

There are a large number of good hotels, and in addition to the electric tramways there are also taxicabs and one-horse carriages in the streets for hire.

Halfway between the Eastern Railway station and the Eidsvolds-Plads is the Stor-Torv, the main square, in which is the post and telegraph office. The Parliament House is situated on the East Side of Eidsvolds-Plads.

The municipal gasworks are situated at the intersection of Hausmanns Gade and Storgaden; new gasworks are being built at the inner end of Bestumkilen, on the western bank of the river.

A corn silo of 10,000 tons has been built at the inner end of Utstikker III. quay, the discharging taking place on the east side of the latter. The conveyance of the corn to the silo is effected through an underground duct. To the north of the city is St. Hans Haugen (St. John's Hill), which is a public promenade, and on the summit of which is a reservoir of the city waterworks.

On the west side of the city there is a long narrow lake from which runs a stream called the Frogner Elv into Frognerkilen Bay; on the east side of this lake is the sports ground, where there is an oval cycle track and flat grass center 720 feet long. There is also an oval sports ground, 490 feet long, on the S.W. side of St. Hans Haugen.

The electric power station for the trams is situated at the west end of Valkyriegaden in the N.W. of the town, and the central tram station is at the south end of Sporvejsgaden, S.S.W. of St. Hans Haugen; the central fire station is situated S.W. of the Slots Park, at the intersection of Bygdø Allé and Drammensveien.

The population of Kristiania in 1913 numbered about 255,857 inhabitants.

COMMUNICATIONS.

By Sea.

The following is a brief statement taken from the press of some of the principal lines of steamers which called at Kristiania (exclusively of regular sailings between Norway and the adjacent countries):—The Forenede Company's New York line was started in 1881, and calls once or twice a week, and the Boston Line, started in 1901-02, calls every fortnight. The Philadelphia and Boston route, started in 1905-06, calls only once a fortnight. Finally the same company has a line, started in 1907, and calling once every three months, to La Plata. The Johnsen Line to Brazil and Argentina calls every three weeks. In 1913 the Östasiatiska Kompani began to call at Kristiania every three weeks for India, China and Japan. The Norway Mexico Gulf Line was started in 1907, and keeps up connection every three weeks with the United States, Cuba and Mexico. The Östasiatiska Kompani also started a line every six weeks to the Pacific coast. Messrs. Fred Olsen began a line in 1911 to Buenos Ayres, which in 1913 ran monthly. The Norwegian American Line began its sailings every three weeks in 1913 to Halifax and New York. In the same year Messrs. Thor Thoresen started a line to East Africa and Madagascar, which is intended to run every two months. The India Line, to run monthly, started in 1914, and Messrs. Lorentzen & Co.'s line to Brazil. To the foregoing may possibly be added sailings of a new South American Line in 1914 from West Norway. Up to 1907 the Forenede Line to the United States was, it is stated, the sole regular transatlantic steamer connection to Kristiania.

There is also a very considerable coastal service, which is of considerable importance owing to the absence of railway communications along a large portion of the coast.

By Railway. (See Map 1.)

Kristiania, being the metropolis, is the center from which all railways to various parts of Norway radiate. There are two stations, the Eastern Railway station (Hoved Banegaard), situated at the head of Björviken Harbor, from which communication with all lines starts, except communication with the Western Railway to Drammen, Telemarken, Housund, and Kröderen which starts from the Western Railway station (Vest-Banegaard), situated at the head of Piperviken. The two stations are connected by a line which runs along the main quays and round the fortress of Akershus. There are locomotive and carriage shops in the vicinity of both stations, and large warehouses. Starting from the south, railway communication is as follows, from Kristiania:—

- (a) Kristiania—Ski (15 miles)—Moss (37 miles)—Sarpsborg (65 miles)—Fredrikshald (85 miles)—Kornsjö (frontier station 105 miles)—Goteborg (221 miles), or Stockholm; with alternative route Ski—Mysen (25 miles)—Sarpsborg.
- (b) Kristiania—Lilleström (13 miles)—Sörumsand (23 miles)—Skulerud (58 miles).
- (c) Kristiania—Sörumsand (23 miles)—Kongsvinger (62 miles)—Magnor (frontier station 82 miles)—Stockholm (357 miles).
- (d) Kristiania—Kongsvinger (62 miles)—Elverum (120 miles)—Trondhjem (371 miles).
- (e) Kristiania—Hamar (78 miles)—Elverum (98 miles)—Trondhjem (348 miles).
- (f) Kristiania—Lilleström (13 miles)—Hamar (78 miles)—Dombaas (213 miles).
- (g) Kristiania—Roa (36 miles)—Fagernes (130 miles).
- (h) Kristiania—Roa (36 miles)—Hönefoss (56 miles)—Bergen (305 miles).
- (i) Kristiania—Housund (43 miles)—Hönefoss (77 miles).
- (k) Kristiania—Drammen (33 miles)—Housund (43 miles).
- (l) Kristiania—Drammen (33 miles)—Tönsberg (71 miles)—Larvik (98 miles)—Eidanger (119 miles); thence, to Porsgrund (121 miles) and Skien (126 miles), or to Brevik (125 miles).

The question of electrifying the Government railways has been under serious consideration, and as a commencement it has been decided to at once start on the work of electrifying

the Kristiania—Drammen Line. Detailed plans are nearly finished, and the field work is to commence at once. Current will be supplied by a power station to be at once erected at Hakavik, which will develop 17,200 H.P. The Kristiania-Drammen railway is a double line of narrow gauge, which is being gradually reconstructed to normal gauge (4 feet 8½ inches), and is to be completed by 1920. It is believed that the tunnels on the railway lines leading into Sweden have all been mined by the authorities.

By Road. (See Inset Plate 5.)

Kristiania is the center of a network of roads, the principal of which are as follows:—

1. Westwards to Drammen, *via* Sandviken. This road, as far as Sandviken, is level and fairly good and wide, but extremely dusty in dry weather. It skirts the fjord and railway at various points, the surrounding country being comparatively flat near the road, and dotted with pine woods and houses. Small streams pass under the road at various points, for instance at Sandviken, Lysaker, Bestum, and Sköien, the Lysaker stream forms a possible line of defense against a force marching on Kristiania from the west, though there is an alternative parallel road more to the north.
2. From Baerum Iron Works, north-west of Haslum and south-west of Bogstad Vand, whence the Lysaker stream issues, a road enters Kristiania at Majorstuen, the terminus of the city electric tram lines. This is also a good level road.
3. The above-mentioned main roads are connected by a fairly good and shaded cross road, running more or less N. and S. on the Kristiania side of the Lysaker stream.
4. Another cross road, narrow and poor, runs northward from near Sköien Railway Station.
5. A moderate, but narrow, road runs northward from Vestre Aker Church to the W. of Gaustad Asylum, and on to Sognsvand Lake, at the S. end of which it is connected by a stony lane with 6.
6. A fair road from Vestre Aker Church to the E. of Gaustad Asylum to Sognsvand Lake, after which the road becomes little better than a cart track.
7. The main road leading N. from Kristiania is an excellent one, about 5 miles in length, on the west bank of the Akers Elv to Maridalsvand, at the north end of which are the Skars Powder Mills.
- 8 and 9. Two fairly good roads lead N.E. to Grorud on either bank of the Loelv.
10. This road is the main approach from the south, and is an excellent road, skirting the east shore of the Bundefjord. It is called the Liabro Chaussée, and enters Kristiania at the suburb of Oslo.
11. This road converges with 10, and has a winding descent from Ekeberg hill; the road is good and wide, but steep near Oslo.
12. An indifferent road crosses the flat summit of Ekeberg hill, and descends at Oslo by steep and sharp turns. *N.B.*—Norwegian roads generally are well constructed for light traffic only, and become dusty and friable in dry weather with heavy traffic, and are hardly yet suitable for much heavy motor traffic.

By Telegraph and Telephone.

The positions of the general post and telegraph office, and of the central telephone exchange are marked on Plate 5. Kristiania is the center of the systems, and especially by telephone communication is almost universal to every village throughout the Kingdom. There is direct communication with Swedish towns and with Copenhagen. The principal telephone exchanges in the district round Kristiania are those at Bæckkelaget, Grorud, Sköien, Slemdal, Stabaek, and Sandviken.

By Electric Tram.

The tramway system of Kristiania is excellent. It is worked on the overhead system, and connects all the principal outskirts of the town with the Stor-Torv. In 1913, an underground electric railway was being built from the center of the city, near the National Theater to Majorstuen; the work was found to be of great difficulty, and it is not known how far progress has been made.

The terminus of the city tram service to the N.W. is Majorstuen, whence an electric tramway runs N.N.W. to Holmenkollen; in 1913 work had been commenced on the extension of this tramway to the top of Tryvandshöien.

To the N.W. an electric tramway runs from Majorstuen to Smestad, where the road to Holmenkollen branches northwards from the road to Bogstad.

A tramway has also been projected from the suburb of Oslo southwards over Ekeberg Hill to Nordstrand, to the east of and almost parallel with the railway to Moss. The electricity for the tramways is derived from the Municipal (Coal) Electric Works, but it is believed that the supply will soon be obtained by water power by the municipality. The Holmenkollen Tramway Company, like most other industrial establishments outside the town boundary, derive their power from the Kykkelsrud Falls on the River Glommen by means of overhead cables. A concession was granted in 1913 to construct and work a private electric tram line from Kristiania to Ljan on the outskirts of the capital.

By W/T.

There is a W/T station at Ovresaeter, about 4 miles north of the city. The station was opened for work in 1916. The station is reported to be situated in a very lonely spot, and is unguarded. The station is on the Marconi principle, but it is also fitted into a short range Telefunken installation.

NAVAL DETAILS.

The headquarters of the First Naval District and the naval station is at Horten and Karljohansvaern, for description of which *see* page 30.

There is no actual building called the Admiralty, but the Admiralty offices are situated in the building assigned to the Ministry of Defense, which is to the E. of Akershus Fortress, and just south of the Norges bank.

The King is Commander-in-Chief of the Army and Navy.

The Defense Department, which was established by Act of Storting of 1899, comprehends the War and Navy Departments (Armee-og-Marinestyrelsen). At its head is a Minister of State (Statsråd).

At the head of the Navy Department is a Vice-Admiral (styled "Commanding Admiral"), who has general direction of all the business of the department, but has under his special supervision the training of the fleet, manœuvres, discipline, and the appointment of officers in command. To assist him he has a personal staff of one kommandörkaptein and one kaptein.

The general business connected with naval administration is performed by the first and second sections (1ste og 2den Afdelingen) of the Navy Department, each under a Kommandör.

The General Staff (Admiralstaben), under a Rear-Admiral, consists of one kommandörkaptein, one kaptein, and two lieutenants.

The Commissariat, Ordnance, Torpedo, Works, and Hydrographic Department of the Navy have their head offices, stores, workshops, &c., in the Royal Dockyard at Horten (*see* page 31).

MILITARY DETAILS.

It has been extremely difficult recently to obtain information with respect to the defenses of Kristiania, but it is understood that very little improvement has taken place during the past two years. An officer of the Coast Artillery, stationed at Dröbak stated in 1916 that for all practical purposes there has been no change in the defenses for the past two years.

Between 1892 and 1895, 55,000*l.* was expended on improving the defenses of Dröbak, one of the chief additions being the howitzer battery on Haað.

In 1897 the Army Department had in hand the sum of 73,500*l.* from the sale of the Akershus site at Kristiania, and of this 24,000*l.* went to purchase the Sejerstein and Husvik properties, &c., 22,000*l.* for guns and ammunition (probably for Kopaas battery, and 27,500*l.* for ammunition for guns already mounted, magazines, lighting installation at Husvik, submarine defense material, and the laying-up harbor at Husvik). In addition 2,500*l.* was voted for completing an unnamed battery (probably Kopaas battery), and other smaller sums were required for a Q.F. gun magazine, and purchasing night sights, &c.

Probably all the defenses, with the exception of Kopaas battery and a portion of the land defense works, had been completed by 1897, since when no large sums have been voted except for maintenance.

In the spring of 1914 the Storting voted a sum of 177,778*l.* for defensive works in Kristiania Fjord; this sum included a vote made in 1912 for fortifications in the Horten district, a sum which at the time was not expended. A press report in 1915 states that a grant of 541,666*l.* was made towards the defense of this area; this sum probably included the 1914 vote, but at the same time appears to show the desire of the Norwegians to improve their defenses. Nothing is, however, known of any changes.

There are no defenses in the immediate vicinity of Kristiania. The coast defenses lie some miles down the fjord at Dröbak (*see* page 13), Tönsberg Fjord (*see* page 36), and Avelvik (*see* page 29), and are described under those headings. Submarine defenses are also combined with the coast defenses.

LAND DEFENSES.

(*See* Plate 6.)

The land defenses on the E. shore of Kristiania Fjord were intended, according to their original plan, first to prevent inroads from Sweden, and secondly to prevent landings on the coast between Soon and Fredrikshald. Two separate lines of works called the *Interior* and *Exterior Lines*, were accordingly commenced in 1900.

Exterior Line.

This *Line* which stretches from Fredriksten (Fredrikshald) through Örje and Urskog to Kongsvinger, was originally intended to consist of permanent works mounting guns of medium calibre at the four places named. They had, however, not progressed very far when

the dissolution of the Union took place, and by the treaty of Karlstad, 1905, all except Kongsvinger, which still mounts two 12-cm. guns were dismantled; 115,000*l.* was the amount originally voted in 1902 for the entire *Line*.

Interior Line.

This *Line* merely consists of prepared positions for field guns, which are only mounted in war time. It stretches from Soon to Fetsund, passing through Moss, Sarpsborg, and Langeles (near Spydeberg). The approximate positions of the works are shown on Plate 6.

83,333*l.* was put aside in 1910 for fortification in the Fossum section (the portion of the River Glommen which lies between the S. end of lake Öieren and Grönsund). In the spring of 1911 the Storting agreed to 56,000*l.* of this amount being used for the above purpose, but no details regarding the expenditure were published. The Storting have now agreed to the balance being devoted to the same object. The big guns, formerly mounted in the border defenses, now razed to the ground, are believed to be mounted in the new defenses.

The works on the west side of the fjord are considered as a continuation of the *Interior Line* above described. Their positions are not accurately known, but some are believed to be situated in the Tönsberg district, and others near Horten, Svelvik, and Drammen. The entire cost was only 4,500*l.*, besides 900*l.* for works on Mokollen (near Sandefjord) and Braarudaasen.

These places can not be identified.

FLYING GROUND.

The only known flying ground in Norway is situated at Lilleström, 13 miles E.N.E. of Kristiania, on the left bank of the Nittedals Elv, where that stream enters Lake Öieren. Lilleström is on the Kristiania—Hamar Railway. In 1917 there were 14 Farman aeroplanes at Lilleström, and the school consisted of 10 pilots and 21 pupils. There is a small factory, able to turn out one machine a month. The position of the station is about 1½ miles south of the railway station, and the aerodrome which is excellent is surrounded by hills.

BARRACKS.

To the east of Akershus Forterss, which is now used only as a saluting battery, is a large drill ground, on the east side of which are extensive barracks.

There are also some barracks close to the electric power station at the west end of Valkyrie gaden, and on the N.W. side of the town.

At Gardermoen, near the station of Hauersæter (31 miles) on the Kristiania—Hamar Railway, is the large training center for the military; there are several barracks situated here.

MILITARY ESTABLISHMENTS.

There is a war college in Kristiania for the training of young officers, and also a cavalry training school for the training of N.C.O.'s.

4,000*l.* was voted in 1916 for erection of barracks on the drill ground at Hvals, near Frogner (18 miles) on the Kristiania—Hamar Railway.

THE COAST FROM KRISTIANIA TO SANDEFJORD.

(See Chart 2 and Admiralty Charts 1974 and 3159.)

COAST FROM KRISTIANIA TO DRAMMEN.

From Kristiania westward, the first notable feature is the Bygdö peninsula, much used as a suburban residential quarter, and well supplied with roads. The Lysaker Fjord which bounds the peninsula on the west is clear and deep, and in it are several anchorages. At the N.W. corner the Lysaker Elv empties itself into the bay, and the Drammen-Kristiania railway crosses the river by a bridge ¼ mile from the mouth. The coast continues in a southerly direction, and is at first much obstructed by a group of large islands and outlying shoal patches, which form the western boundary of the main passage to Kristiania, and between which are the approach channels to the small towns of Sandviken, a description of which is given in the Pilot. For 7 miles the coast runs almost due south to the Vest Fjord on the western side of Haaö, when it turns S.E., and again south, forming the east side of Hurum Landet peninsula, and the western boundary of the Dröbak narrows. The Hurum peninsula is hilly, but it is crossed by several roads, one of which runs from Slottet, opposite Dröbak, to Hurum and the point opposite to Svelvik, whence a ferry communicates with it. Telephonic communication too is fairly general. The western boundary of the Hurum peninsula is Drams Fjord, which runs in a northerly direction for 16 miles inland, and is divided into two parts of very different

character by the narrow strait opposite Svelvik (*see* Pilot). There is a channel dredged through Svelvik-ström with a depth of 26 feet, but the passage is dangerous in consequence of the strong currents running through the strait. Work on deepening the Svelvik channel to admit vessels drawing 26 feet was commenced during 1911, and was completed in 1915.

Drammen.

The town of Drammen, together with its suburbs of Bragernes, Strömsö, and Tanger, had a population of 25,377 in 1912, and is one of the chief timber ports in Norway, though in recent years this industry has begun to deteriorate, owing to a demand for white wood by the pulp factories. The town is situated on both banks of the Drams Elv, and is picturesquely situated amongst high hills. A wooden bridge leads from the railway station on the south bank across the river to Bragernes Torv, and the main part of the town. In the mouth of the river is the island of Holmen, over which passes the railway to the station on the south bank. The river is not navigable above its mouth, and only vessels of moderate draught can approach the harbor.

The Commercial Port.

There is extensive quayage at Drammen, all of which is convenient and lit by electric light. It consists of the Bragernes Quay, which is 1,451 feet in length, with an average depth alongside of 12 feet; the Upper Railway Quay, 1,026 feet long, with 15 feet alongside; the Lower Railway Quay, 2,000 feet in length, with from 20 to 22 feet alongside. Of these, the approach to the first two is made somewhat dangerous by vessels having to pass a bridge with a width of opening of 31 feet. There are also the Toldbod Quay, 380 feet long with a depth alongside of 16 feet, and the Gyldenløves Plads Quay, 530 feet in length, with 14 to 16 feet alongside. All the depths at quayside given above are at ordinary water level.

There are two small cranes on one of the quays.

The harbor authorities in 1909 invited tenders for the supply of two additional cranes of a lifting capacity of 1.5 tons and 2.5 to 5 tons respectively, and of coaling apparatus capable of taking in 50 tons per hour.

The only firm of shipbuilders of any importance is that known as the "Drammens Jernstøberi og Mekaniske Verksted," which firm builds small vessels and also constructs engines and boilers. There is at the works, which are situated at Tyveholm, an island in the mouth of the river, a large boiler crane of a capacity up to 25 tons.

Repairs to machinery and boilers can be quickly carried out at the above-mentioned shipbuilding yard.

There is a patent slip, operated by steam, belonging to the "Drammens Jernstøberi og Mekaniske Verksted." It is 300 feet long, 75 feet in width, and will take a vessel of 130 tons dead weight.

Coal imports have gradually increased, and in 1913 the figure was that of 221,431 tons. From 2,000 to 3,000 tons are usually kept in stock, and coaling is performed either from lighters or alongside.

There is an ample water supply, which is obtained from Klopkaern, a lake in the hills $\frac{1}{2}$ mile north of the town, from which it is brought down through a small supply reservoir.

Navigation is kept open in the winter by icebreakers.

The principal exports from Drammen are timber, which is almost $\frac{1}{3}$ of that of the whole country. It also exports zinc and nickel from Skouger and Ringerike, and wood-pulp (both chemical and mechanical) from the factories on the Drams Elv and the Baegna. The commercial fleet of Drammen is one of the largest in Norway, and according to Norwegian statistics of 1912 totalled a tonnage of 50,000 for steamers and 40,000 for sailing vessels. A British Vice-Consul is resident.

Communications.

Steamers run daily to Kristiania and other neighboring ports, and there is occasional communication with Hamburg, Rotterdam, and other European ports.

Drammen is an important railway center. (*See* Map 1.) It is a junction for the Hongsund-Kongsberg railway, which is at present being completed to normal gauge and extended to Kragerö (74 miles) and Skien (47 miles); also for the Hongsund-Hønefos railway and the Krøderen lines. The railway to Kristiania (33 miles) has a branch running from Lier ($3\frac{1}{2}$ miles) to Svangstrand (13 miles) on the Holsfjord, whence there is steamer communication to Sundvolden.

There is considerable means of communication by road. A road crosses the river by bridge at Drammen, and another crossing is at Hongsund, 11 miles higher up the river. The main road to Kristiania runs inland to Asker, when it follows the coast through Sandviken to the capital. There are two roads south to Holmestrand, one of which follows the west coast of the Drammens Fjord, and passes through Svelik.

Drammen is a main center of the telegraph and telephone systems from Kristiania along the west side of the Kristiania Fjord, and for the main trunk lines running to Skien and along the south coast of Norway, with a branch to Kongsberg and the interior of the country. There is general telephonic communication with the neighboring towns and villages, amongst them with Svelvik.

Svelvik.

Work on deepening the Svelvik channel so as to admit vessels drawing 26 feet was commenced during the year 1911 and was completed in 1915.

The naval and military authorities offered no objection to this work being undertaken, but stated that, from a military point of view, the improvement would necessitate the strengthening of the defenses here and a greater number of mines more powerful than the present ones would have to be provided, the existing defenses having been arranged on the supposition that an attack in force by water could not be carried out by an enemy on account of the impossibility of taking large vessels past Svelvik.

The town of Svelvik is a loading port of about 1,200 inhabitants; it is situated on the western shore of Svelvik Ström, and is of no great importance. There is a harbor which is well sheltered, and the main quay at the paper mills is 450 feet long, with a depth of 14 feet alongside. There is also a small wharf at which vessels can be keel-hauled, with 12-13 feet alongside.

Communications.

There is no railway communication, but a road follows the Drammens Fjord northward to Drammen, and southward along the coast to Holmestrand; a ferry across the Svelvik Ström connects with a road crossing the Hurum peninsula to Slottet, opposite Dröbak. There is communication by telephone with Drammen, across the fjord to the Hurum peninsula, whence one route is to Kristiania, and another follows round the south end of the peninsula. Southwards there is communication by both telegraph and telephone with Holmestrand.

COAST DEFENSES AT SVELVIK. (See Chart 2.)

The Svelvik defenses were commenced in 1897; 6,200*l.* was sufficient for constructing them, as the 15-cm.s were old naval guns.

It has been stated on good authority that two light Q. F. batteries have been constructed near Svelvik. A careful search in 1907, however, failed to discover any trace of them. They are therefore conjectured to be temporary batteries and only armed in war time.

No magazine has yet been provided. The 1900 Estimates stated that two rooms were used for storing ammunition. Later on, the new barracks were especially designed to contain an ammunition store.

There are two barrack buildings, one of which has been erected since 1900. The position of the latter is near the 15-cm. battery. The two together can accommodate the whole detachment.

500*l.* was voted in 1902 for completing the telegraph and telephone systems.

Two orographs have lately been provided.

The garrison consists of the 4th Company of Coast Artillery, besides mining and signalling ratings detached from Oscarsborg.

Ryggen Battery. (No. XV on Chart 2.)

Its situation is about the center of Svelvik promontory, on the crest of the ridge, between 100 feet and 200 feet above the water. It consists of an earth parapet, with neither embrasures nor traverses. The emplacements are faced with masonry. In rear it is quite open, the breeches of the guns being plainly visibly from N. Between the E. and center guns is a small masonry structure, evidently the battery commander's position.

The guns are those dismantled from the "Ellida" gunboat, previous to 1900. There were originally five, but only three appear to have been brought to Svelvik. The ammunition in the ship at the time being insufficient, 1,100*l.* was spent in purchasing more.

There are a few small buildings in the rear of the work among the trees.

The following were seen in 1907:—

3—15-cm. (5.9-inch) L/25 B.L. Krupp guns, without shields.

Minefield.

Norwegian accounts state that the minefield is laid in the "Ström," at the narrowest part of the channel.

A small earthwork, surrounded by wire fencing, was noticed in 1907 at the W. extremity of the promontory: and in the center of it, an iron hood with a narrow slit, set on a masonry foundation. The trees are cleared away on the channel side. This is evidently the firing station for the minefield.

A minefield was officially stated to be laid here during the war.

Mining Establishment.

1,200*l.* was voted in 1900 for the mining establishment and purchase of the site. Its position has not been ascertained.

COAST FROM DRAMMENS FJORD TO HORTEN.

(Admiralty Charts 1974 and 2330.)

To the westward of the entrance to Drammens Fjord is Sandesogns Fjord which runs inland about 5 miles in a N. W. direction. There is no port of any importance in this bay, but the railway from Drammen to the south strikes the coast at its head, and follows it close to the water's edge as far south as Mulevik.

Holmestrand. (Admiralty Chart 3159.)

Holmestrand is a small town with about 2,300 inhabitants, and is situated just north of Horten at the foot of a steep cliff.

There are two harbors, of which the outer is available for ships of any draught. The depth of water in the inner harbor is 20 feet, and there is no rise and fall of tide. The railway quay is 120 feet long, and there is a steamer quay 216 feet in length; other quays have a total length of 700 feet, and the depth of water alongside is from 19 to 21 feet. The Custom House Quay (Toldbodbyggen) is being reconstructed with stone, and when finished it will be about 120 feet long, with up to 24 feet alongside. There is a brisk trade in timber.

Communications.

Holmestrand has communication by rail (*see* Map 1) with Kristiania (53 miles), *viâ* Drammen (20 miles), and southwards with Skien (73 miles), *viâ* Larvik (45 miles); there is also a railway to Eidsfoss (17 miles) at the south end of Lake Ekern, where there are railway carriage works, and to Vittingfoss (19 miles); the junction for these two lines is at Hoff (12 miles). There is road communication to Drammen along the coast, and southwards to Horten, about 6 miles; also a good road leads westward, *viâ* Hillestad to the Lagan Valley and Kongsberg. The town is situated on the main coastal telegraph and telephone route.

HORTEN AND KARLJOHANSVAERN.

(*See* Chart 2 and Admiralty Chart 3159.)

Horten, situated on the W. shore of Kristiania Fjord, about 30 miles from the open sea, is a town of 10,000 inhabitants. It is of no commercial importance, and is only mentioned on account of its proximity to Karljohansvaern, where the chief naval station of Norway is situated.

Karljohansvaern, with its spacious harbor, which is enclosed by Horten Spit on the E. side and by the islands of Lövä, Mellemö, Östö, and Vealös on the N. side, is situated just N. of Horten. The naval establishment lies on the inner side of the Spit. The entrance to the harbor, which lies between the third and last of the above-named islands, does not admit the largest vessels. Inside, however, there is ample accommodation for all vessels. There is also an entrance for small craft between Möringen and Vealös; while very narrow, intricate, and shallow passages are to be found between the other above-mentioned islands.

A Special Committee reported in 1905 that 22,000*l.* would be required for dredging the harbor to the required depth, but no portion of this sum has yet been voted.

For several years past about 600*l.* has been the annual sum expended on dredging. It is believed that Vealösgabet has been deepened to 7½ or 8 metres, so that the largest Norwegian war vessel may enter.

A canal has been cut at the root end of Horten Spit from the fjord to the harbor, for the purpose of causing a change of water in the latter. It is understood that torpedo boats *cannot* make use of this canal.

The total length of quayage at Karljohansvaern is 1,460 feet; the depth alongside varies from 10 feet to 21 feet.

NAVAL DETAILS.

Karljohansvaern is the headquarters of the principal (1st) Naval District, and, besides being the chief Naval Station of Norway, is the only one where repairs to ships can be effected in a Government yard. The Stationschef, or officer commanding the station, is a Kommandör (post-captain), and has on his staff two other naval officers. In addition to his district duties he has the command of all the naval establishments, including the fortifications of Horten, and, in part, the dockyard. The laying-up harbor at Melsomvik and the 1st Signalling Company, likewise come under his orders.

The naval establishments include the Dockyard, the Naval Barracks, residences for officers and officials, the War College for officers, schools for petty officers, the Naval Hospital, and the Observatory.

In its present unprotected state Karlsjohansvaern is practically valueless in war time. The advisability of providing new defenses, or removing the station to another location, is now under consideration. Until a decision is come to, little money is likely to be spent either in extending the old or in constructing new buildings, &c., at Horten.

The Special Committee which assembled in 1906 to consider the question has recently reported in favor of one of the two following plans, the choice being left to the Government:

- (1) To re-fortify Karljohansvaern at a cost of 540,000*l.*;
- (2) To abolish Karljohansvaern, and to establish a new naval station at Tromsund, north of Arendal, at a cost of 440,000*l.*, and to erect defenses there at a cost of 410,000*l.*

The Defense Law, passed in the Storting in 1912, provided for an expenditure of 38,889*l.* on the naval station in Kristiania Fjord, which presumably referred to Horten, but as already stated there has been considerable discussion as to the advisability of retaining this station for the use of the fleet. According to the opinion of experts, in 1914 the Naval Yard itself was considered to be well suited as the headquarters of the fleet, and as principal building and repairing base; it was as well equipped as could be expected in view of the money allotted for its upkeep, but it lacked suitable defenses. In the same year the sum of 122,222*l.* was allotted to a naval station in the Tönsberg district, so it may be assumed that in time to come the main base will be allocated elsewhere than at Horten; meanwhile money is to be spent to keep the Karljohansvaern yard in a suitable state for present requirements, and in April 1916, a proposal was laid before the Storting for a secret grant of 33,472*l.* for various extensions and modernising operations connected with the Karljohansvaern Naval Station, which points to the desire for at least a temporary retention of the site.

THE ROYAL DOCKYARD.

The dockyard is under the superintendence of the Vaerfts-director, formerly an officer in the navy, who holds the relative rank of kommandör. In regard to the working and financial management of the yard, he is directly under the Navy Department; in military matters he is subordinate to the Stationschef.

The four departments of the dockyard are:—

1. Engineering (Det Mekaniske Vaerksted).
2. Constructor's (Skibshyggeriet).
3. Bookkeeping (Bogholderiet).
4. Rigger's (Ekkvipagen og Takkelveesenet).

The following departments of the Navy Department have their head offices, stores, and workshops, &c., in the dockyard:—

1. *Commissariat* (Hovedintendatur).
2. *Ordnance* (Artilleri). The director is a kaptein. The Laboratory and Ordnance workshop are under a kaptein. The Chief of Ordnance (Kanon Kontrollor) is a kaptein.
3. *Torpedo* (Minevaesen). Director—a kommandörkaptein; assistants—two kapteins and one engineer.

Since the mine defenses were transferred to the Coast Artillery, this department has charge of the locomotive torpedoes only, including the batteries at Oscarsborg and Bergen, and mines carried on board ship. It also has charge of all electrical instalments, both afloat and ashore.

4. *Works* (Bygningsvaesen).
5. *Hydrographic* (Navigationsvaesen). In charge—a kommandörkaptein; assistants—a kaptein and 1st lieutenant.

The dockyard, the development of which has for some years remained stationary, is only capable of building, engining, and boilering torpedo boats, and executing repairs to larger vessels. The extent of the site, on the other hand, would permit of greatly increased activity. With the exception of building large ships, all work required by the navy is executed here, and the plant is presumably capable of meeting normal demands for alterations and repairs.

The destroyer "Garn" was built at this yard in 1913, and in the 1914–15 Estimates money was voted towards the fitting out of the Horten Dockyard for the construction of submarines, though so far as is known no steps have yet been made to lay any down.

The number of workmen employed in 1911 was 600.

Improvements.

In September 1914 work had commenced on a quay for submarines and torpedo boats, also an accumulator house and an experimental laboratory. 16,667*l.* was voted in the 1913–14 Estimates for new machines, and other improvements to the torpedo workshop, and new machines and tools for the dockyard shops were also to be supplied.

Lifting Appliances.

Three pairs of sheers, the largest being up to 30 tons, are mounted on the quays. A floating crane of 200 tons lifting capacity was provided in 1910, and on the same hull there is a smaller crane with a capacity of 25 tons.

Docks.

The Government Dock is 305 feet long on bottom, 60 feet 4 inches wide at entrance H. W. O. S., and 20 feet 4 inches deep over sill, H. W. O. S. The longest Norwegian warship can be accommodated. Money was voted in the 1914-15 Estimates for altering the dock to afford more room for workmen, and consisted principally of an extension of the floor of the dock; it is believed that this has now been completed. The dock can be used by mercantile vessels under exceptional circumstances only.

Building Slips.

There are four building slips for torpedo boats or destroyers.

It was reported in 1911 that a new slip was to be constructed for which a sum of 2,805*l.* had been appropriated.

Water Supply.

The water supply is from a reservoir on the hill to the west of and immediately opposite to the dockyard.

Coal.

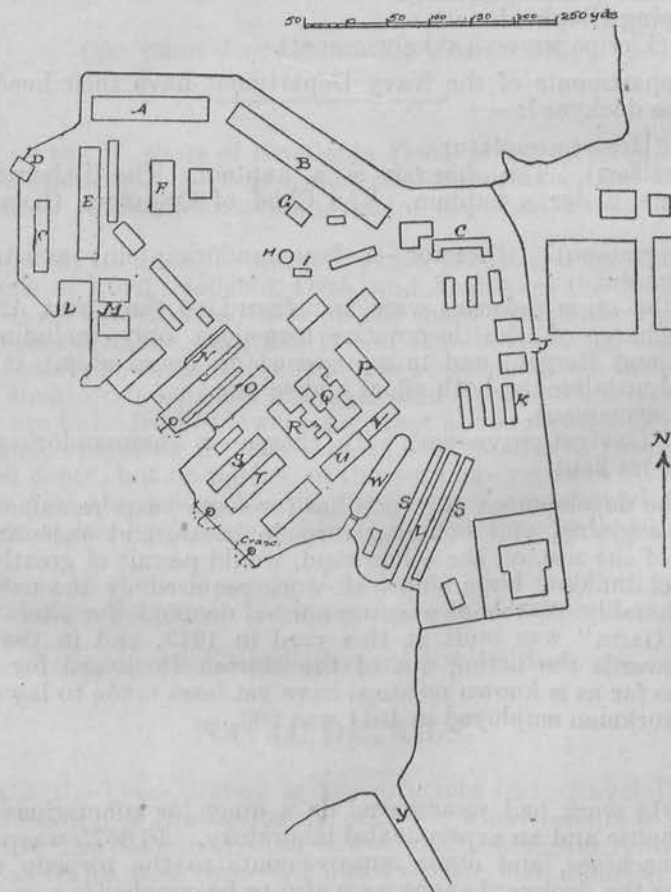
It is understood that a considerable quantity of coal, the property of the Government, is kept at Horten. Vessels of 21 feet draught can coal alongside the wharf. Coal is stored on board two hulks in the harbor, which are fitted with steam winches; also in sheds at the coaling point on the N. W. side of the yard, and at the N. E. end of the dockyard.

Various Shops, &c.

The situation of the various shops, &c., is shown on the plan below.

Royal Dockyard at Karljohansvaern.

Approximate Scale.



Reference.

A.—Boat shed.
B.—Torpedo boat store.
C.—Coal.
D.—Torpedo testing station.
E.—Wood store.
F.—Torpedo store.
G.—Submarine safety tank.
H.—Signal station.

I.—Charts.
J.—Dockyard entrance.
K.—Joiners' shop.
L.—Camber.
M.—Boats.
N.—Building slip.
O.—Repairing slip.
P.—Offices.

Q.—Machine shop.
R.—Boiler shop.
S.—Stores.
T.—Rigging loft.
U.—Power station.
V.—Coppersmith's shop.
W.—Dock.
Y.—Canal.

Machinery and Tools.

The machine and erecting shops were recently supplied with modern electrically-driven machines. The erecting shop has two cranes of 12 and 6 tons capacity respectively. In addition to repairs the boilers and machinery for torpedo boats built in the yard are made here.

Power Station.

The power station contains two machines, but a third was to be installed which will admit of the yard being electrically lit.

This has probably now been completed.

Whitehead Torpedo Store.

The Whitehead torpedo store (210 feet by 45 feet by 20 feet) which is situated in the northern part of the dockyard, just south of Old Battery A., consists of a workshop, offices, and storeroom. The air compressor is in a small building close by. When visited in 1910 the building had been extended 40 feet; upwards of 180 torpedoes, mostly 45-cm., were seen, belonging chiefly to the torpedo boats stationed here. The total value of the stores is about 10,000*l.* (Estimates, 1904). There are rail tracks to the torpedo sheds and quay.

A new building was seen in 1910 at the north end of the yard immediately in rear of the torpedo store.

Torpedo Boat Sheds and Store.

Of the two torpedo boat sheds, one can accommodate 22, and the other 4, boats. All can be launched simultaneously. With the exception of coal, which is kept stored in bags, and provisions, the stores that are not actually in the boats are kept in lofts overhead. Provisions are kept ready for each boat in another storehouse. Boats that cannot be accommodated in the torpedo sheds, are hauled up during the winter in other parts of the yard, or remain in the water. In 1905, 1,400*l.* was spent in repairs to the slips, of which one was extended in 1909 to take two more boats.

Torpedo Testing Station.

A new testing station was erected in 1907 on the quay adjoining the store; torpedoes are fired into the harbor.

Mine Store.

As far as is known, there is no proper mine dépôt in the dockyard. Only a small reserved stock is kept on the upper floor of one of the large storehouses.

Magazines.

There are four modern magazines on Mellemø and an explosive store on Östø.

Gun and Small Arms Store.

In the gun store are kept the light guns taken out of the ships during winter. The small arms store exists for the same purpose. Only small repairs to guns and mountings can be executed.

Tank.

A tank was erected in 1910 for exercising the crews of submarines in escaping from the conning tower in case of accident. It is situated in rear of the long torpedo boat store.

Drill Battery.

The hulk "Kong Sverre" is berthed alongside the yard; in addition to providing accommodation for conscripts the hulk is fitted up as a drill battery. There are 75, 65, and 57 mm. guns as well as smaller guns and loaders. The gymnasium, situated outside the yard, is also fitted up as a drill battery, and contains three guns fitted with swinging targets, and a fourth gun fitted with an aiming tube.

COMMUNICATIONS.

By Railway.

Horten is situated at the terminus of a branch line, which joins the coast railway from Kristiania to Skien, at Skoppum (4½ miles). The railway station is at the south end of the town, and the railway follows the coast for 2 miles before branching inland.

By Road.

Two main roads leave Horten, one northwards along the coast to Nykirke, the other south along the coast through Borre to Tønsberg.

By Telegraph and Telephone.

The coastal telephone lines pass through Horten, and there is also telegraphic communication with Tønsberg and Holmestrand.

By W/T.

There is an instructional W/T station in the dockyard.

MILITARY DETAILS.

COAST DEFENSES.

The coast defenses of Karljohansvaern are antiquated and totally inadequate. A committee was appointed to draw up a scheme of defense in 1908, but the result of their report is unknown, though it is believed that nothing has yet been done to improve the present armaments, which are only M.L. guns.

The existing batteries are only armed with old M.L. guns.

The batteries are briefly as follows:—

A on Chart 2.—Small earthwork at N.W. corner of Dockyard; armament, 7 small M.L. guns.

B on Chart 2.—A similar work inside the Dockyard.

C on Chart 2.—A 2-gun (9-inch M.L.R.) battery at N. end of Horten Spit (Möringen).

D on Chart 2.—A battery of 3 M.L. guns midway between Möringen and the canal.

E on Chart 2.—An earth battery of two 9-inch M.L. guns on the Spit near the mouth of the canal.

F on Chart 2.—Fort "Norwegian Lion" (Norskelöve) on Vealös Island, small M.L. guns.

There were no signs of works A and B at the time of a visit in April 1912, and it may be assumed that the works enumerated under this heading no longer exist, with the exception, perhaps, of a few guns retained for saluting purposes.

The question of including a vote in the estimates for fortifications at the naval station at Horten was under consideration in 1912; it was decided, however, that this matter should remain in abeyance for the present, as it was considered to be of greater importance for the moment to provide the material and personnel required by the fleet for upholding Norway's neutrality and for defending the west coast.

A committee appointed to consider the question of the defenses of this locality issued its report in May 1913, in which an expenditure of about 555,000*l.* on defensive works was recommended, to be allotted as follows:—355,000*l.* on works at Bastö, 37,000*l.* on Horten, and the remainder on Tönsberg.

There are altogether 21 S.B., M.L. guns used for saluting purposes.

In 1916 it was reported that there were no defenses on Bastö Island.

LAND DEFENSES.

Land defense works have recently been constructed on the high ground west of Horten. A visitor in 1907 was informed that the armament included several large modern B.L. guns. The position is said to be of considerable extent, near Apenaes. One battery can be distinguished from Horten, surrounded by wire entanglement, but no guns are visible. There is no knowledge of any other work.

No vote for these defenses has appeared in the estimates. It is conjectured that the guns are those originally intended for the new-dismantled works on the east shore of the fjord, and, if this is the case, no fresh vote would be required.

Quite distinct from the above are the works in connection with the land defenses on the west shore of Kristiania fjord, situated (it is stated) in Falkenstein Forest, a few miles from Horten. They were constructed about 1900 to 1902, and are probably merely prepared positions for light mobile guns, which are only mounted in war time.

SEAPLANE STATION.

There is a seaplane station situated on the north side of Horten Spit, east of the Dockyard. In May 1917, there were six seaplanes, but 20 more were proposed during the year. The housing sheds face the sea, and launching rails are laid down. There is a small factory attached to the station.

COAST OF TÖNSBERG FJORD.

The coast to the south of Horten is peculiarly free from natural obstruction as far south as the small town of Vallö, which stands on a promontory 6 miles further south. Vallö is only 3½ miles from Tönsberg, with which town it communicates by road, and it is of importance for the petroleum refineries which form the principal industry. To the south of Vallö there is a mass of islands as far south as the entrance to the Tönsberg fiord, of which Notterö and Tiömö are the largest. From Traelen, the bay west of Vallö, a canal has been dredged for vessels of 21 feet draught into the south-eastern basin of Tönsberg harbor, thus separating Notterö from the mainland. Vraengen, the sound between Tiömö and Notterö, connects the Sandö sund, which lies amongst the islands, with Tönsberg fjord, and has anchorage at several places, but it is very narrow and crooked, and there is a strong current. A ferry communicates between

the islands near the western entrance, and a telegraph cable crosses the strait from close to Tuten lighthouse in Nötterö to Tiömö. There is telephonic communication between these islands and the mainland, and there is a commercial W/T station, situated in the southern part of Tiömö, on Thoraas hill.

TÖNSBERG.

(See Chart 2 and Admiralty Charts 3158, 3159.)

The port of Tönsberg is situated at the inner end of Tönsberg Fjord, which extends about 14 miles inland, and is separated from the Kristiana Fjord by the islands of Tiömö and Nötterö. The southern part of the fjord is about 2 miles wide, studded with numerous islands, rocks and shoals, which render its navigation difficult, especially for large ships. Approaches to the Tönsberg Fjord may be made either through Töndegabet, the channel westward of Olsskier, or through Tiömö Kilm; the latter is the most usual route, the former being too narrow and dangerous for the easy access of large ships.

The northern lights of the basin which forms Tönsberg harbour are very shallow, and on the south side shoals extend 2 cables north and north-east from Danholm.

The south-eastern basin of the harbour is also shallow, but a channel, known as the Steens canal, has been dredged to 21 feet through which vessels may approach Tönsberg direct from the Kristiana Fjord, between Nötterö and the mainland.

Small vessels of not more than 7 feet draught may pass through the Oslebak channel, on the east side of the Island of Veierland in the fjord, but this passage is very narrow and intricate. There are a considerable number of anchorages in the fjord, all of which are described in the Pilot. On the east side of the main islands, Sandö sund is a channel through the "Skärgård" for vessels drawing not more than 16 feet of water, and Rysse sund may also be used by vessels of moderate draught; there are also several approaches to these channels through the outer rocks, all of which are described in the Pilot.

THE COMMERCIAL PORT.

The port is available for ships of large size, though only those of moderate draught can approach the quays. Of late years it has been chiefly known as the headquarters of the Norwegian whaling and sealing fleet, which consists of about 50 vessels, one third being steamers.

Quayage.

The total length of quayage is about 2,000 feet with a depth alongside of from 16 feet to 20 feet.

Shipbuilding Capabilities.

The "Kaldnaes Patent Slip" Company owns a shipbuilding yard at Tönsberg. An auxiliary fuel oil steamer for the Norwegian Government has recently been launched by this firm, which had total orders in 1916 for five vessels, the largest of which was to be of 550 tons dead weight. In 1916, it was reported that the "Kaldnaes" Company had increased its capital for the purpose of building a large new dock, which is said to have some connection with the new fortification of the Kristiania Fjord.

A large new shipyard was reported in 1916 to have been established at Tönsberg in Jarlsö (? Gaasö) Island, where for many years there have existed smaller yards for sailing ships. It is stated that the new yard will be able to build steamers of upwards of 6,000 tons and that the company will commence with a capital of one million kroner. An arrangement has been made with the "Fredrikstad Mekaniske Verksted" to supply all the engines and boilers required by the new yard.

Repairing Facilities.

Small repairs to hull or machinery can be carried out by the firms of "Kaldnaes," and "Foyens Vaerft" on Husö; there is also a small repairing yard at Vallö for quite small vessels.

Patent Slips.

The "Kaldnaes Mekaniske Verksted" owns a patent slip which can take vessels up to 200 feet in length. In connection with this slip there is a side slip which can take three ships, each of a length not greater than 100 feet. The "Foyens Vaerft" Company owns a small slip for the use of whaling vessels and such craft, not more than 90 feet long.

Coal and Coaling Facilities.

In 1913, coal imports to the amount of 20,500 tons were brought to Tönsberg. About 1,000 tons is usually kept in stock. Vessels usually coal alongside the coaling wharf where there is a depth of water of 16 feet.

Trade and Shipping.

The principal exports are pit props, oil, and guano, and imports consist chiefly of coal, barley, hemp, and salt. In 1911, 276 vessels with an aggregate tonnage of 76,074 tons, entered the port in the foreign trade. According to the Norwegian Veritas Register for 1912, the port of Tönsberg owned 237,000 tons of steam tonnage and 15,000 tons of sailing vessels.

THE TOWN.

The town is beautifully situated at the inner end of the Tönsberg Fjord, facing S. W. It is the oldest town in Norway and was originally a town of very considerable importance in the Kingdom. In 1915 the population was about 11,000 inhabitants.

COMMUNICATIONS.**By Sea.**

There is daily communication with Kristiania and the coast ports by steamer.

By Railway. (See Map 1.)

Tönsberg is situated on the main coast line from Kristiania (71 miles) to Skien (55 miles). There is also a branch railway line *via* Hillestad (20 miles) to Eidsfoss (30 miles), at the south end of Lake Ekern with its railway carriage works.

By Road.

Two main roads actually leave the town, one to the eastward where it splits up into two branches, the southern running to Vallö and the northern following the coast line to Aasgaardstrand. The other main road communicates in a N. W. direction with the main road running from Larvik to Drammen.

By Telegraph and Telephone.

Tönsberg is a main center of the coastal telegraph and telephone system, communicating direct with Kristiania. There is communication by telegraph and telephone with the W/T station on Tiömö, and with several of the outlying islands at the entrance to the Kristiania Fjord. There is telephonic communication only to Eidsfoss.

MILITARY DETAILS.**COAST DEFENSES.**

(See Chart 2.)

Tönsberg Fjord was fortified a few years ago in order to provide a base for the Fleet less open to attack than Horten. The defenses were completed about 1898.

A committee appointed to consider the question of the defenses of this locality recommended, in May 1913, a sum of 163,000*l.* to be appropriated for this purpose, but it is not known whether any further steps have been taken as no details have appeared, excepting that a grant was made in 1914 of 144,444*l.* towards the Tönsberg defenses.

A permanent garrison now mans the guns of the forts and serves continuously for a period of six months. There are altogether 14 field guns in the Tönsberg defense area, the position of some of which are on Nötterö, but none are permanently mounted. A steamboat was purchased in 1901 for running trips to Tönsberg from Melsomvik and other establishments. A new range-finder was purchased in 1908.

HAA ISLAND SITE.

On the north-east shore of the island, opposite Tinvik, there are three buildings, the northernmost of which has the appearance of a mine store, the next that of a boathouse, and the third that of a magazine. Close to the mine store a number of sinkers are stored in the

open. On the wharf close to the magazine is a small crane. A telephone cable leaves the island just north of these buildings and is landed on the shore opposite immediately north of Tinvik.

On the north-west shore, near the northern extremity of the island, there are six buildings, the northernmost of which has the appearance of a magazine; the next one is a dynamite store, and the third has the appearance of a magazine. The fourth and fifth are two-storied and appear to be used as storehouses and coal stores. The southernmost building also appears to be a coal store. A water tank is secured close to the dynamite store and on the wharf is a small crane.

On the west side of the island, a short distance north of battery No. XVIII. and close to the water edge, are two small buildings; one is apparently an engine house and has a pipe running down to the water, the other is almost hidden behind a rock and is protected by wire entanglements.

Close to the water's edge and a short distance west of the southern extremity of the island is an entrance into the rock, also protected by wire entanglements.

All the gun positions are surrounded by wire entanglements, as also are the magazines at the north end of the island.

No. XVI on Chart 2.

The guns are mounted independently near the S. end of the island. Two 21-cm. guns are mounted on the summit of two peaks about 120 feet above the sea level.

Slightly northward of, and a little higher than, the westernmost of these two guns, is a third, judged to be a 15-cm.

On a third peak to the E., and about 80 feet above the sea level, is another (apparently) 15-cm. gun.

When the guns were seen in 1907 they were all housed in, so that the caliber of the two smaller guns may have been misjudged. Two 21-cm. guns, however, are known to be mounted here.

The heavy armament on Haa Island consists of—

- 2—21-cm. (8.2-inch) guns.
- 2—(?) 15-cm. (5.9-inch) guns.

Nos. XVII and XVIII on Chart 2.

On each side of the island, in the positions marked on the chart, two light Q. F. guns are mounted about 30 or 40 feet above the sea level for the protection of the minefields.

The light armament on Haa Island consists of:—

- 4—57 mm. (6-pdr.) Q. F. guns.

SUNDSAAS SITE.

No. XIX on Chart 2.

This battery has been constructed on the high ground at Sundsaas, on the western shore of the fjord.

Two guns at the summit of Sundsaas were clearly seen against the sky-line from the northward in July 1913, and appeared to be of at least 15-cm. caliber.

An alternative earlier report of the possible armament has been stated as—

- 2—12-cm. (4.7-inch) Q. F. guns.
- 4—65-mm. (10-pdr.) Q. F. guns.

There is a magazine and some houses used as barracks on Sundsaas.

SUBMARINE DEFENSES.

There are two minefields, one on each side of Haa Island, for which the observation station is on Haa Island.

The firing station is on Haaoholm, and is surrounded with wire entanglement.

In July, 1913, a mining launch was observed weighing cylindrical mines, which had evidently been some time in the water, in the position marked on chart 2, "Probable Minefield" to the westward of Haa Island. Altogether three mining launches were seen, two of which were alongside the mine store on the N. E. shore of the island.

In 1914, the commandant of Tönsberg forts issued an announcement to the effect that mines had been laid at Vraengen, in the strait between Nötterö and Tiömö, the guard ships for which were stationed at Buerstad and Burstangen, and during the war a further announcement was made warning ships of the presence of a minefield at Vraengen.

There is also believed to be a minefield between Husö and the mainland to protect the approach to the Steens Canal.

SEARCHLIGHTS.

There are known to be searchlights on Haa Island, but their number and position is unknown.

BARRACKS.

Five buildings, erected about ten years ago, are situated on Haa Island for the accommodation of 20 officers, 50 N. C. O's, and 350 men.

GARRISON.

The war garrison of the Tönsberg defenses is believed to consist of the officers and men above-mentioned with the addition of a mining section.

Melsomvik. (*See Chart 2 and Plate 7.*)

Situated about 5 miles south of Tönsberg, and on the west side of the fjord, is the small bay known as Melsomvik, on which is situated the naval laying-up harbor of that name. The locality is thickly wooded. It is a calling place for the Tönsberg—Tiömö steamers, otherwise communication is by railway from Tönsberg to Stokke, whence Melsomvik is about $1\frac{1}{2}$ miles by road.

A certain amount of coal used to be stored here, in addition to that kept in hulks moored off the yard. A landslide occurred here, however, in November 1912, and at the time of a visit in July 1913 no coal could be seen. Further up the fjord on the west side opposite Kausen there was a large heap of coal, containing some 3,000 or 4,000 tons, which leads one to assume that the depôt has been shifted.

In the yard there are some boat sheds, a torpedo store, and various other stores, one of which has been converted into a small machine shop with some lathes, a planing machine, &c.

There are two small cranes on the wharf.

The water supply is from a reservoir on the hill, west of the yard, which is connected up by telephone.

To the south of the yard there are five buildings which have the appearance of magazines or mine stores. They are all connected by rails with the wharf.

About a third of a mile to the south of the yard, and close to the water are two buildings, probably intended for mine stores.

Plate 7 gives a view of the laying-up harbor and of the two buildings, a third of a mile south of the yard; at the time the photos were taken (1912) the latter were under construction, but have since been completed.

This establishment is under a naval officer of Kaptein rank, with two officers of the commissariat branch under him.

It was once the intention to make Melsomvik the chief naval station of Norway in war time, but, owing to the narrowness of the approach up Tönsberg Fjord, this idea has probably been abandoned.

In 1914, a vote of 122,222*l.* was made toward the establishment of a naval station in the Tönsberg district, and a further grant was made in 1915 for the requisitioning of land at Melsomvik, but there is nothing further to show that this base has been specially selected as a new naval station on a large scale, except that a further report in 1916 stated that it was proposed to build a harbor here for the accommodation of men-of-war, though at the time no progress had been made toward construction. It is believed that a coast defense gunboat is usually stationed at Melsomvik.

COAST FROM TÖNSBERG FJORD TO SANDEFJORD.

(*See Chart 2 and Admiralty Chart 3158.*)

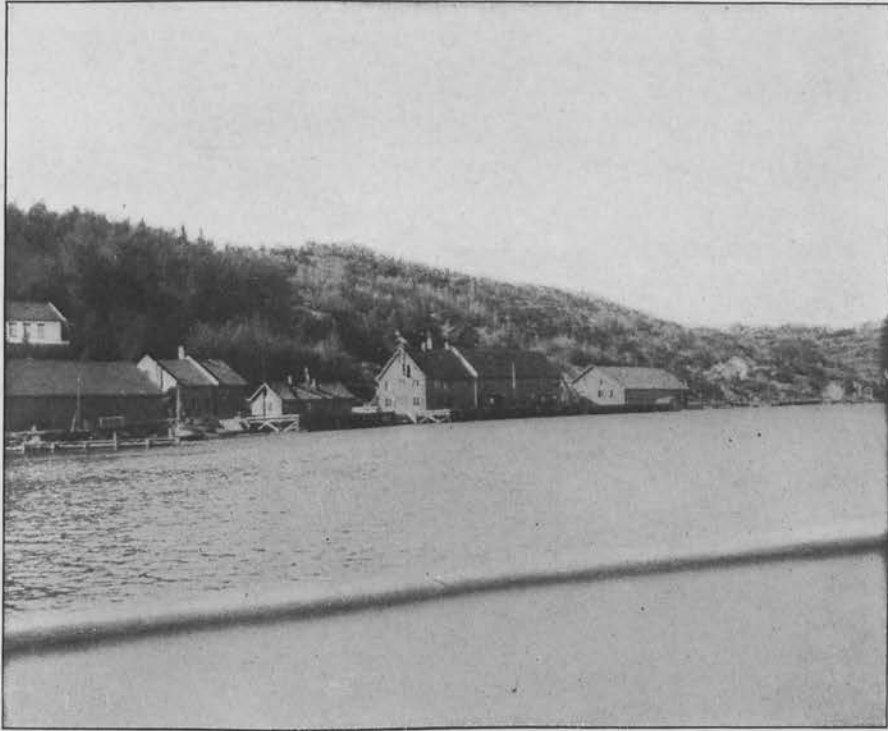
To the westward of the entrance to Tönsberg Fjord, the coast line is conspicuous by two long peninsulas, down each of which run roads from Sandefjord at the head. Between the two peninsulas is Midtfjord, which extends nearly 5 miles inland, and contains a number of anchorages (*see Pilot*). The entrance to Sandefjord is one mile west of Midtfjord, and vessels may approach it either eastward or westward of Rauöer and south Eastgrund, both of which lie off the entrance 3 miles. The islands of Svenöer, to the westward of the Rauöer group, mark the west side of the entrance to Kristiania Fjord.

Sandefjord.

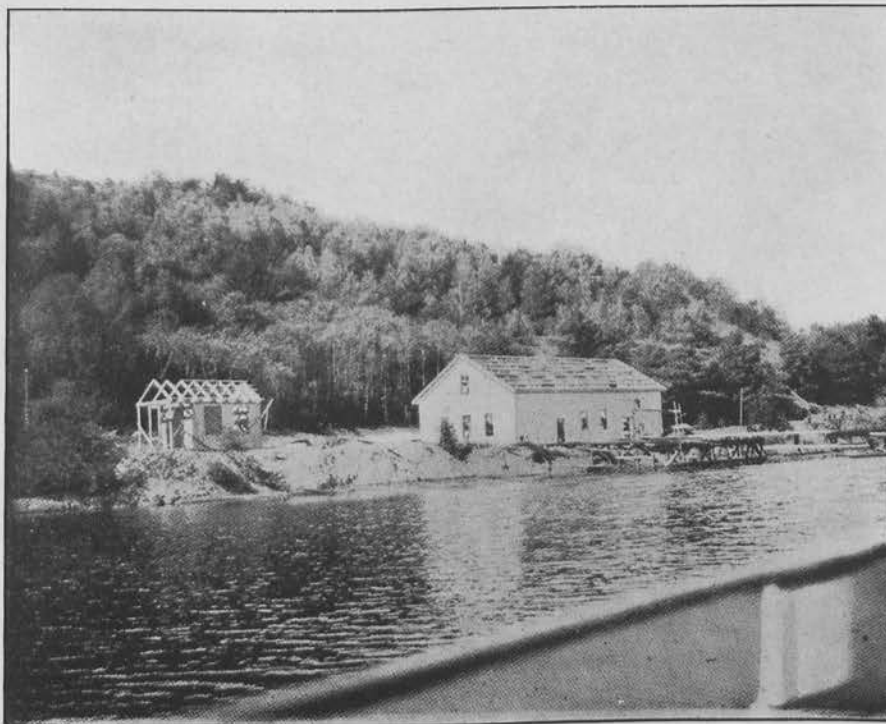
Sandefjord lies at the head of the fjord of the same name, and has a good harbor with a depth of 7 fathoms, shoaling to $4\frac{1}{2}$ and $2\frac{1}{2}$ fathoms. The town is a favorite watering place, and is much frequented by invalids on account of the medicinal effect of its mud and sulphur baths. It is also a busy shipping port, and according to the Norwegian register of 1913 the town owned about 88,000 tons of steamer tonnage, and 27,000 tons of sailing.

There is a navigation school in the town which had a population in 1913 of 5,800 inhabitants.

MELSOMVIK.
Naval Laying-up Harbour.



? Magazines or Mine Stores.



? Mine Stores.

The Commercial Port.

The length of quayage in the harbor is about 1,000 feet with a depth of water alongside varying from 10 feet at the eastern end to 17 feet at the west quay. There is one crane to lift 4 tons.

Steel steamers up to 1,883 tons have been built by the "Framnes Mekaniske Verksted" at Sandefjord, which is a firm which builds a considerable number of vessels of the smaller type. There is a mechanical workshop where large repairs to machinery can be undertaken, and the works have two cranes, lifting respectively 30 and 15 tons.

The three floating docks operated by this company, having a lifting power of 5,500 tons, 1,600 tons, and 900 tons respectively, and the two smaller docks can be combined to take a vessel 330 feet long and of 4,000 tons displacement. Further details are given in the "Dock Book." There are three building slips for small steamers.

Coal for steaming purposes can be obtained, the quantity usually kept in stock being about 2,000 tons.

Communications.

In addition to steamer communication, which is fairly frequent to other coast towns, Sandefjord is situated on the main railway line from Kristiania (86 miles) to Skien (40 miles); the distance from Tönsberg by rail is 21 miles. Sandefjord is the center of a network of roads which communicate with various parts of the coast, and inland; it is within about 2 miles of the main road from Kristiania to Larvik, and is in communication with the main road running northwards from Larvik up the Lagen River valley.

The town is on the coastal telegraph and telephone system, but there is no communication by either directly inland.

Land Defenses.

It was reported in 1902 that the fortifications at Sandefjord had recently been completed at a cost of 900L. They consist, it is understood, of a work on Mokollen (near Sandefjord), and another on Braarudaasen (unidentifiable). There is no further information.

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Confidential!

NORWAY: COAST REPORT

PART II THE COAST, PORTS, AND COAST DEFENSES

SECTION 2 KRISTIANIA FJORD TO TRONDHJEM FJORD

JUNE, 1917

OFFICE OF NAVAL INTELLIGENCE



FEBRUARY, 1918



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OFFICE OF NAVAL INTELLIGENCE,
Washington, February 15, 1918.

This reprint of a confidential British Admiralty publication is intended for the use of officers generally, and in certain cases may be shown to persons in the Navy of the United States below the rank of commissioned officer who may require to be acquainted with its contents in the course of their duties. Nevertheless, this is to be considered a confidential book and due caution must be observed in communicating its contents to persons not commissioned officers of the Navy.

ROGER WELLES,
Captain, U. S. Navy, Director of Naval Intelligence.

NORWAY:
COAST REPORT.

PART II.
THE COAST, PORTS, AND COAST DEFENSES.

SECTION 2.
KRISTIANIA FJORD
TO
TRONDHJEM FJORD.

JUNE, 1917

The information contained in this book should be verified
and supplemented whenever an opportunity offers.

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THE COAST FROM KRISTIANIA FJORD TO TRONDHJEM FJORD.

COAST FROM KRISTIANIA FJORD TO LAURVIK.

The western boundary of the entrance to Kristiania Fjord is considered to be the small group of islands known as the Svenøer group, which is situated just to the eastward of the entrance to Laurvik Fjord. Between these islands and the coast there are numerous obstacles and dangers, and islands, rocks, and shoals obstruct the entrance to Viks Fjord, which runs in a north-easterly direction from the entrance to Laurvik Fjord. (See Admiralty Chart 3158.)

From Laurvik Fjord a ship may pass inside Svenøer and Rauøer, bound eastwards, through the ship channel, and in fine weather vessels of 16 feet draught may make use of the Baad-leden, which runs close in shore amongst the rocks off the mouth of Viks Fjord.

Laurvik. (See Admiralty Chart 3158.)

The town of Laurvik (Larvik) is situated at the head of the fjord of the same name, and is a port of some considerable importance. The fjord extends inland for about 4 miles, and on the N.E. side, near its head, it receives the waters of the Laagen River. Laurvik Fjord is deep and clear in the middle, but a long sandy spit projects nearly half a mile from the mouth of the Laagen River, though it presents no obstacle to ships approaching the town. The entrance to Laurvik Fjord is free from dangers.

The town skirts the head of the fjord in the form of an amphitheatre, and has a very picturesque appearance from the sea. It was formerly the capital of a county, and is now a favourite watering place in consequence of the mineral and sulphur springs to be found in the neighbourhood. There are several hotels, and the red-brick church is a conspicuous building.

The population, including the suburbs of Langestrand to the west and Thorstrand to the east of the town, was in 1913, about 11,000 inhabitants. In 1913 the town owned a fleet of 45 steamers of a total tonnage of 41,142 tons, and of 25 sailing vessels of 27,571 tons. A British vice-consul is resident in the town. Near the west end of the town is the outflow of Faris Lake, which supplies the motive power for the Fritzø saw mills and several other factories.

Commercial Port.

There is ample water in the harbour for the largest ships, and the rise of tide is only 1 foot at the quays, which consist of the West quay, 508 feet long, with 15 to 30 feet alongside; the Railway quay, 506 feet long, with 15 to 27 feet alongside; and the Revbryggen, with 18 feet of water alongside. There are three cranes, to lift 15 tons, 5 tons, and 3 tons respectively.

There are two shipbuilding yards, which have up to the present constructed principally wooden ships only; in 1916, however, it was reported that the old "Archer" shipbuilding yard had been disposed of to a new company, which will enlarge and modernise the establishment to build motor vessels of between 800 and 1,000 tons dead weight.

The Fredriksvaern municipal authorities are also reported to have disposed of a site to the "Laurvik Slip and Verksted" for the construction of a shipbuilding yard and workshops, which appears to show an increase of work in this establishment also. This latter firm had an order in 1916 for eight vessels, the largest of which was to be of 1,200 tons dead weight. There are two patent slips, one of which is 320 feet long and will lift 500 tons, belonging to "Höllens Verksted"; the other patent slip is owned by the "Laurvik Slip and Verksted," and is 330 feet long, and will lift 300 tons.

About 2,000 tons of coal is usually kept in stock; coaling is carried out alongside; there are two good coaling jetties with 16 to 23 feet of water alongside.

In 1913 only nine British vessels, of a tonnage of 13,473 tons, visited the port.

Communications.

Kristiania-Skien steamers and Kristiania-Bergen steamers call daily at Laurvik either way, and once a week there is communication to Newcastle-on-Tyne.

Laurvik is situated on the Kristiania (98 miles)-Skien (34 miles) railway; the station is at the harbour, which the railway skirts, before turning N.W. up the western shore of Fairsvand. (See Map 1.)

The town is a center of main roads: N.E. to Tönsberg and Kristiania; north, up the valley of the Laagen River, on which there is a motor-bus service twice a day as far as Styrvold (20 miles); N.W. to Porsgrund (13 miles); and S.W. to Helgeraaen (6 miles) and Nevlunghavn (8 miles), with which there is communication three times a day by motor bus. There is also a road to Fredriksvaern. Laurvik is situated on the coastal telegraph and telephone service, and there is separate communication by both with Fredriksvaern.

Fredriksværn. (*See Admiralty Chart 3158.*)

Fredriksværn is situated on the west side of the entrance to Laurvik Fjord. This town, which was formerly the principal naval station of Norway, is now no longer in use by the fleet; it is quite small and of no commercial importance; the population numbers about 1,000 inhabitants. In 1916 it was reported that the municipal authorities had disposed of a site to the "Laurvik Slip and Verksted" Company for the erection of a shipbuilding yard and shops.

Communications.

There is no railway communication nearer than Laurvik, distant $3\frac{1}{2}$ miles by road. There is also communication with Laurvik by telegraph and telephone. There is a signal station on Stavaernsø Island off the town.

COAST FROM LAURVIK FJORD TO LANGESUND FJORD.

(*See Admiralty Charts 3158 and 1327.*)

Westward of the entrance to Laurvik Fjord the coast is much obstructed by the shoal ground known as Rakkeboerne, which causes ships approaching the fjord from the west to keep well out. Naver Fjord can be used as an anchorage in case of necessity in depths of 5 to 8 fathoms over clay, but it is exposed to the south.

Nevlunghavn has a good and roomy anchorage in depths of 10 to 15 fathoms over clay, and it is well protected by the rocky islands at the entrance, through which there are four channels of approach (*see Pilot*).

Three miles west of Nevlunghavn is the entrance to Langesund Fjord and the neighboring fjords and channels which run inland from the sea. The outer part of Langesund Fjord is studded with islands, and between Fuglø and Brevik the eastern shore is very irregular, forming several branches, of which Helgeraa is the most southerly, and in which there is anchorage in 8 to 10 fathoms over clay off the village of Helgeraaen. The channel leading north from Helgeraa and to the west of Haaøen is known as Kalven, but is scarcely ever used, though it has deep water; out of it to the eastward extend the Mørie Fjord on the east side of Haaøen, and Landgangs Fjord, which stretches for a distance of about $4\frac{1}{2}$ miles inland northward of Arø. There are anchorages, which are described in the Pilot, in both these fjords.

Vessels bound up Langesund Fjord, which extends about 5 miles inland in a N.N.W. direction from Fuglø to Brevik, may either proceed through Langsund, Gamle Langsund, or Dybingen, all deep-water channels between the islands (*see Admiralty Chart 1327*).

At the head of Langesund Fjord an arm called the Eidanger Fjord continues due north from Brevik for a distance of $3\frac{1}{2}$ miles, and is safe and has deep water throughout, except for a short distance off both shores. The railway to Brevik runs close to the western shore of the Eidanger Fjord.

Brevik. (*See Admiralty Chart 1327.*)

The town of Brevik is situated at the south-eastern extremity of the rocky peninsula which separates Frier Fjord from Eidanger Fjord, and where the two join Langesund Fjord. There are various small outports which are in close proximity to the town:—Saetre, to the north of the town on the Eidanger Fjord; the island of Sylterø, off the town, and Stathelie and Rødningen, situated on the western shore of Langesund Fjord. There are quays at all of these small places, which are chiefly employed in the export of timber. In 1913 the population of Brevik was 2,318 inhabitants.

The Commercial Port.

The port is available for the largest steamers, and there are three good quays, of which the railway quay is used by the coasting mail steamers. The railway quay is 256 feet long, with a depth of water alongside of from 16 to 18 feet; other quays are the Langbryggen quay, which is 412 feet long, with 8 to 13 feet alongside, and the new quay, which is 80 feet long, and with 20 feet of water alongside. There are no docks or patent slips. Timber is the principal export and coal the principal import.

Communications.

Steamship lines running between Kristiania and Skien, and Skien and Arendal, call at Brevik, the former every day, and the latter three times a week. There is also daily communication by steamer with Kristiansand. A joint Norwegian-Danish committee has been considering the question recently of establishing communication between Southern Norway and Jutland. Brevik appears to be the Norwegian port most favorably considered, and either Frederikshavn, the Skaw, or Hirtshals will probably be the Danish port.

Brevik is the terminus of the railway line from Kristiania (125 miles). The town of Eidanger ($5\frac{1}{2}$ miles) is the junction for that part of the railway which runs north to Porsgrund (8 miles) and Skien (13 miles).

There is communication between Brevik and Eidanger by road, and at the latter place communication is made with the main road from Laurvik to Skien; there is also a road running from Eidanger down the east side of the Eidanger Fjord. The main road from Laurvik to Skien above mentioned crosses the head of Landgangs Fjord.

There is communication by telegraph and telephone with Langesund and Porsgrund, also westward overland by telephone to the villages of Surtebogen and Aaby on the main coastal trunk lines connecting Kragerø and Skien.

The continuation of Langesund Fjord above Brevik is Frier Fjord, which extends for a distance of about 6 miles northward to Porsgrund, at the mouth of the Skien river. A strong current usually runs out through the Frier and Langesund Fjords. Volds Fjord extends in a W.N.W. direction from the northern extremity of Frier Fjord, but it is obstructed by islands and rocks.

Porsgrund. (*See Admiralty Chart 1327.*)

The town and port of Porsgrund is situated on both sides of the Skien river, and about one mile above Thorsberg at the entrance. Vessels may anchor in any part of the Skien river, but above Porsgrund the stream is so strong that vessels bound for Skien must either use steam or warp. The town of Porsgrund had in 1913 a population of about 5,000 inhabitants, and there was every reason to suppose that its importance would grow rapidly, especially when, by the construction of the Rjukan railway, the port would become the terminus for the export of the products of the interior. Considerable schemes are in progress for the development of the port, by which new quays, provided with the most up-to-date appliances for loading and discharging, are to be constructed. The port is easily accessible, excellently protected, and the port is spacious and well situated, with extensive and suitable areas for commercial purposes. The "Meteor Company" owns an important ferrosilicon factory at Porsgrund, and it is understood that a large factory for alloys of iron and for carbide is being constructed on the island of Rolighed at the mouth of the river, from which there is a bridge to the mainland; there is also a bridge across the river connecting the two portions of the town. The town is supplied with electric light and power for its factories, &c., from the Rjukan power station, about 40 miles distant. Dredging operations have taken place in the harbor during recent years and several rocks have been removed; the completion of this work should have been made by the end of 1913, when the entire programme for the widening and deepening of the river at Thorsberg, at the Strömtangen rocks, and at Graaten (near Skien) should have been completed, and a fairway from the sea past Langesund, Brevik, and Porsgrund to Skien of nearly 23 feet established.

The Commercial Port.

The depth of water at present in the harbor is between 22½ and 23 feet. The quays run along the front of the town for about 1 mile. There are two cranes, to lift 1 to 2½ tons, respectively, on the steamship quay. The "Porsgrund Mekaniska Verksted" is a shipbuilding yard at which ships up to 1,000 tons have been built. Engines and boilers are also constructed. This firm owns a floating dock, capable of lifting 1,600 tons; the dimensions are given in the Dock Book. The company also owns a patent slip, 295 feet long, and capable of taking a ship of 200 tons gross. It is worked by electricity.

A second patent slip is owned by "Jorgen C. Knudsen" Company, which is 145 feet in length, and capable of lifting a ship 100 feet long; it is worked by electricity. The building slip at this yard is only 133 feet long. There are a pair of sheers up to 50 tons' lifting capacity.

The principal exports from Porsgrund are ice from the ice-houses at Traag, and timber. According to the Norwegian Register of 1912, Porsgrund owned a total steam tonnage of 31,000 tons, and of sailing vessels of 36,000 tons.

Communications.

The daily steamer communication between Kristiania and Skien calls at Porsgrund, as also does the service between Skien and Arendal, which runs three times a week.

Porsgrund is situated on the main railway line from Kristiania (121 miles) to Skien (5 miles); it is also in communication by rail with Brevik (8 miles), *via* Eidanger (2½ miles). For the new Rjukan railway *see* under Skien, "Communications." The railway line from Porsgrund to Skien follows the left bank of the river. Porsgrund is in communication by road with Skien and Laurvik (15 miles), *via* Eidanger, whence a branch runs to Brevik, down the west side of the Eidanger Fjord. A good road also leaves the west bank of the river to join the Skien-Ulefoss road at the village of Kloveland, at the southern end of Lake Nordsjö.

The town is on the coastal telegraph and telephone system, and there is independent communication by both with Brevik and Langesund.

Between Porsgrund and Skien the river is narrow, and the depth of water is now believed to average 21 feet, but there is considerable current to contend with. The local district is well studded with farms and agriculture is an important industry. There are quays on the right bank at Graaten, just south of Skien.

Skien. (*See Plate 8 and Admiralty Chart 1327.*)

The town of Skien is situated at a bend of the river about 5 miles above Porsgrund. It is one of the oldest trading towns in Norway, and though repeatedly burned down, has become an important commercial and industrial center, with a population in 1913 of 12,268 inhabitants. Between the two steamboat piers are two powerful waterfalls, known as the Klosterfos and

Damfoss, which are crossed by bridges to the island in the middle. In the Jernbane-Torv, near the harbor, which is just below the falls and has lately been improved and deepened, are the railway station and the Raadhus, and the chief hotels are close by.

Between Ulefoss, on the west side of Nordskjö and Kragerö, is one of the richest iron districts in the country. Electric light and power are universally used. Current is supplied from the Rjukan power stations at the Aarlifos waterfall in Hitterdal, 40 miles away. Modern gasworks have recently been erected in the town. At Tinfos, near Hitterdal, and at Ulefoss, there are important electric smelting works for iron ore.

The Commercial Port.

It is believed that ships of 21 feet draft can now come up to Skien, but dredging operations are still in progress. There is an inner and an outer harbor, and in the latter a new quay has been erected of a length of 860 feet, with a least depth alongside of about 22 feet. Other quays total a length of about 2,500 feet, with depths alongside varying from 17 to 24 feet.

Only the smallest repairs can be effected, and there are no docks nor patent slips.

In 1913 a total of 85,378 tons of coal was imported, but the average stock in hand is about 900 tons; it is generally delivered in barges.

The principal exports are saltpeter, timber, pulp, and paper. Imports consist chiefly of coal. There is a British vice-consul in the town.

Large quantities of nitrate of lime and nitrate of ammonia were shipped from Skien to France and England for munitions during the war.

Communications.

There is daily communication by steamer with Kristiania and intermediate ports, and with Arendal three times a week. River steamers communicate above the falls with Dalen, at the western end of Lake Bandak, whence a good road leads to Odde (78 miles) at the head of Sör Fjord, an arm of the Hardanger Fjord (*see* page 30) on the west coast of Norway. There is communication by motor car between Dalen and Odde. Communication is maintained *viâ* Ulefoss (two hours) on the west side of Nordsjö, whence the Bandak canal carries the inland steamers west for 13½ miles to Strengen on the Flaavand, from which Dalen is reached in 10 hours through the medium of lakes and rivers. The Bandak canal has a system of 16 locks and 2 dams, the differences of level between the highest and lowest points reached being nearly 178 feet; the locks are 120 feet long, 22 feet broad, and 8½ feet deep.

Steamers also run to Gvåry (in four hours) at the northern extremity of the Nordsjö, whence there is communication inland by two or three good roads.

Skien is the terminus of the main coast railway from Kristiania (126 miles), *viâ* Drammen (93 miles), Holmestrand (72 miles), Tönsberg (55 miles), Sandefjord (40 miles), Laurvik (28 miles), and Porsgrund (5 miles). The junction for Brevik is at Eidanger (7 miles).

The new Rjukan railway is being built from Skien to Juxa (about 30 miles), whence lines are under construction from Juxa to Notodden (12 miles), where there are important nitrate ammonia works, and from Juxa to Kongsberg (24 miles), the completion of which is expected early in 1917; its opening will much enhance the importance of the ports of Skien and Porsgrund. (*See* Map 1.)

A considerable number of roads leave Skien in different directions, of which the two chief ones are that running south along the left bank of the river to Porsgrund and Laurvik, and that running west up the western shore of the Nordsjö to Ulefoss and the interior.

Skien is an important center in the telegraphic and telephonic system of Norway. The main coastal system leaves the town for the south and west coasts, and there are two direct routes by each means to Kristiania, one of which follows the coast of the Kristiania Fjord, the other running north and inland. A third route, which is quite independent but more circuitous, follows the western shore of the Nordsjö, and turns east from Notodden, *viâ* Kongsberg to Kristiania.

Langesund. (*See* Admiralty Chart 1327.)

Langesund is a small trading town, with a population in 1913 of 1,650 inhabitants, situated on the west side of the entrance to the fjord of the same name. There is a British consular agent for Langesund and Brevik, but the trade is inconsiderable. At Bamle, 7 miles N.W. of Langesund, there is an important nickel mine.

The Commercial Port.

The harbor consists of three ports, Langesund (south), Langesund (north), and Kongs-havn (inner). There are quays on both sides of this harbor, the north quay having a depth of 19 feet of water alongside, and the south quay 13 to 14 feet depth. On the east side there is a small mechanical wharf at which there is a patent slip, 200 feet in length, and with lifting capacity of 85 tons. There are small cranes on both sides of the harbor. A report in 1915 stated that a dry dock was to be built, as also building slips for ships of 1,200 tons, but nothing further is known of this project. A salvage steamer belonging to the "Norsk Bjaergnings Kompagni," of Kristiania, is stationed at Langesund.

The average stock of coal is between 300 and 500 tons. Coaling may be carried out alongside or from lighters.

Communications.

Steamers bound from Kristiania to Skien, or Bergen, call daily at Langesund, as well as a line running from Brevik to Kristiansand. There is also communication three times a week by steamer with Arendal and Skien by the Arendal-Skien line.

There is no communication by railway, the nearest station being Brevik (5 miles), with which town there is communication by road. There is also a road running parallel with the coast, but at some distance inland, and which communicates with Kragerö (19 miles).

There is communication by telegraph and telephone with Brevik and Porsgrund.

COAST FROM LANGESUND FJORD TO KRAGERÖ.

(See *Admiralty Chart 1327.*)

From Langesund the coast trends in a general south-westerly direction for 6 miles, and is much obstructed by rocks and shoals which extend off-shore for about 4 miles, though there are channels between them available for deep-draft ships. In this part of the coast there are several anchorages, described in the Pilot, and the harbor of Brevikstranden, which is difficult of approach, but has room for 15 to 20 ships in from 5 to 7 fathoms.

After passing Vittenskiul Lighthouse the coast runs in a westerly direction and then south-west, forming a large bay, at the inner end split up into various fjords, and with the mouth choked with islands, some of which are of large size. The outer channel passes between Askholmene Islands and Straaholm into Jomfrulands Renden, which is narrow and winding, but can be used by vessels of 18 feet draft.

The inner channel passes northward of Askholmene on either side of Mosholm, and it is throughout very narrow, and can only be attempted by small ships with local experience. There are numerous anchorages in the inner fjords and under the lee of these islands, all of which are discussed in the Pilot.

Kragerö. (See *Admiralty Chart 1327.*)

The passage westward of Jomfrulands Revet is the deepest entrance to Kragerö, and that usually preferred, especially in bad weather, and through it vessels of the deepest draft can approach the harbor. The harbor is well sheltered, and the town, which had a population in 1913 of 5,000 inhabitants, is situated on the S.E. shore of the peninsula formed by the Kils and Helle Fjords.

The steamship quay, which is 206 feet long, has a depth alongside sufficient for ships of medium draft. The new quays at the works of the Norwegian Chemical-Electro Company, Limited, can accommodate ships drawing 22 feet. The steamboat wharves lie between Öen and the town, and are connected with both by bridges. This is an important carbide factory, and was working at high pressure during the war, and was stated to be German owned.

It has been stated that on the island of Skaatö is to be erected a new large wharf and dry dock to take ships of 10,000 tons. At present no dock exists at Kragerö. In addition, two or three slips will be built for the construction of ships up to 7,000 tons, and the building of Diesel motor ships will be a specialty of the company, which is starting with a capital of 1,700,000L.

At present repairs can only be effected on a small scale, and ships must be careened at one of four repairing wharves. The harbor is usually obstructed by ice for a short period, but the outer fjord rarely freezes. There is no ice-breaker, but a tug can assist when required.

A small quantity of coal only is obtainable, and vessels drawing upwards of 12 feet are supplied from barges; otherwise for small vessels coaling is carried out alongside a wharf. At Kragerö the shipping industry in 1915 gave very good results, and freight rates ruled high. Several new shipowners established themselves, and at the end of 1915, 23 steamers and 10 sailing ships, with a total tonnage of 35,040 gross tonnage, were owned by local firms.

On the island of Berö, E. of Kragerö, there are important white quartz quarries, the produce being used for the manufacture of the finest steel, and the iron mines on Langö produced in 1913 a total of 8,300 tons, of which 2,320 tons was exported from Kragerö.

Communications.

Steamers running between Kristiania and Bergen, and those running between Brevik and Kristiansand, call daily at Kragerö. Steamers communicating between Skien and Arendal call three times a week.

At present there is no railway to Kragerö, but a line is under construction from Kragerö to Noraguto, which will there join the new line at present under construction between Kongsberg and Skien. From Kragerö a good road leads S.W. within a short distance of the coast and communicates with Risør (27 miles) and Arendal (44 miles). N.E. there is communication by road with Langesund (15 miles) and Brevik (18 miles). A posting road leads N.N.W. into the interior *viâ* Stöen (6 miles) and Lenaes (16 miles), on the Tokevand to Bö (41 miles), whence there is a road communicating with that from Arendal to the north at a distance of 18 miles beyond Bö.

Kragerö is situated on the main coastal telegraph and telephone system; there is also communication by telephone with Skaatö and Jomfruland Islands.

THE JAEREN COAST.

(See Admiralty Chart 3151.)

The coast trends in a general southwesterly direction along the Jaeren coast, which close in shore is fronted by rocks and shoals and is without harbors over a distance of 7 or 8 miles until Söndeled Fjord and Sandnes Fjord are reached, in which there are anchorages for moderate-sized vessels.

Risör or Öster Risör. (See Admiralty Chart 3151.)

Risör is a small trading town, situated between the entrances to the Sandnes and Söndeled Fjords. The population in 1913 was 3,700, the principal industries being devoted to the export of timber and wood pulp, and a small amount of shipbuilding is carried out.

The harbor is close to the open sea and is easily accessible; it consists of an outer harbor in which there is ample water and room for ships of any class, and in which there is a length of about 600 feet of quayage, with 13 feet alongside. In the inner harbour there is a depth of from 12 to 36 feet, and the quayage is about 900 feet in length, though the depth of water alongside is only about 8 feet.

A company has recently been formed with a large capital to acquire at Badskjaerholmen, near Risör, a yard for the construction of small steamers, fishing vessels, and lighters, and for the construction on a small scale and repair of engines. At present there are no means of repairing machinery or iron hulls. A salvage steamer belonging to the "Norsk Bjaergnings Kompagni" of Kristiania is stationed here.

The harbor occasionally freezes over for short periods. No good steam coal can be obtained, but about 500 tons of the kind used by coasting steamers is usually kept in stock. Vessels drawing not more than 15 feet of water may coal alongside stages rigged out from the wharf, otherwise coal is delivered by lighters. Coal is the chief article of import.

In 1913, Risör owned a total of 15 steamers of 11,000 tons, one motor boat of 41 tons, and 19 sailing ships of 20,895 tons. A British vice consul is resident.

Communications.

Steamers running between Kristiania and Bergen and between Brevik and Kristiansand, call daily at Risör. There is also communication three times a week with Skien and Arendal.

There are no railway facilities.

A road runs inland up the peninsula to join the main coast road from Arendal (27 miles) to Kragerö (30 miles), and before this junction is made, a branch leaves it in a southerly direction, crossing the Sandnes Fjord by ferry, eventually winding along the coast to Tvedestrand, about 17 miles distant. Risör is situated on the coastal telegraph and telephone system.

COAST FROM RISÖR TO TVEDESTRAND FJORD.

After leaving Risör the coast remains exposed to the sea for the first 5 miles, after which there are a number of large islands forming channels which are comparatively sheltered, though intricate and available only for moderate-sized vessels between them and the mainland. On the island of Lyngör there is a harbor of refuge of the same name, which can be approached by numerous channels through the rocks, and affords good and safe anchorage for medium-sized ships in a narrow harbor. Odden, the island opposite to Lyngör, has a telegraph station communicating with the main trunk system. There are numerous anchorages in this part of the coast, all of which are fully described in the "Pilot."

Tvedestrand. (See Admiralty Chart 3151.)

Tvedestrand Fjord, a continuation of Okse Fjord, which communicates with the open sea, runs inland for a distance of about 3 miles to the small trading town of Tvedestrand. Its principal industries are shipbuilding and the timber trade, and the population of the town in 1913 was about 1,600 inhabitants. There are two roadsteads in the inner part of Oksefjord, in which there is plenty of water and good bottom.

The harbor of Tvedestrand can be approached by the largest ships, and there is good anchorage in the outer harbor in 7 fathoms. In the inner harbor there is a depth of water from 32 to 50 feet, and there is quayage 2,100 feet in length with 28 feet of water alongside. There are no cranes.

In 1913 the town owned 14 steamers of 11,600 tons and 57 sailing ships of a total of 86,099 tons.

Communications.

No regular steamers call at Tvedestrand, and there is no railway. The main road between Arendal (14 miles) and Kragerö (28 miles) is within half a mile of the town; there is also communication with Risör by the above-mentioned road, or by the coast road, with a ferry across Sandnes Fjord, the total distance being about 17 miles. A good road runs north up the valley of the Nisser Elv to the northern extremity of Nisser Vand (59 miles), whence there are branches, one of which runs to Odde (136 miles) at the head of Sör Fjord (Hardanger Fjord).

Tvedestrand is situated on the coastal telegraph and telephone system; there is also communication by telegraph with the islands of Boröen and Lyngör.

COAST FROM TVEDESTRAND FJORD TO ARENDAL.

(See Admiralty Charts 3151, 3150.)

For a distance of about 10 miles, as far as Arendal, the coast continues to trend in a southwesterly direction, and is throughout protected by numerous islands, which afford many sheltered anchorages. One of the principal anchorages is that at Narestö, a bay on the south side of Flostaöen, where there is a good and roomy harbor with depths of from 7 to 24 fathoms over clay and sand. Other anchorages are described in the "Pilot," but in general Tromsund affords temporary anchorage almost anywhere over its length, and it is a usual approach for ships of moderate draft to Arendal from the eastward. The shores of the Tromsund are thickly wooded.

In 1906 a special committee reported in favor of removing the Karljohansvaern Naval Station to Tromsund, but no further information has been received as to the furtherance of this suggestion.

Arendal. (See Plate 9 and Admiralty Chart 3150.)

The outer entrances and approaches to Arendal through the islands and rocks leading to Galte Sund are all fully described in the "Pilot," and certain of them are available for the largest ships. Galte Sund has its dangers, which, however, are not numerous, and for large ships this is the main entrance to the harbor of Arendal.

The town, which is picturesquely situated on a hill at the mouth of the Nid Elv, is a busy trading and shipbuilding locality, and the harbor is excellent, and large vessels may haul into the inner harbor to make use of the quays, the total length of which is about 3,000 feet. In 1914 a new quay of a length of about 377 yards was projected, but no further information of any progress has been received. The Government was to be asked for a vote to assist the municipal authorities in proceeding with the scheme.

The population of the town in 1913 consisted of 10,400 inhabitants, and the town was in a thriving condition. A new harbor has been opened at Staknes, an outport of Arendal, and the name has been changed to Eydehavn. The principal factories at Eydehavn are those of the "Arendal Smelteverk," and the "Norsk Nitrid Aktieselskab." New quays have been erected close to the factories, which are situated near the water's edge. The annual production of the latter factory before the war was 3,000 tons of nitrate, but during the war the output was increased to 4,000 tons. The principal work done is the manufacture of aluminium, for which the factory receives electrodes from the United States and Great Britain principally.

Private Shipbuilding Yards.

Shipbuilding is an important industry. The principal shipbuilding yard is that known as the "Pusnaes Stöberi og Mekaniska Verksted," whose works, it is stated, are to be shortly considerably extended, and which are situated on the north side of the island of Tromö, and partly on Skilsö, opposite Arendal. The speciality appears to be the manufacture of steamships' winches, and about nine double winches were being turned out weekly in 1916. Engines of 200 h.p. can be made, but those of much greater size could be repaired.

There are two building slips for the construction of steamers up to 3,000 tons dead weight, and a third slip of similar dimensions is under construction.

In December 1916 one steamer was on the stocks and expected to be launched within three months, and one keel was newly laid. A steamer had been launched in September 1916, and lay at the quay awaiting engines. These three steamers, each of 1,250 tons dead weight, formed the first part of an order for five similar ones. In December 1916 there were also two wooden vessels of about 400 tons dead weight each under construction.

In a large shed, with mold loft above, plate bending rolls, shearing, cutting, planing, punching frame, bending machines, &c., are installed and driven by electricity, and a large steam hammer is being completed.

Work is continually being carried on in the fitting shops, molding, turning, smithy, metal molding, carpenters, &c., shops, and in a large erecting shed for the machinery made at the works.

The smithy contains two large pneumatic hammers and one spring hammer.

In December 1916 about 500 workmen were employed.

There are only two small cranes on the premises, the larger lifting only 5 to 7 tons.

There is a "Crandell" patent slip, capable of taking ships of 3,000 to 3,500 tons dead weight. The cradle is wedge-shaped, thus the ship remains perfectly horizontal when being drawn up out of the water. The gear is electric.

The quays at the works is small, there being one wooden quay about 400 feet long and 40 feet wide at the works; there is also a stone quay at a little distance away which is used for breaking-up purposes.

No turbine plant has been installed, the power at present being obtained from the Arendal Power Station, which in turn is supplied by the "Arendals Fosse Company" with turbine gear at Boilefors.

In 1906, a company was formed for the purpose of constructing a dry dock, 500 feet in length, at the inner end of Galte Sund. In return for a loan of 5,500*l.*, the Government was to have the right of priority in its use. There is no information, however, that up to the present anything further has been done in the matter. In 1913 the import of coal into Arendal totaled 31,872 tons, and there was an increasing demand. About 5,000 tons are usually kept in stock; 10 lighters of 50 tons each and four tugs are available; ships may also coal alongside a wharf,

where there is a depth of water of 18 feet. The principal exports from the town are wood pulp, timber, &c., and the chief imports are coal, metals, and iron plates. The commercial fleet in 1913 consisted of 62 steamers of 68,176 tons, one motor boat of 56 tons, and 50 sailing ships of 50,431 tons. A British vice consul is resident.

Communications.

There is considerable communication by steamer. Steamers bound from Kristiania to Stavanger call twice a week each way, Kristiania to Bergen daily, Brevik to Kristiansand daily; there is also daily communication with Skien, and Kristiania-Newcastle steamers call once a week. Steamers from Trondhjem to Copenhagen and Stettin also call at Arendal.

A normal gauge railway line has been built from Arendal northwards to Tveitsund (56 miles), with a junction at Rise (6 miles) for a private line running to Grimstad (20 miles).

A main road runs from Arendal to Kragerö (37 miles) and from it, opposite Tvedestrand, a road runs north up the valley of the Nisser Elv to the northern extremity of Nisser Vand (65 miles), whence there are branches, one of which communicates with Odde (142 miles) on the Sör Fjord (Hardanger Fjord). Roads also run west to Grimstad (12 miles) and Kristiansand (46 miles).

Arendal is situated on the main coastal telegraph and telephone system. There is also communication by telephone, *viâ* Blakstad and Mykland, with the Otter Elv.

There is a W/T receiving station at the seamen's school in the town.

Three submarine cables [to Dühnen, and Hoyer (or Sylt)] (*see* Map 1 and Plate 9) are landed near Stölsvigen, on Hisöen (*see* Admiralty Chart No. 3150), and "Norway Pilot," Part I., 1907, page 167). Their route lies between Aerö and Hafsö, and through Torungengabet. The route of the Dühnen cable is not accurately known.

A new cable was laid down in 1910 between Arendal and Newbiggin; this cable lands at Flödevigen, near Stösvigen. A fourth cable, to Hirtshals (Denmark), lands at Grödevigen, on the opposite side of the promontory.

All these cables inland follow the course of the Nisser Elv for some miles.

COAST FROM ARENDAL TO LILLESAND.

(*See Admiralty Chart 3150.*)

The coast continues in a general south-westerly direction, and, as before, is bounded by rocks, shoals, and islands which form an "Inner Lead" between the islands of Hesnesö and Leiholmen, and can be used by vessels of moderate draft.

Fevig.

Ships are built and repaired at this small harbör, which is situated on the coast about 8 miles by sea to the S.W. of Arendal.

The principal shipbuilding yard is that belonging to "Fevigs Jernskibsbyggeri" (formerly "Sörlandets Skibsbyggeri"), which builds a large number of ships of between 1,000 and 2,000 tons, though ships can be built up to 3,400 tons. The yard usually employs about 500 workmen. The firm imports most of its plates from England. The six building slips range from 200 feet to 400 feet in length. There are two patent slips, one of which is 175 feet long; the other slip is also worked by electricity and is 108 feet long.

Large repairs can be carried out, and for building purposes the firm is affiliated to the "Fredrikstad Mekaniska Verksted" (*see* Section I.), which company often completes ships constructed at Fevig.

The "Randolph Shipbuilding Company" has been newly formed at Fevig with a subscribed capital of 37,000*l.* The area of ground occupied by the works is 40,000 sq. yards. Four building slips were completed by March 1917; they will be used for the construction of vessels up to 6,000 tons D.W.

There is a water frontage of 1,000 feet and a wood and stone quay 500 feet in length, with a depth alongside of about 20 feet. Height of quay above the water is about 6 feet.

It is expected to employ 300 workmen when the yard is finished; labor is abundant in the neighborhood, and there is additional space, so that the yard may later be enlarged if necessary. The yard is quite modern, and worked electrically, power being supplied from the Company's own waterfall.

In December 1916 one crane lifting 7 tons, and a large set of plate-bending rolls had already been installed. Further machinery, such as sheers, punching and drilling machines, etc., had then arrived at the yard and were expected to be shortly fitted up.

The company's first contract consists of two steel four-masted schooners, each to carry about 2,500 tons dead weight, and each to be fitted with two Bolinder auxiliary motors of 250 h.p.

Grimstad.

Grimstad is a small town situated round a bight on the western shore of Grosfjord, and is of little importance except for the export of timber. Boat and ship building is carried

on, and repairs of all kinds can be undertaken, though there is no patent slip. The harbor is good and available for the largest ships, and the quays, including those of the outports of Gros and Hesnaes, have a total length of about 2,009 feet, mostly wood, and supplied with only one 1-ton crane. A private branch railway runs from the quays at Grimstad to join the Arendal-Tveitesund line at Rise.

The inlet called Vigkilen runs N.E. from Grimstad, and in it there is deep water and safe anchorage; the shores are studded with villages, and there is ample communication by roads, telegraph, and telephone.

Continuing S.W., the coast is broken by Bu Fjord, in which there is anchorage in 11 fathoms, as also in Homborsund, which separates Homborö from the mainland. These and other anchorages are all described in the "Pilot." West of Homborsund is Kalvell Fjord, a shipping place for timber, which extends inland about 3 miles in a northerly direction, but the channel leading to the fjord is narrow and crooked and has only a depth of 16 feet. A road to Lillesand runs up the west side of the Kalvell Fjord.

Lillesand. (*See Admiralty Chart 2260.*)

This small trading town is beautifully situated in a bight on the west side of the bay northward of Skogerö. It was formerly a place of some importance, but most of its trade has been now removed to Arendal and Kristiansand, and the population is now only about 1,300 inhabitants. Timber is the principal article of export. The harbor is roomy and good, and anchorages in the neighborhood are well protected (*see "Pilot"*).

The quays, the depth alongside which varies from 15 feet to 25 feet, consist of the Steamship Quay, 200 feet long; the Railway Quay, 150 feet long; Municipal Quay, 225 feet long; and Custom House Quay, 45 feet long. There are no cranes, nor are there any facilities for repairs.

Communications.

Steamers running from Brevik to Kristiansand call here regularly daily; those communicating between Kristiansand and Arendal call three times a week. There is also daily communication with Kristiansand. A private railway runs from Lillesand to Flaksvand (10½ miles) on the Topdals Elv.

A road runs inland to Flaksvand, where it branches, on branch following up the course of the river, the other proceeding down the left bank and crossing the river at Foss, about 7 miles below Flaksvand, whence it communicates with Kristiansand.

Lillesand is situated on the coastal system of the telegraph and telephone.

COAST FROM LILLESAND TO KRISTIANSAND FJORD.

(*See Admiralty Chart 2260.*)

The coast continues for about 15 miles to the entrance of Kristiansand Fjord, becoming in its course somewhat more broken, and is of a bold and rugged nature.

The continuous fringe of islands extends out to sea for about 3 miles, but numerous safe anchorages, such as Gamle Hellesund, are frequent. The mainland itself consists of a succession of deep valleys alternating with rocky hills, and communications are somewhat conspicuous by their absence until the immediate neighborhood of Kristiansand is reached.

KRISTIANSAND, S.

(*See Chart 3 and Plate 10.*)

The principal approaches to the harbor of Kristiansand are by way of the Kristiansand Fjord, the channel of which is unobstructed and having very deep water throughout, and from the westward through Vestre Gabet, a channel leading between Inner Flekkerö and Outer Flekkerö. There is also an approach from the eastward through Randösund, but it is very narrow and tortuous, and there are dangerous rocks and shoals between the northern peninsula of West Randö and the mainland.

There are various safe anchorages behind the islands on either side of the Fjord, the principal of which, on the west side, are in Sandvigdals Fjord and Fiskaabugt in Inner Flekkerö, at Kiaerskilen, Flekholm, Laksvigen, and Sudervarden in Outer Flekkerö. On the east side, in addition to Topdals Fjord, there are anchorages behind Herö in deep water, and off Breivigen in an inlet leading north from Randösund; there is sufficient water for smaller vessels of 14 feet or 15 feet draft.

On the north-east side of Kristiansand Fjord and east of Kristiansand and inlet, known as Topdals Fjord, runs inland for 5½ miles, and receives on the eastern shore the waters of the Topdals river. There is a good and spacious harbor at Kongsgaardbugt on the west side of the outer part of this fjord, and there is deep water right up to Aalefier at the inner end. A sandbank off the mouth of Topdals river prevents any possibility of navigation up it.

Kristiansand harbour, at the head of the fiord, is divided into two parts by Odderö Island, lying immediately south of the town, from which it is separated by the narrow and shallow channel Graven, across which is a swing bridge. The western portion of the harbour, Vestre Havn, is regarded as the port for merchant vessels and has a depth of 32 feet of water. It is one of the best and roomiest harbours on the Norwegian coast. Östre Havn, on the eastern side of Odderö Island, is an indifferent harbour for large ships.

The port is a natural harbour, well sheltered, and available for vessels of any size.

THE COMMERCIAL PORT.

Quayage.

The undermentioned table shows the lengths and types of the quays and the depths alongside:—

Quays.	Length in feet.	Depth, &c.
1. Reinhardt's Pier (wood).....	281	18-24
2. Kommene Pier (iron).....	416	17-45
3. Fish Pier (wood).....	139	16-20
4. Customs Pier, New?.....	360	18-19
5. Moss Bryggeri (wood).....	330	18-19
6. Smith's Quay.....	413	20
7. Railway Quay.....	405	16-19

There are railway facilities to all the quays.

Harbour Improvements.

The harbour board is planning a new pier to be built from the railway quay, estimated to cost about 58,800*l*. New quays, on which a coal discharging and bunkering plant have been erected, were constructed at Reinhardt's wharf in 1915.

In January 1917 the depth of water alongside Reinhardt's coal wharf was being dredged from 18 to 24 feet.

A new quay, 500 feet long, 125 feet wide, with a depth alongside of 30 to 32 feet, was reported to be under construction in 1914. The position is not known.

Lifting Appliances.

The quays lack a good service of cranes. There are only two cranes to lift 3 and 2 tons respectively. There is a 60-ton sheers at the "Kristiansand Mekaniske Verksted," and a 27-ton sheers, belonging to the military authorities on the east side of Odderö.

Shipbuilding Capabilities.

Considerable expansion in this industry has taken place during the war. The principal yard is described in detail below, but there are also several yards in which small craft may be built.

Repairing Facilities.

There are facilities at the various shipbuilding yards for carrying out repairs to hull and machinery, both to wooden and iron vessels.

Dry Dock.

There is a dry dock, which belongs to the "Kristiansand Tørdok Company"; it is 330 feet 5 inches long, 36 feet 3 inches wide on the sill, and 18 feet deep. The dock is situated at Bredalsholm, about 1 mile north of Outer Flekkerö, and some distance from the harbour of Kristiansand.

A breakwater 120 yards in length extends in a northerly direction from the north-west corner of the island.

Patent Slips. (*See under "Private Shipbuilding Yards."*)

Coal and Coaling Facilities.

The amount of coal annually imported by the local coal merchants is about 13,000 tons. About 3,000 tons are usually kept in stock. Coaling is usually carried out by lighters, of which there are 39 of 13 to 40 tons capacity. There are two coaling jetties on the east side of Vestre Havn, of which Reinhardt's coal wharf is fitted with temporary transporters, and the depth of water alongside is being dredged from 18 to 24 feet.

Water Supply.

Water is obtained from contractor's sailing boats, each holding about 8 tons.

Trade and Shipping.

In 1915 there was a remarkable expansion in the shipping of that port. Prior to the war Kristiansand, S., already possessed an appreciable tonnage, and is now fast assuming an important standing as a shipping centre.

The net increase in the tonnage at Kristiansand, S., in 1915 was 24,945 tons. The value of ships has risen enormously. The shipbuilding yard at the port is being extended. With the extraordinary high freights, shipping profits have been very large, although heavy taxation, especially upon excess profits, has reduced the net profits considerably.

During 1915, 57 British steamships of 57,928 net tons arrived at Kristiansand, S., with cargoes from the United Kingdom, and 38 steamships of 37,298 net tons cleared with cargoes for the United Kingdom, the remaining 19 sailing for other Norwegian ports.

A British vice-consul resides in the town.

PRIVATE SHIPBUILDING YARDS.

KRISTIANSAND MEKANISKE VERKSTED.

The shipyard is situated on Vestre Havn on the west side of the town. It has been proposed to enlarge it for ships of 2,000 tons, to be later enlarged for ships up to 4,000 tons. Up to now the shipbuilding programme has only been for steamers of small size, but there are facilities for the repair of hull and machinery for vessels of 2,000 to 3,000 tons. There are 250 workmen employed. In 1916 it was reported that this firm had more than doubled their share capital, it being now 650,000 kroner. There are berthing facilities for steamers up to 400 feet in length at six piers. There is no turbine plant. There is a 60-ton sheers on the wharf, but it is not considered to be safe for a maximum load.

Dry Dock.

The dry dock at Bredalsholm is used by this company for repair work. The idea of enlarging it has been abandoned. Work on vessels in dock which requires to be done in the shop is executed at the company's shipyard in the town, the workmen being conveyed backwards and forwards every day by steamboat.

Patent Slips.

There are three patent slips, which will take ships of 360 feet, 250 feet, and 160 feet length respectively.

Building Slips.

There are two building slips, each 150 feet in length.

THE TOWN.

Kristiansand, S., is the principal town and port on the south coast of Norway. It is situated at the mouth of the Torridals Elv, or Otteraa, which is not navigable. Kristiansand is one of the most regularly built towns in Europe, being almost square, and entirely laid out in long, rectangular, and very broad streets. The principal part of the town was devastated by fire in 1902. The population of the town in 1909 was 15,370, and the principal occupation is in shipbuilding and shipping generally. The town is the seat of the district governor and of one of the five Norwegian bishops, and contains a permanent garrison. In the centre of the town there is a large square in which stands the Cathedral and other principal buildings. The principal hotels are Ernst's, which is close to Vestre Harbour; the Grand Hotel, in Dronningens Gade; the Skandinavie and the Victoria Hotels. The railway station is situated on the west side of the town. The post office is in the centre of Kogens Gade, and the telegraph office in Vestre Strand Gade; the customs office is situated at the inner end of Toldbodbryggen, while the town hall is on the eastern side of the park situated in the centre of the town. The town hospital is on the north side of the town. From the southern angle of the town, where the Vestre and Østre Strand-Gade meet, a swing bridge crosses to Odderø; a second bridge (pontoon) crosses from the eastern side of the town over the Otteraa to the village of Lund on the left bank. A fine view of the harbour can be obtained from Hamreheia, a hill which is situated just to the south of Lund. The country around the town is very hilly and a comparatively wide valley runs N.W. and inland, up which runs the railway and a small stream called the Grimsbakken. A ferry crosses the river from the N.E. corner of the town to a hamlet on the opposite bank.

There is a large wood-pulp factory near the town, and in 1913 the company proposed to erect an electric cable transporter from Aalefier, in Topdalsfjord, to bring the material to the port at Kristiansand, the distance being about 4 miles. There are also several nickel-refining works, and the washing plant for the molybdenite ore found in the neighbourhood is situated at Flottorp.

COMMUNICATIONS.

By Sea.

Steamer communication is frequent to Kristiania, Stavanger, and Bergen; to Fredrikshavn (Denmark) daily; to Copenhagen weekly; to Hamburg twice weekly; to London, Hull and Leith weekly; to Liverpool fortnightly; also frequently to Amsterdam, Antwerp, &c. Small local steamers ply daily to Arendal, Brevik, and to Mandal and Farsund.

By Rail. (*See Map 1.*)

There is a narrow gauge single track railway which practically follows the course of the Sæterdal Valley as far as Byglandsfjord (48 miles), which is situated at the southern end of Sandnes Fjord. At Evje (41½ miles) there are important nickel and copper mines. The railway is owned by the State, and in the immediate vicinity of Kristiansand it bears away to the N.W. to avoid the hills, and returns to the valley a few miles above the mouth of the river at Kveravolden Station.

It has been proposed to construct a new railway through South Norway from Kristiania to Kristiansand, whence there would be communication by steamer to Hirtshals in Denmark.

By Road.

Three main roads leave Kristiansand. One to the westward along the coast to Mandal (25 miles) and Flekkefjord (62 miles), whence there is a railway to Stavanger. A second road follows the railway to Mosby (6 miles), when it continues almost due north, and in a more direct line than the railway, to Byglandsfjord (40 miles by road), whence it continues to the north as far as Rige (87 miles). The third road proceeds to the eastward, crossing the Otteraa by bridge to Lund on the shore opposite to the town; this road connects the various coast towns with Arendal (46 miles), whence the broad gauge railway goes north to Tveitsund.

By Post, Telegraph and Telephone.

This is general.

By W/T.

There is a naval station on Hogfjeld, a hill on Outer Flekkero.

NAVAL DETAILS.

Kristiansand, S., is the headquarters of the Second Naval District. The Chief of District, a kommandørkaptein, has under him the laying-up harbor at Marvik and the second signalling company.

The laying-up harbor has been established in recent years, but it apparently is not much used, though the old storehouses are believed to be still in use, and in 1912 the Defense Law assigned the sum of 5,555*L.* to this naval station. An additional grant of 6,111*L.* was approved for the naval station in 1914, and in 1917 a grant of 300*L.* was allowed. The rough lay-out shown on Chart 3 was obtained in 1907, and it is on the same lines as the laying-up harbor at Melsomvik (*see* Section I). Stores for the men-of-war attached to the station are kept at Marvik, and it is under the direct command of a kaptein.

Kristiansand Fjord is only about 5 miles long and the unobstructed channel for the first 2 miles is only a mile in width. The water in this main channel is too deep to mine, but mining could be effectively carried out both in Vestre Gabet and Randosund, though this action would not save a town from bombardment by long range guns.

MILITARY DETAILS.

The defenses of Kristiansand, S., are of comparatively recent date. The Q.F. batteries and mine defenses at the entrance to Topdals Fjord were completed in 1895, at a cost of 22,300*L.* The heavy gun and Q.F. batteries on Oddero were completed in 1903, at a cost of 140,000*L.*, the original estimate having been reduced by 44,620*L.*, by striking out two 21-cm. guns from the "Hoved" Battery, the mine defenses, and the torpedo battery.

Guns mounted on Oddero command the principal entrance channel, but ships entering by Vestregabet can approach under cover of Inner Flekkero, Ando, and Bragdo.

Oddero, which is separated from the southern corner of Kristiansand by a narrow channel, is about 1,640 yards long. The highest point is 292½ feet above the water.

A hostile landing on the island, except on the side near the town, would be attended with great difficulties. The lowest part of the island nearest the town consists, on the western side, of some cliffs, which, though not high, are steep in places toward the sea. These cliffs are succeeded at Linnerigen and Hidoddin by a steep fir-clad mountain slope, which extends to the lighthouse. From this point to the disused "South Battery," the slope of the hill (Overberg) falls sheer down to the sea. From the "South Battery" the shore is lower, and when the sea is calm, boats can come alongside, especially in the cove, where the road between the "South" and "East" batteries approaches the sea. From this cove to the churchyard the shore becomes higher and steeper again, the last part of it being partly precipitous where the disused "East Battery" stands—44.6 feet above the sea level.

At the churchyard there is a stone pier and the usual landing place for boats. In the quarantine harbor, a cove in the Eastern Harbor, which is small and narrow, and runs up into the island, there are a couple of places where, though with difficulty, a landing can be effected from small boats. A massive stone wall, about the height of a man, runs at a short distance inland from the beach from the northern end of the quarantine harbor to the hospital. On the short north side of the island opposite to the town there are three piers with corresponding approaches; the center one of these approaches leads by a flight of 96 steps direct to the hospital.

The high portion of the island toward the S. facing the sea, the plateau of which is 656 yards in diameter, consists of rough ground difficult to traverse except by the roads. A somewhat lower hill, separated by a depression from the main hill of the island, projects toward the N. in the direction of the town, the northern slopes of which are, for the most part, steep. At the foot of this hill, which serves as an outwork, there is a small extent of flat ground, partially under cultivation, broken by rocky knolls, and closed in by the isolated hill on which the old quarantine hospital stands.

There is a marshy tarn about 50 paces in length in the dip between the farthest and the middle hill, but several other marshy hollows can be enlarged by being dug and cleaned out.

In addition to these, there are wells at the "South Battery," and at the lighthouse keeper's cottage, and also in several places on the low ground. In dry summers these are inadequate for the inhabitants of the island, and water has to be procured elsewhere. For this reason, an aqueduct has now been conducted from Kristiansand to the quarantine hospital. This aqueduct lies on the outside of the hospital hill, so that it can be destroyed by an enemy.

From the network of the roads on the low ground a single road only leads to the foot of the hill around which it runs. It divides, however, one branch running eastward to the quarantine harbor and the "East Battery," and then on farther to the "South Battery," where it meets the eastern branch. These old roads are about 8 feet wide, and are substantially constructed, but the metal has, especially in the steep parts, which are numerous, been washed away in the course of years. The western branch of the road has another road branching off from it and leading down to the lighthouse, which joins it again near the "South Battery," regaining the level by means of a flight of 126 steps.

A swing bridge 135 feet long joins Oddero to the north-west corner of the town. The depth of water under it is 9 feet, and its span 60 feet. It is not commanded by Battery No. IX, nor any of the batteries on Oddero. A 27-ton sheers belonging to the military is situated on a wharf on the west side of Oddero.

A sum of 2,500*l.* was voted in 1916 toward improvement of the defenses.

COAST DEFENSES.

Oddero Position. (*See Chart 3.*)

All guns are mounted in emplacements hewn out of the rock and cemented. No protection is provided except the gun shield.

The armament of all the guns in this position was verified in 1909. It is thought, however, that the positions of some of the works are not shown quite accurately on the chart. A permanent garrison now mans the guns, and serves for six months continuously.

In peace time the guns are usually enclosed in wooden structures, which render them more conspicuous than they otherwise would be.

A great deal of wire entanglement is everywhere visible, especially at the S. end of the island.

The 1902 Estimates stated that the searchlights and power plant would be ready by the following year; the presence of searchlights have since been reported, but their positions are not known.

Several magazines are situated at the N. end of the island, some being of recent construction.

Barracks or storehouses are visible near the summit of the island.

Strangers are not permitted to land on the island; nor would it be possible to advance very far, on account of the wire entanglements.

A saluting battery of eight light M.L. guns is situated as shown on Chart 3.

The island has its own water supply, which is obtained from wells.

"Hoved" (*Main*) Battery (No. I on Chart 3).

Two 21-cm. guns, which command the Vestre Havn as well as the main approaches to the Sound, are mounted in emplacements cut in the rock, and stand about 120 feet and 150 feet respectively above the water, the upper gun being slightly E. of the lower one.

When observed in 1907 the guns and shields were painted black.

The armament consists of—

2—21-cm. (8.2-inch) L/45 Q.F. Armstrong guns, on M/1900 C. P. mountings with shot davits and shields.

The shields differ considerably in shape from those for the same guns at Bergen, and are probably of Elswick construction.

Howitzer Battery near Summit of Position (No. II on Chart 3).

This battery stands between two flagstaffs (*see sketch*), and has a command of 250 feet, or thereabouts.

The gun shields, which are painted light grey, show up prominently, about 30 feet apart.

High wire entanglement has been observed on the slope S. of the battery.

The following report was received in July 1914, and considered to be reliable:—

"A concrete position finder cell shows up distinctly between the two flagstaffs on the summit of the island. The left-hand mast, looking from south, has a series of lamps on the stay, possibly for signalling. There appears to be a newly constructed emplacement for 1—15-cm. gun some feet directly below the above-mentioned position finder. There was a shield, but no gun was visible."

The armament consists of—

- 4—24-cm. (9.4-inch) B.L. (probably St. Chamond) howitzers, with shields.
- 1—15-cm. (5.9-inch) gun.

Nos. III, IV, V, VI, VII, and VIII on Chart 3.

With the exception of No. VIII. these are all single gun emplacements. The guns all show up very prominently on the sky line, some being painted black.

The armament of these batteries consists of—

- 3—15-cm. (5.9-inch) Armstrong Q.F. guns, with shields (Nos. III.—V.).
- 2—21-cm. (8.2-inch) guns, with shields (Nos. VI. and VII.).
- 2—65-mm. (10-pdr.) Q.F. guns (No. VIII.).

DEFENCES AT THE ENTRANCE TO TOPDALS FJORD.

Battery No. IX on Chart 3.

This battery stands at the S. extremity of Gleodden, and is intended to protect the mine-field. Ships approaching between Oksö and Grønningen come under its fire.

Two of the guns are mounted close together 40 feet above the water; the third is lower down. All three show up very distinctly from seaward.

The armament consists of—

- 3—15 cm. (5.9-inch) guns (probably Armstrong with shields).

Battery No. X on Chart 3.

Situated at the E. extremity of Gleodden, this battery stands about 20 feet above the water, and shows up distinctly from seaward.

The armament consists of—

- 2—57 mm. (6-pdr.) Q.F. guns.

Old Disused Batteries.

An old earthwork with a saluting battery of smooth bore field pieces is situated on Langmandsholm in Vestre Havn. The old guns formerly mounted in Kristiansholm Battery at the head of Østre Havn have now been removed.

SUBMARINE DEFENSES.

The original minefield, which was laid in 1900, stretched in several lines from Gleodden to Smedholm. During the war the Norwegian Government notified the existence of mine areas in the naval district of Kristiansand, but it is not known where the minefields are now laid.

In 1909 a tent containing a theodolite or other instrument was seen at the E. extremity of Gleodden, between the two batteries, and another one at the N.W. corner of the island of Smedholm opposite. They were probably D.P.F. stations.

In 1914 it was reported that a large building existed under the high ground at the end of Varodden Point. This building had several lightning conductors attached to it, and had the appearance of being a mine store. A part of the red roof only is visible from the south.

SEARCHLIGHTS.

No searchlights were visible during the visit of H.M. Fleet to the port in June 1914. There is little doubt, however, that they do exist both in Odderö and also on Bragdö, or one of the other islands. An agent reported in 1916 that searchlights exist, but he could not state the positions. The lights are probably run by a small engine on the island of Odderö, as the town current is stated to be unsuitable. The vegetation and configuration of Odderö facilitate concealment.

MAGAZINES.

There are magazines for the batteries on Odderö, as above stated, situated on that island. There is a magazine situated immediately in rear of Battery X., and two others about 70 yards west of it. All three are quite sheltered from the south.

There is a magazine on Langmandsholm.

GARRISON AND MILITARY ESTABLISHMENTS.

A garrison is stationed at Kristiansand, but the numbers and distribution are not known. There are barracks on Langmandsholm, and in the vicinity of Kristiansholm; also, it is reported, on Odderö.

The general's house and the general staff office are situated in Östre Strand Gade, immediately N.N.W. of Kristiansholm. The military hospital is at the eastern end of Dronningens Gade.

LAND DEFENCES.

There are no land defences to Kristiansand, the only existing defences being those already described under "Coast Defences." The hills around are rocky and in places precipitous, and it would be impossible to drag heavy guns on to the hills without previously constructing roads. The undermentioned heights form suitable commanding positions for guns, but at present no roads exist suitable for the passage of guns to them.

(a) Duekniben Position. (See Chart 3.)

This is $\frac{3}{4}$ mile west of Kristiansand. The height is 280 feet, and it commands the harbour and town, and is about 12 feet lower than the highest point of Odderö. It is doubtful whether the guns of Odderö can train on to this position. A small footpath leads up to the hill from the main road on the west side, and it is stated that this might be made suitable for the passage of guns.

There is a reservoir of water close to the summit.

(b) Graamanden Position.

This is situated $3\frac{1}{2}$ miles west of Kristiansand, and is accessible from an unmetalled road to the south. The height is 620 feet. The summit is rocky and there are no paths leading up it. Only the actual summit of Odderö is visible from this hill, but Fort No. IX. at Gleodden can be clearly seen, while it commands the valley running down to Kristiansand and a portion of the town also.

(c) Tönden Position. (See Chart 3.)

This lies 800 yards west of Mövig, overlooking Inner Flekkerö Harbour. The height is 300 feet.

This hill commands the town and harbour of Kristiansand and the coast from S.W. to E. for some distance. There is a large open platform near the summit suitable for guns.

The ground is rocky and there are no existing roads or paths. Water can be obtained from a small lake near the summit.

AVIATION.

There is a seaplane station at Kristiansand. A grant was made towards it in the 1917 Estimates. The position is not known, and there are no details, except that two sheds were under construction in May 1917.

LANDING PLACES.

There are only two places in the nearer neighbourhood where landings may take place with the reduction of Kristiansand as the objective. From each there is direct communication with Kristiansand, and they do not come under the command of the existing defences.

These landing places are at (1) Höllen, and (2) Mövig, or Inner Flekkerö Harbour.

(1) Hollen Landing Place.

The reasons for selecting this particular landing place are that:—

- (a) It is the best landing place suited for an attack on Kristiansand from the north-west, the undefended side.
- (b) It is connected with Kristiansand by a first-class metalled road.
- (c) It is commanded by no existing defences.
- (d) Ships can approach at night without being sighted from the wireless station on Outer Flekkerö Island.
- (e) Only in the severest winters is the harbour likely to be blocked by ice.

The anchorage ground in the near vicinity of the landing place is very restricted, and large vessels would be obliged to lay off the entrance of Höllen Fjord, between Mönso, Skarpö, and the Kieö group. Ships of any size could use this anchorage; the holding ground is good, and shelter from all winds should be found there.

The available area is about 60 acres. In addition to this, a single ship, moored, would find swinging room to the northward of Rodskier and westward of Saltholm, actually in the fiord. The depth in both anchorages is about 20 fathoms, but there is a 13 fathom patch in the outer anchorage.

The maximum distance from the landing place would be just over a mile.

Finally, a ship of moderate size might anchor, with a stern hawser to the shore, close off the landing place itself, in a depth of 10 fathoms.

The least dangerous of the numerous channels by which Höllen Fjord may be approached is that west of Skarvö and between Monsö and Skarpö. This channel could be used at night provided that Songvaar and Ny Hellesund (Tö Point) light were exhibited as usual.

By day it would be necessary to replace any buoys which might have been removed, and in the case of ships drawing over 20 feet, to buoy the $3\frac{1}{2}$ fathom patch nearly 2 cables E.S.E. from the E. point of Langö.

Leading lights at Höllen would enable a ship to pass west of Röds kier at night, but there would probably be no object in going so far in.

If the inner anchorage is to be used, the $2\frac{1}{2}$ fathom patch on the south side of Saltholm should be buoyed.

The rise and fall under ordinary conditions never exceeds 1 foot.

The general direction of the current is to the westward. In the autumn and winter it often slackens during westerly and southerly gales, and even sets to the eastward with considerable force; but when this happens it seldom lasts more than a day. During summer gales the current generally maintains its westerly direction. Off Kristiansand it is felt at least 20 miles from the coast, but most strongly at a distance of from 5 to 10 miles, where it sometimes attains a rate of 3 knots.

Between and within the rocks and islands fringing the coast there is not unfrequently an eddy setting to the eastward.

From April to September inclusive westerly winds prevail, whilst in the winter months north-easterly and easterly winds are more frequent. In October and November, however, south-westerly gales accompanied by rain and thick weather may be expected.

Landing Place.

The shore on the west side of the landing place is rocky, the depth being about 6 feet close up to the shore.

On the east side there is a sandy beach shelving very gradually.

Boats can land in all weathers on the west side of the pier.

Rise and fall of tide is 9 inches, and never exceeds 1 foot.

There is little space for military purposes above high-water mark, the ground being rocky.

On the north side of the village of Höllen the country is open and the houses are few.

War vessels can without difficulty cover the disembarkation of troops.

Landing Facilities.

1. The pier is built up with stones and faced with woodwork.

Length of pier 110 yards, width 9 feet.

Depth of water at the end is 2 feet, but on the W. side there is a landing stage 15 yards long with a depth of water alongside of 9 feet.

Height of landing stage above water is $4\frac{1}{2}$ feet at high water.

2. In the small shipbuilding yard at the N. end of the pier there is a large supply of wood, which could be used for constructing temporary landing stages.

3. There are no local tugs or lighters. The only local craft available are a few small fishing boats.

4. There are no positions at present fortified to oppose the actual landing.

The landing place is surrounded by high ground which commands it; approaches to it are impassable by artillery, and the nearest guns are stored in Kristiansand, distance 12 miles from Höllen.

5. The ground at the landing place is absolutely sheltered from fire inland, when the high ground immediately overlooking the landing place is once held.

6. Three hundred men and four machine guns can land simultaneously at Höllen as a covering force.

7. In the valley of the River Søgne, which runs near the main road to Kristiansand at a distance of 2 miles from Höllen, there is ample ground available for camps and bivouacs.

8. In the village of Höllen there are a number of two-storeyed wooden buildings suitable for stores.

Communications.

8. Owing to the impassability of the country movement is confined to the roads.

There is only one road running from Höllen, a first-class metalled road, width 8 yards, which branches off 2 miles N. of Höllen into two roads. One runs W. to Holme, distance 12 miles, and the second runs N. to Kristiansand.

At Brennaasen the road to Kristiansand again divides. One follows the course of the River Søgne, the second runs between hills 600 feet high to Kristiansand, entering the town at the S.W. corner. This road comes under fire of the guns of Odderö as soon as it approaches the sea coast.

From Greipstad a second-class metalled road, width 5 yards, runs N.E., joining the main road from Mosby-Kristiansand one mile N. of Kvernvolden, where there is a railway station.

By following this latter road it is possible to approach Kristiansand from the N.W. without coming under fire of the guns of Odderö Gleodden.

There is telegraph and telephone communication between Höllen and Kristiansand. Each farmhouse along the road to Kristiansand is also in telephonic communication with Kristiansand.

The only railway line is a single line of railway running N. from Kristiansand to Byglands Fjord. Length of railway line, 45 miles. Gauge, 3 feet 9 inches.

9. Distances:—

Höllén to Kristiansand by direct route, 12 miles.

Höllén to Kristiansand *via* Kvernvolden, 15 miles.

10. The road Höllen to Kristiansand crosses the River Søgne, 2 miles N. of Höllen by a wooden bridge.

The river here has steep banks, 18 feet high; span is 40 feet.

In the event of this bridge being destroyed, the material available at Höllen is amply sufficient to build a new bridge.

(2) Mövig, or Inner Flekkerö Harbour, Landing Place.

1. The reasons for selecting Mövig as a landing place are that:—

(a) It is the nearest place to the objective where there are facilities for landing, the distance from Kristiansand being 6 miles by road only.

(b) It is commanded by no existing defences.

2. There are no defences in the immediate neighbourhood of Mövig. The defences of Odderö are 2½ miles distant in a straight line, but the conformation of the ground shelters this landing place from fire from the guns of these batteries.

3. During severe winters only the harbour may be blocked by ice.

A number of vessels of moderate size might be berthed in this small harbour if moored by stern hawsers to the rings on shore.

It has depths of from 11 to 16 fathoms over an area of about 30 acres, the bottom being principally clay, though there are a few rocky patches.

Within the harbour there is no room for a ship to swing, even if moored, but large vessels might, if necessary, anchor just outside in Vestre Gabet and would still be only about ½ mile from the landing place. Here, however, the depth is very irregular, varying from 9 to 27 fathoms in a distance of about a cable, and the holding ground is probably very bad.

In Vestre Gabet and the harbour entrance some sea would be felt with south-westerly winds, and ships would be more or less exposed to these.

Vestre Gabet could be navigated by night only if Torstenæs light and Jongeholmskier light (58° 51' N., 8° 0' E.), or lights in similar positions, were exhibited. By day, it would be necessary to replace any buoys which had been removed or displaced—particularly that marking the dangerous shoals off Smaavardeboen—and also to buoy the extensive shoal N.W. of Frederiksholm in Inner Flekkerö Harbour.

Landing Place.

The beach is shelving and the shore is rocky. The water close in shore is 6 feet deep.

There are no sunken rocks or other dangers close in shore.

The rise and fall of tide is 9 inches; never exceeds 1 foot. Boats can land in all weathers.

Above high-water mark the ground is open but rough and rocky, all of it is available for military purposes.

War vessels can cover disembarkation and can lie within 500 yards of the landing place.

Landing Facilities.

1. The pier is wooden; length, 10 yards; width, 4 yards; height above water, 4½ feet; depth of water alongside, 9 feet.

There is a second smaller pier a few yards west of the first; length, 5 yards; width, 6 feet; depth of water alongside, 6 feet.

2. There is very little material available for constructing landing stages.

3. No local craft are available.

4. There are no positions at present fortified to oppose the actual landing.

The batteries of Odderö are $2\frac{1}{4}$ miles from Mövig in a straight line, but the harbor and landing place is sheltered by Bragdö and Andö from fire from these batteries.

The ground surrounding the harbor is open and rocky.

Tönden hill is 350 yards west of the landing place, height 300 feet. This commands the harbor and surrounding country, and forms an excellent observation station.

5. The ground at the landing place is sheltered from fire inland, from the direction of Kristiansand, but is commanded from the high ground west of the harbor.

6. One hundred and fifty men and two machine guns can land simultaneously at Mövig as a covering force.

7. There is ample ground available for bivouacs or camps close to the landing place.

8. There are four small two-storyed cottages close to the landing place, in addition to two cottages which are inhabited. With the exception of these there are no buildings suitable for stores.

Communications.

A road runs from Mövig to Kristiansand, average width 5 yards. It is unmetalled for the first mile, after which it becomes a second-class metalled road until within 2 miles of Kristiansand, where it joins the road from Höllen, and is a first-class metalled road.

There is telephone communication from Mövig to Kristiansand.

The road from Mövig to Kristiansand comes frequently under fire of the Odderö batteries.

There is no railway.

8. The distance from Mövig to Kristiansand is 6 miles.

Resources.

1. There is an ample supply of fresh drinking water from the River Søgne, in which there is plenty of water at all seasons of the year.

Numerous streams cross the road between Höllen and Kristiansand, also between Mövig and Kristiansand.

There are also a number of freshwater lakes near the roads.

2. The country is little cultivated. Corn and vegetables are only grown in the valleys. The time of harvest is at the end of August.

3. There is an unlimited supply of wood.

4. The local transport is poor. The carts are very small. The native ponies are small and strong.

General Conclusions.

The landing place would prove valuable if a surprise landing were intended.

There being no land defenses to Kristiansand, an attack upon the town from the direction of Kvernfolden, N.W., would be very effective.

The garrison of Kristiansand consists of only about 200 men in peace time.

An attack on the Odderö position from any side except that near the town is almost impossible.

COAST FROM KRISTIANSAND TO MANDAL.

Nine miles south-west of Kristiansand, the Songvaar Fjord is thickly studded with islands, rocks, and shoals, which continue westward as far as Manne Fjord, which receives the waters of the Mandal river.

Mandal. (*See Admiralty Chart 3012.*)

Mandal is the most southerly town in Norway, and had a population in 1914 of 3,600 inhabitants. It consists also of the suburbs of Malmö and Kleven.

Outside the town there are several large steam saw mills and a rope-walk.

Mandal's Havn is itself nothing more than a small estuary, but there is a deep approach, available for the largest vessels at any time of the tide to the anchorage in 8 to 10 fathoms. There are quays 930 feet long with from 12 to 13 feet of water alongside, and it is stated that the river has now been dredged to 16 feet to permit of such vessels approaching them.

At Kleven there is 620 feet of quayage with 14 to 16 feet alongside, and at Gismorö Skibs Verft quay there is a length of 240 feet with from 12 to 22 feet alongside. At Ko-odden, opposite Gismorö, a new quay has been constructed 125 feet in length with 23 to 25 feet alongside; this wharf is used for coaling, and is the nearest coaling depot to the Naze.

There is a wharf at Kleven where wooden ships can be repaired, but there are no mechanical works; there are no docks or patent slips. The average stock of coal kept is between 200 and 400 tons. A British vice-consul is resident at Mandal; the principal exports being timber and fish, while imports consist principally of coal and foodstuffs.

Communications.

Communication by steamer is frequent. Mandal is a center of good roads; the coast road proceeds eastwards to Kristiansand (30 miles), and westward to Lyngdal (18 miles) and Flekkefjord. A road also proceeds inland up the valley of the Mandal river to Aaseral (62 miles) on the Örevand, and a continuous network of less important roads lead east and west from this road through the mountains. Mandal is a station on the main coastal telegraphic and telephonic system.

COAST FROM MANDAL TO FLEKKEFJORD.

West of Mandal the coast is very irregular and fronted by a "Skärgård" about $3\frac{1}{2}$ miles wide; there are numerous harbors of refuge and anchorages under the lee of islands, which are described in the "Pilot."

The Naze, or Lindesnaes, to which a road leads, marks the most southern extreme of the mainland of Norway, and from it rises some mountainous country.

Grönsfjord, immediately westward of the Naze, is about 6 miles in length and less than half a mile in width at its entrance, which is easy of access; it leads through a narrow strait to Lenefjord, at the head of which passes the main coast road, and the main coastal telegraph and telephone system. On the west side of Raevö, the island on the west side of the entrance to Grönsfjord, is the excellent little harbor of Korshavn, where there is good anchorage for small ships.

Farsund. (*See Admiralty Chart 3011.*)

This small seaport town, with a population of 1,600, lies at the entrance to Lyngdalsfjord on the side of a steep hill. The harbor, which is of little commercial importance, has an inner harbor with a depth of water of about 31 feet. Quays surround the whole harbor and have a depth of water alongside of from 12 to 18 feet.

There are mooring rings and dolphins in the harbor.

There are no docks or slips, but there is a wharf for keel-hauling ships up to 900 tons. Only 100 to 200 tons of coal are usually kept in stock; coal is delivered by lighters, or ships may coal alongside a wharf in 14 feet of water. There is a British vice-consulate.

Communications.

A road runs up the east side of Lyngdal's Fjord to Lyngdal, where it meets the main coast road from Flekkefjord to Mandal. There is communication by telegraph and telephone with Lyngdal, which is on the main coastal system; there is also telephonic communication with Flekkefjord, and with Vanse on the coast to the south-westward.

The promontory west of Farsund, and between it and Lister Fjord, is comparatively flat, and terminates in a low sandy shore bordered by ranges of sand hills; this formation is a peculiarity not met with elsewhere on the coast of Norway, except in places in the Jaederen.

Northward of Lister, the coast forms a deep inlet for 11 miles, called Lister Fjord, in which there are several anchorages. A ferry crosses the Lister Fjord from Fedde to Rörvig, joining the two ends of the main road.

Flekkefjord. (*See Map 4 and Plate 11.*)

The town of Flekkefjord lies at the head of the fjord of the same name, which connects with the sea by way of the Strands (Stroms) Fjord, or Stols Fjord, through Lister Fjord. (For detailed description of approach, see "Norway Pilot," Part II., 1915, and Plate 11.)

The narrow passage between Flekkefjord and Grisevåg to the north divides the town into two parts which are connected by a drawbridge. The town is beautifully situated, with a good harbor, and its principal industry is connected with its extensive tanneries. A British vice-consul resides in the town, which has a population of a little over 2,000 inhabitants. There are only two hotels.

In the neighborhood are Leervig harbor, in Feddefjord, where there is a new quay, 125 feet long with 20 feet of water alongside and which steamers visit for wood pulp; nearer to the entrance and on the north shore of Feddefjord is the village of Fedde, at the mouth of the Gylands River. There is road communication east to Kvinesdal and west to Flekkefjord, while from the opposite shore a road winds over the mountains to Mandal.

Nearer to the sea are three well-protected harbors; two of these, viz., Rasvaag and Kirkhavn, are on the island of Hitterö. The third, Risholmen, is at the entrance to Flekkefjord. All afford good shelter and have depths varying from 30 feet upwards, while there is telephone communication to the mainland from Kirkhavn and Risholmen, the cable for the former crossing from Lauvnes on the north coast of Hitterö. From Abelsnaes, opposite to Risholmen, a road leads to Flekkefjord.

The Port.

The harbor is roomy and free from dangers, with a depth of water from 9 to 14 fathoms; it is frequented by coasting steamers, and, in 1911, 21 steamers and 21 sailing vessels visited the port. There are two new quays with a depth of water alongside of from 16 feet to 18 feet. The average repairs are only of a small nature. Coal can be obtained up to 200 to 300 tons; it is delivered on board from lighters, though there is a coaling wharf with a depth of 17 feet alongside.

Communications.

There is communication by steamer and by telegraph; a road and narrow-gauge railway communicate to the westward and inland with Egersund (37 miles) and Stavanger; to the S.E. a road goes to Mandal (40 miles). The railway station is on the east side of the town. Telephonic communication is possible with Egersund and Farsund; also, eastward with Mandal and Kristiansand, and northward with Netlandsneset.

COAST FROM FLEKKEFJORD TO STAVANGER.

From Hitterö the coast continues in a N.N.W. direction and is high and free from dangers as far as Egersund, with the exception of some rocky patches between Sireaaen and Jossing Fjord, between which and the mainland, however, there is a channel which is sometimes used by coasting vessels.

At Soggendalstrand there is a telegraph station, and there are important iron mines close at hand, from which a private light railway runs to Rekefjord.

Egersund. (*See Map 4 and Admiralty Chart 3007.*)

Egersund, or Ekersund, is a town of about 3,200 inhabitants, situated in a rocky region at the south end of Jæderen, the flat coast district extending to Stavanger. The town is the headquarters of a fishing fleet.

The Port.

The actual harbor of Egersund, to which there are two approaches—one to the eastward and the other to the northward of Egerö—is divided into the Outer and the Inner Harbors. The Outer Harbor is well protected from the sea, and there is sufficient room for a large number of ships to anchor at an average depth of 36 feet. The depth of water at the entrance to the Inner Harbor is only 20 feet, and there is a steamboat quay, 350 feet in length, with a depth alongside of 14 feet; there is also a railway quay, but this has only 12 feet of water alongside. Only the smallest repairs can be executed, and there is a patent slip for vessels up to 150 tons.

Communications.

Egersund is a station on the narrow-gauge railway connecting Stavanger (47 miles) with Flekkefjord (37 miles). There are railway bridges crossing the arms just north of the town, and a third crosses an arm a little further to the westward. The two main roads practically follow the railway each way to Stavanger and Flekkefjord. The town is connected by telephone and telegraph with the general Norwegian systems through the coast towns, and by telegraph only northward *via* Aalgaard to Helle on the Høgs Fjord, and continuing to the north.

The Danish cable to Peterhead (Scotland) is landed near Hestnes, about 2 miles south of Egersund town. Its route (only approximately known) passes within about a cable of the east side of Skarvö.

JÆDEREN COAST.

At Sirevaag the mountainous coast begins to fall toward the sea, and immediately to the northward is situated the lowland of the Jæderen district. This part of the coast is very low, but a range of hills begins to rise at a distance of 4 or 5 miles inland. From Sirevaag to Vigdeldsnaes, a distance of 24 miles, there are no harbors and the beach is of white sand; off the north end of Jæderen there is an extensive group of islands and rocks, while the coast to the southward is hilly. This is one of the most peculiar tracts of Norway; its surface is undulating and occasionally there are low hillocks; at rare intervals there are groups of trees, and the country is intersected by a network of stone walls which divide up the luxuriant meadows and farm lands. A considerable number of roads cross this district in every direction.

The railway continues within a mile of the coast as far as Obrestad (W. of Naerbo), when it takes a northerly course and continues up the west side of Gands Fjord to Stavanger.

The south side of Skudesnaes Fjord is much intersected by islands, rocks, and shoals, and the islands and mountains further inland are very lofty.

(For further details, and for detailed approaches to Stavanger, see "Norway Pilot," Part II., 1915, and Admiralty Charts 2281 and 1662.)

STAVANGER.

(See Map 4, Plate 12, and Admiralty Chart 1662.)

The main approach to Stavanger from the southward is by way of Haastens Fjord into Byfjord, while the best and easiest approach by day and night, both from the northward and westward is through Skudesnaes Fjord and Kvidsø Fjord. These channels may be used by all classes of vessels, and there is anchorage in 11 to 14 fathoms off the town. In addition, there is an inner channel between the rocks and the mainland for ships having local pilots when approaching from the southward; this channel can be entered between Feisten Light-house and Sørskod. The fjords eastward of Stavanger and Skudesnaes form a deep bay, with numerous branches extending inland in different directions. The south side of this bay is studded with thickly-wooded islands, and northward of these a broad, deep channel, formed by the Bukne and Neerstrand Fjords, extends 26 miles E. N. E. from Skudesnaes Fjord. These fjords are termed collectively Stavanger Fjord, and afford numerous anchorages, but the vollages and small townships near them have no significance from a military point of view, as communications are lacking except by sea.

THE COMMERCIAL PORT.

The harbor of Stavanger is divided into the Östre Havn and the Vaagen by the Holmen Peninsula. As a rule large steamers use the quays at the mouth of Vaagen where there is a depth of water of 33 feet alongside the Eastern Quay. The fjord steamers and local craft use the quays at Ryfylke-Bryggen on the N.E. side of Holmen. The outer portion of Vaagen Harbor has depths of from 11 to 14 fathoms, decreasing to 8 and 4 fathoms toward the head. (For further details—see "Pilot.")

Quayage.

The various quays from west to east are as shown in the Table:—

Quayage.	Length.	Depth alongside.
	<i>Fet.</i>	<i>Fet.</i>
1. Kranenkaien.....	270	6 to 14
2. New Quay.....	1,049	29½
3. Storekaien.....	1,290	9 to 33
4. Skandeskaien.....	570	
5. Ryfylkekaien.....	330	
6. Kjerringholmen.....	750	6 to 14
7. Stenkarkaen.....	850	6 to 14
8. Jorenholmekaien.....	300	

There are also several piers, with a depth alongside of 3 to 14 feet. All the quays are about 4 feet above the level of the water at high tide.

Harbor Improvements.

A new quay is under construction in the south-west part of Vaagen Harbor, opposite Storekaien. A length of 485 feet had already been completed by January 1917, the work having been commenced at the northern end; there is a depth alongside this section of 29½ feet. Work is proceeding, and eventually the total length of the new quay will be 1,049 feet.

A new pier is also under construction in Östrehavn, running out from Rosenkilde Alm, opposite the fish market. The total length of this pier when completed will be 393 feet, and if will be 60 feet wide; in January 1917, a length of 196 feet and a width of 49 feet had already been completed, and the depth of water was 6½ feet at the inner and 23 feet at the outer end.

Lifting Appliances.

There is one crane to lift 15 tons, one to lift 3 tons, and nine cranes to lift 1 ton each. The positions of these cranes are shown in Plate 12.

Shipbuilding Capabilities.

The two largest shipyards in Stavanger completed during 1915 six steamers of 3,100 tons. These two yards are dealt with later under "Private Shipbuilding Yards."

Repairing Facilities.

Repairs to both hull and machinery can be effectively carried out either by "Rosenberg's Yard," or that of the "Stavanger Støberi and Dok Company." In addition, repairs can be undertaken by the "Graesholmen Slipway Company" on the island of Graesholmen, the "Sølyst Slipway Company" on the island of Sølyst, "Rosenberg's Works" on the south-west side of Buøen, and "Strömstenensvaerft," situated on the peninsula east of Østre Havn.

Dry Docks.

The "Stavanger Støberi and Dok Company" owns two dry docks, which are situated at their yard in the eastern quarter of the town. The largest vessel yet docked is one of 1,849 tons with a draught of 11 feet 6 inches. The dimensions of these docks are given in the dock book.

A new dry dock is proposed as an addition to "Rosenberg's Mekaniske Verksted's" extension works in the island of Buøen. The headland on the south side of the entrance to Nyhavn is to be cut through to form the dock, which is to be of an ultimate length of 570 feet, and large enough to accommodate the biggest ships of the Norwegian-American Line. There is to be a gate pontoon inside the dock, by closing which the dock may be divided into two parts, so that two small ships may be docked at the same time.

Patent Slips.

There are two patent slips in the "Rosenberg's" extension works on Buøen, and one in yard belonging to the "Stavanger Støberi and Dok Company." In addition to these, there are two slips in Graesholmen, belonging to the "Graesholmen Slipway Company," these two slips are situated, one on the north-east side and the other on the south-west side of the island. The extreme length of slip No. 1 is 170 feet and of slip No. 2, 150 feet; the cradles are 60 feet and 50 feet long, with a capacity for vessels of 9 feet and 8 feet draught respectively; the lifting capacity is 80 tons and 30 tons dead weight respectively.

The "Sølyst" Patent Slip is situated on the south-east side of the island of that name. The extreme length is 120 feet, and the cradle is 40 feet long; it is capable of lifting 60 tons dead weight, and of taking a ship of 9 feet draught.

In the island of Buøen there is a patent slip belonging to the "Nyhavnsverft"; it is situated on the west side of Nyhavn; the length of the cradle is 46 feet, and the lifting capacity is 20 tons dead weight; it can take a ship drawing from 6 to 10 feet.

An eighth patent slip is situated at Strömstenensvaerft, on the peninsula east of Østre Havn. The length of the cradle of this slip is 30 feet, and it has a lifting capacity of only 12 tons dead weight. The depth of water at the slip is from 6 to 10 feet.

Salvage Appliances.

The salvage steamer "Hercules" is stationed here; she belongs to the "Norsk Bjaergnings Company," and has a pumping capacity of 1,000 tons per hour. She is also fitted with all kinds of gear and has a speed of 10 knots.

Coal and Coaling Facilities.

72,300 tons of coal were imported in 1913 by the local coal merchants. Five thousand tons are usually stocked. Twenty-seven lighters are available. The two private coal wharves are 350 feet and 200 feet long respectively, with depth varying from 20 feet to 23 feet alongside.

Water Supply.

There is abundance of fresh water which is supplied by the Stavanger Waterworks Company. The waterworks are situated on a hill called the Vaalandshaug, or Vaalandspiben (328 feet), which is situated to the S.W. of the town, and has a conspicuous tower.

Trade and Shipping.

Stavanger is the headquarters of the extensive herring fisheries on this part of the coast; of late years, however, these fisheries have deteriorated, and shipbuilding is the principal branch of industry. According to the Norwegian Register for 1912, the port of Stavanger owned 35 steamers and 4 motor ships of a tonnage of 52,000 tons, and 35 sailing ships of a total tonnage of 21,353 tons. The principal exports are herrings and other fish, and artificial manure; imports include chiefly coal, salt, and grain. A British vice-consul is resident in the town.

PRIVATE SHIPBUILDING YARDS.

Rosenberg's Mekaniske Verksted.

The older part of this yard is situated on the west side of the entrance to Vaagen, and occupies the site of an old naval yard at Sandvig Bay. Extensions, however, are in progress on the south-east side of Nyhavn, in Buøen, which will enable the yard to deal with much larger orders, and it is stated that on completion the firm will be able to turn out vessels up to 12,000 tons gross. Progress on the improvements is already started, and the building slips will be completed in January 1917.

At present the largest steamer built by this company has been one of 329 tons, fitted with oil engines, but during 1916 the firm had an order for five steamers, the largest of which were to be of 800 tons dead weight; two of these steamers were already under construction in January 1917, as well as one fishing vessel of 133 tons gross.

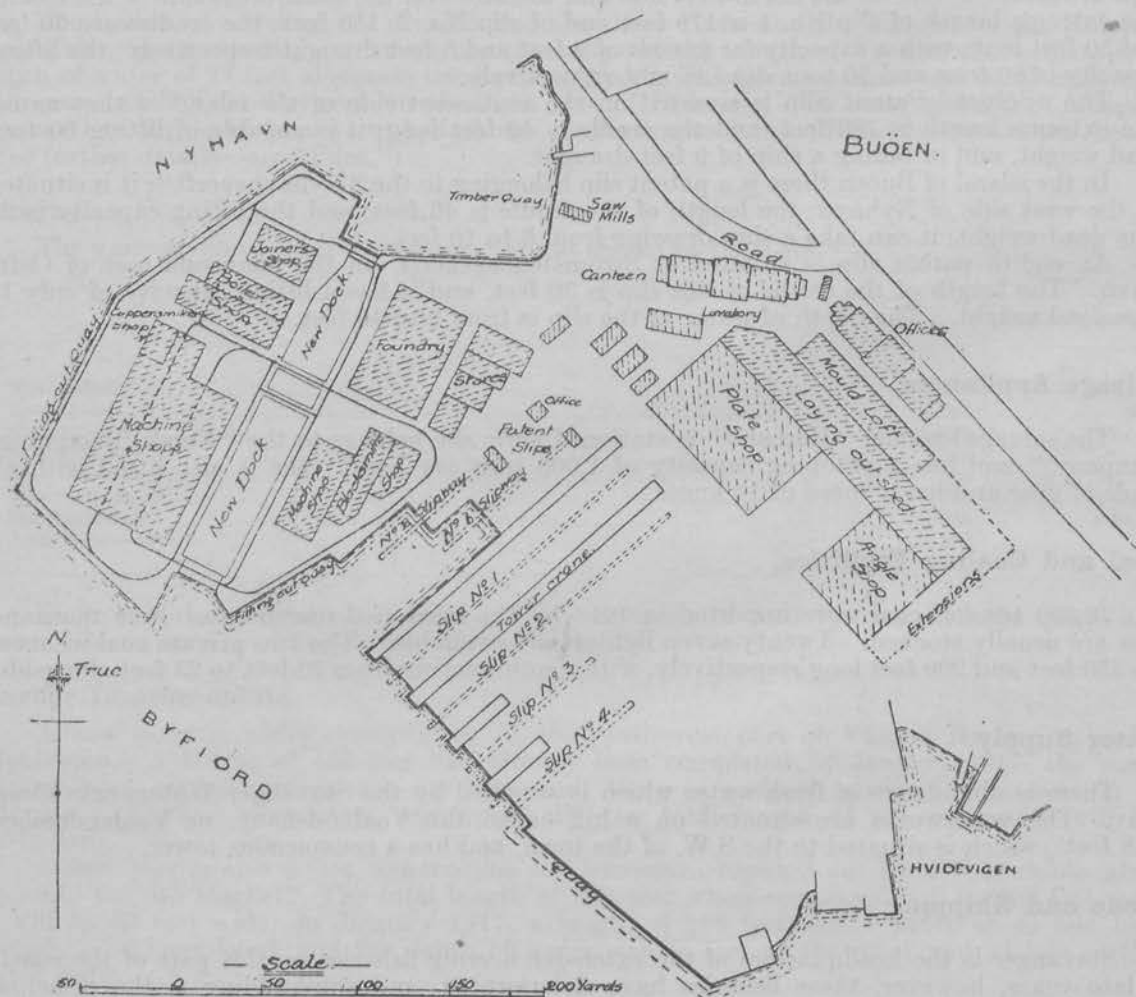
Ships are repaired and engines and boilers are constructed by this company, which employs about 250 men at the Stavanger works, and at present 130 men at the Buøen Extension Works. There is a boiler crane to lift up to 40 tons at the old works in Stavanger.

The extension works at present under construction are shown on plan below, and the following description gives the progress of the work up to January 1917. At present the quay to the east of the slips is under construction, and 160 feet have already been completed. Ships drawing 30 feet of water will be able to go alongside, where there is a minimum depth of 32 feet 10 inches.

It is expected that Slip No. 1 and Slip No. 2 will be completed during the summer of 1917, when two vessels of 9,000 tons d.w. each will be laid down, and it is anticipated that the number of employes will then be increased to 700. The engines for these steamers have already been ordered in Sweden. Power is generated by steam.

An electrical crane of six tons, marked "Tower Crane," to serve both slips is to be put up in the summer, and two smaller cranes are to be erected on the quay to the east of the slips.

Two other building slips will eventually be built immediately adjoining and parallel to Slip 2. There are two patent slips to the north and adjoining Slip No. 1. These have already been in operation some time, but lately No. 1 has been dismantled, and a new one is to be erected in its place, with a cradle 250 feet long and a lifting capacity of 3,000 tons dead weight. This patent slip is expected to be ready by September 1917. The extreme length of No. 2 patent



ROSENBERG'S MEKANISKA VERSTED, STAVANGER.

slip is 337 feet, with a cradle 140 feet long in two parts; this slip is capable of taking a vessel 165 feet long, and with a draught of 9 feet forward and 15 feet aft, and not exceeding 550 tons gross.

It is anticipated that it will take 2½ years to construct the dry dock, which is to be 570 feet long and built right across the peninsula, as shown in the plan. This will enable it to be entered from either end, as necessary, and in addition it is to be provided in the center with two gate pontoons, which will enable the dock to be used by two small ships at the same time.

The workshops, &c. shown on the side of the proposed dry dock nearest the slips are to be built during 1917, while those on the other side of the dry dock towards the end of the peninsula are not to be started until the dock is completed.

It is considered that on completion of the whole work, the number of workmen employed at this yard will be at least 2,000.

Stavanger Støberi and Dock Company.

This yard is situated in the eastern quarter of the town of Stavanger. In addition to large repair work, the firm is able to construct steel ships up to 2,000 tons, as well as engines and boilers, but no turbines are built. The orders for 1916 included six steamers, of which the largest was one of 2,050 tons dead weight. In January, 1917, two cargo steamers were under construction, both with two boilers and triple expansion engines of 900 I.H.P. These steamers were 254 feet and 235 feet long respectively. The number and actual lengths of the building slips is not known. The number of employees in January 1917 was 380.

The company owns two dry docks, which face N.E. and N.W. respectively. The dimensions are given in the "Dock Book."

There is also a patent slip, the extreme length of which is 265 feet; the cradle is 109 feet long, and is capable of taking a vessel 120 feet long, and of 7 feet draught forward and 12 feet aft.

There is a crane to lift 36 tons.

THE TOWN. (See Plate 12.)

The town of Stavanger is one of the oldest in Norway, and is the commercial center of the district surrounding the fjord. It is the capital of an "Amt," and had a population in 1915 of 42,000 inhabitants. The town dates from the ninth century, but has suffered from many fires and is now completely modernized. The chief industries consist in fish canning and shipbuilding. The main street of the Holmen quarter in the peninsula is the Kirke-gade which leads up to the Cathedral and Town Hall. There are several squares in the town, of which the principal are the Valbjergstaarnet, E. of the Vaagen quays; the Kongsgaard, on the south side of the Cathedral; that in which stands St. Peter's Church, to the east of the Cathedral, and a large square, in which stands Hetlands Church, which lies to the west of the Støberi Dock Company's shipbuilding yard.

Stavanger is the center of an agricultural neighborhood, the farmers being employed chiefly with dairy farming.

The town is gradually being extended towards the west and south, and the islands in the immediate neighborhood are dotted with houses. To the south of the town are Mosevandet and Hillevaagsvandet which are two comparatively large lakes, situated on either side of Vaarlands hill, on which stand the waterworks and a high tower; there is also a small lake immediately to the south of Vaagen harbor, and called the Bredevandet. There is a sports ground with a cycle track running round it, situated a little to the north of Mosevands Park, which skirts the northern shore of Mosevandet. The town gasworks are situated to the south of Rosenberg's shipbuilding yard at Sandvigen. To the south of Lake Brede are the railway station, the theater, and the museum, the latter being a conspicuous building on a small hill; adjacent are the hospital, a gymnastic hall, and other new buildings. On the hill N.W. of the town, and beyond Sandvigen, is a public park, called the Bjergsted, which is hilly and well timbered. About 2 miles S.S.W. of the town there is a conspicuous hill, 460 feet high, called Ullanhaug or Ullenhaug, on which there is a tower; a new W/T station has been erected on this hill. The principal hotels are the Victoria, near the steamboat pier; the Grand Hotel, in Valbjerg Gade; the Nordstjernen; and the Fru Eeg Larsen Hotel. The Post and Telegraph Office is in Øvre Holme Gade, in the center of the Holmen Peninsula; there is telephonic communication throughout the town. The electric transformer station and the waterworks are situated to the south of the town; the former close to the east side of Lake Mosevandet.

It was reported in 1916 that a new company had been formed in Stavanger with a capital of one million kroner for establishing electrical smelting works near Lysefjord. There are also electro-steel works in Stavanger.

COMMUNICATIONS.

By Steamer.

There is direct communication by steamer with Kristiania, Bergen, and other coast ports, with Göteborg, Stettin, Hamburg, Rotterdam, Hull, Newcastle, and Liverpool, &c.

By Rail. (See Maps 1 and 4.)

There is communication by narrow-gauge railway with Egersund (47 miles) and Flekkefjord (93 miles). South of Naerbö (22 miles) the line approaches the coast, but again turns inland from Egersund. This is a State-owned railway. The station is situated in the center of the town, just south of Brede Vandet.

By Road. (See Map 4.)

With the exception of the coast road from Stavanger through the Jaederen to Egersund, which is fairly level, the roads around Stavanger have steep gradients, and wind through the mountains. Several roads run to the coast. From Sandnes (9 miles), at the head of Gandsfjord, two main roads communicate with Egersund, the coast road and a road of about the same length (37 miles) running through the mountain country.

In the northeast corner of Stavanger Fjord there is a fjord called Sandsfjord, at the head of which stands the town of Sand; from this town a road leads east to the extremity of Suldalsviken (18 miles), whence a ferry connects with Nesflaten at the further end of the lake; the road continues from this point due north through mountain country to Odde (37 miles), an important center for carbide, situated on a southern inlet of the Hardanger Fjord; at the Breifonn hotel near Röldal on this road, a motor road leads S.E. *viâ* Dalen to Skien. From Odde there is direct communication by sea or road with Bergen. From the north shore of Stavanger Fjord there is also road communication with Haugesund, from the little ports of Skudeneshavn, Aarvik, Hersvik, Nerstrand, and Vikedal. Motor traffic is possible on the main roads, but the usual form of conveyance is by means of the local carriages called "Skyds," which are frequently obtainable.

By Telegraph.

There is communication by telegraph to Egersund; also to Tungenaes Point, whence a cable crosses to Skudesnaes.

By Cable.

The telegraph and telephone cable crosses from the south side of Tungenaes Point to Kvitingsö Island, which it crosses and lands on the island of Karmö, east of Skudenaes Harbor.

By Telephone.

Telephone communication is direct with Skudesnaes, the islands of Bru, Aamö, Fogn, Mosterö, Rennesö, Finnö, Helgö, and Sjernerö in the Fjord, north of Stavanger; *viâ* Sandnes, northwards through the coast villages to Sand, whence cables run to Nesflaten, Sandesjöen, and round the fjords to Ölen, whence there are again branches to Haugesund, and northward along the coast; also south to Aalgaard; and along the telegraph route to Egersund.

By W/T.

The new W/T station on Ullanhaug hill, near Stavanger, was completed early in 1916 at a cost of 40,000*l.*, but the high power instruments were not installed at the end of that year, owing to the war. This station is to be the transmitting station for the Inter-Oceanic duplex system with the stations at Marin and Chatham in Massachusetts, U.S.A. The receiving station corresponding with Marin is situated at Naerbo, about 25 miles south of Stavanger, and though completed in 1916, lacked instruments for the same reason as Ullanhaug. For a few months during the war a set of short distance instruments were installed at Ullanhaug for communication with Stonehaven, but these have now been removed to the station at Kristiania.

NAVAL AND MILITARY DETAILS.

Stavanger is considered to have many advantages as a base for H.M. naval forces in case one were needed on the S.W. coast of Norway. It is an open town, at present entirely undefended, and it appears to be the intention of the Norwegian Government not to defend it in case of hostilities occurring. It is not connected with any of the main railway systems. The town is situated on the northeast apex of a low and comparatively flat peninsula, formed by Gans Fjord and the sea. South of it lies Jaederen, a flat plain, principally pasture land, which is probably one of the most fertile regions in Norway. A railway runs through this plain which connects Stavanger with the undefended seaports of Egersund and Flekkefjord, and in places runs so close to the sea as to make it very vulnerable to destruction. Stavanger, if it can be attacked at all from the land side, can only be attacked from the south where communications are more possible. Moreover, the harbor is not land-locked, and can not, therefore, be subjected to an effective cross fire from placed land batteries. The entrance is considered to be too deep to mine effectively. If Stavanger was seized as a base against the wishes of the Norwegian Government there should be no obstacle against its capture where surprise is employed, but it should be observed that three Norwegian torpedo boats are usually stationed at Hvitingsö at the southern approach to Skudesnaes Fjord.

At Malde, about 5 miles southwest of Stavanger, there are wooden barracks with a rifle range of 500 yards length. Troops were formerly regularly drilled there. About 2,500 men were concentrated at Malde in May-July 1916.

COAST FROM SKUDESNAES FJORD TO MOLDE FJORD.

Coast.

Northward of Skudesnaes Fjord, the characteristic features of the Norwegian coast begin gradually to appear.

As far north as Espevaer, a fishing station on the north side of the entrance to Bømmel Fjord, the coast is protected for the first 16 miles by Karmö, a long narrow island, which is much lower than the mainland. There are several outlying clusters of islands, among which Utsire is important as being one of the several W/T stations on this coast, used for communication with the fishing fleet. Northward and southward of Karmö are the Bømmel and Skudesnaes Fjords, and Karmsund connects the two; these form the Inner Lead, and Karmsund is available for vessels of moderate draft.

There are several anchorages on the west coast of Karmö, as well as in the entrances to the Inner Lead; they are fully described in the "Pilot."

Skudesnaes Havn. (*See Admiralty Chart 1662.*)

This port is situated on the south end of Karmö, and is a good harbor of refuge. In the outer harbor there is a depth of water of from 24 to 30 feet, but the inner harbor has a depth at low water only up to 16 feet and is therefore only available to ships of moderate draft. The harbor authorities own the quayage, which consists of a length of 260 feet, with no crane facilities, and with only 10 feet of water alongside at low water. There are no docks or patent slips, but the port has facilities for careening vessels for repair up to 400 tons. In 1914 there was a population of 1,300 inhabitants, most of whom are employed in the fishing industry.

A telegraph and telephone cable connects with Stavanger, and northward to Haugesund.

Kopervik (or Kobbervig). (*See Admiralty Chart 881.*)

This small harbor, which is a great center of the herring fishery, is situated 9 miles north of Skudesnaes on the southern shore of a narrow fjord on the east coast of Karmö. The peninsula connecting the north and south parts of the island of Karmö is here less than half a mile wide to the head of Veavaag, a long narrow fjord which opens off the west coast (*see "Pilot"*).

The harbor of Kopervik is small and shallow, but is much used by small craft as a harbor refuge.

There is considerable wharfage, and minor repairs can be effected; there is a patent slip which will take a ship up to 300 tons. The cradle, which is 103 feet long, is worked by steam.

The telegraph and telephone lines between Skudesnaes and Haugesund pass through Kopervik, which is also connected by telegraph with Utsire, the cable leaving the west coast of Karmö from Aakrehavn just south of Veavaagen.

Bö.

At the small anchorage of Bö, an outport of Haugesund and 5½ miles north of Kopervik, there is a small coaling station (marked on Chart 881). There is a wharf here with a depth of water of 22 feet alongside. In 1916 there was a stock of about 200 tons of German coal.

A new dry dock is to be built here, capable of taking at first ships up to 8,000 tons. It is to be later enlarged to take ships of 14,000 tons. The length at first is to be 400 feet, which will eventually be lengthened to 528 feet, with a width of 78 feet and a depth of 33½ feet.

The site for the new dock was secured in 1914, but it is not known whether construction has commenced.

Haugesund. (*See Plate 13 and Admiralty Chart 881.*)

Haugesund is situated at the north end of Karmsund, partly on the mainland and partly on the islands of Hasselö and Risö. There is a small harbor between Hasselö, Risö, and Garpeskier, and in Smedsund, which lies between Risö and the mainland, there are three quays for steamers, which have recently been lengthened by 300 feet and fitted with electric light. The total length of quayage at Haugesund is 500 yards, which is supplied with six small hand cranes. It is proposed to extend the quay, but work had not commenced in March, 1917. The proposed new dry dock is described under Bö. There are three ship-repairing yards, of which "Haugesund's Mekaniske Verksted" and "Hauge's Jernskibsbyggeri" each employ about 150 workmen. Ships of an average size of from 600 to 800 net tons can be repaired on their slips, of which that belonging to the former company is situated on the opposite side of Risöen from the yard, and has a cradle 250 feet long. Steamers up to a length of 290 feet can be accommodated on this slip. The latter company is situated on Hasselö. The slip is 510 feet long, and the cradle 259 feet long; vessels of length up to 290 feet and of 3,000 tons d. w. can be repaired on it. "Haugesund's Slip Company" owns three small slips of 260 feet, 235 feet, and 220 feet length respectively. A new shipbuilding yard was reported in 1916 to be under construction at Nordheim, south of Haugesund, and it is stated is to be built on modern lines; it will be provided with a dry dock, slips, &c. A moderate supply of coal may be obtained; the total quantity imported in 1913 being 38,305 tons. The town owns

a considerable quantity of shipping, and the Norwegian Register for 1912 showed that it then totalled 83,000 tons steam and 2,000 tons sail.

Fish is the principal export, and the chief imports are coal and salt. There is a British vice-consulate. The population of the town in 1913 was 13,147.

Communications. (See Map 4.)

Communication by steamer with Bergen, Stavanger, and other coast ports is frequent. There are good roads on the island of Karmö, and on the mainland roads connect up the heads of almost all the fjords; the principal road communication inland is via Skjold and Ölen to Saevereid on Aakre Fjord, or southwards from Ölen to Vikedal on the Vindfjord.

The coastal telegraph and telephone system passes through Haugesund, and there is also communication by both inland, to meet the inland north and south cables at Ölen. There is communication by telephone alone to ports on the Bukken Fjord, and by telegraph to the outlying islets of Foeöen and Rövaer.

Coast.

Northwards of Haugesund there are a mass of large islands lying off the entrance and northward of Bömmelen and the Hardanger Fjord. Numerous channels, all more or less navigable, separate them from each other on the mainland, and there are a variety of anchorages and harbors of refuge. These are all discussed in the "Pilot." One of the principal anchorages is that at Lervig (plan on Admiralty Chart 2304), a large bay on the S. E. side of Stordöen, which affords suitable anchorage for vessels of all classes, but is open to the S. E.

There are important sulphur and pyrites mines near Lervig.

Communication is maintained by telegraph and telephone with all parts, and mail steamers call regularly.

Hardanger Fjord. (See Admiralty Chart 2304.)

The Hardanger Fjord is the best known of the Norwegian fjords, and presents a most characteristic example of Norwegian scenery; a wide fjord, with bold rocky shores, and a strip of fertile land fringing the water.

The principal entrance is through the Bömmelen from the S. W., which has great depth of water and an unencumbered channel, though the entrance from the sea is somewhat obstructed by numerous rocky islets, which can, however, be easily avoided. Vessels proceeding to Bergen from the south through the "Inner Lead" pass through Bömmelen and then strike northward through either Stoksund and Nyleden or take the somewhat longer course through the wider and less obstructed Langenuen.

Both of these channels are available to ships of deep draft approaching the southern end of Hardanger Fjord from the north, while the channel through Loksund, which connects Björne Fjord with the northern extremity of the Hardanger Fjord, is about 4 miles in length and has a depth of from 7 to 12 fathoms in the narrowest part.

The main branch of the Hardanger Fjord extends, under various names, about 50 miles in a north-easterly direction from the entrance, when it bifurcates, one branch, Sörfjord, extending 20 miles to the southward to Odde, the other, Eidfjord, 15 miles to the eastward to Vik. There are also numerous branches, in most of which anchorage may be found. Hardanger Fjord is for the most part free from danger, but its shores are nearly everywhere almost steep-to.

There is ample water in Sör Fjord for the largest ships, and at its head off the town of Odde there is good anchorage over mud in a roadstead about 10 cables long and 6 wide, with deep enough water for the largest ships. Steep mountains rise to over 3,500 feet on either side of the anchorage, but a deep valley runs south from Odde, in which there is a fairly good road communicating with Telemarken and the Stavanger Fjord, also to Dalen on Lake Bandak, whence there is communication by steamer with Skien (see Section 1). There is a pier for steamers, and in the town are three hotels. The main importance of Odde is due to the calcium-carbide and zyanamide factories which have lately been installed there; several of these are situated to the S. E. and above the town on the right bank of the Aabo River; they are supplied with electric power from the power station at Tyssedal (3 miles up the fjord on the east shore) and are connected with the quay by a tramway and overhead transporter. There is a post office and a telegraph office in the town, and trunk telegraph and telephone lines connect direct with Kristiania and Bergen.

Nearly opposite to the entrance of Sör Fjord and leaving Hardanger Fjord in a north-easterly direction is a small fjord, called Graven Fjord, at the head of which is the village of Eide, where there is a steamer pier and anchorage in 27 fathoms. A road leaves the village and proceeds north for about 2 miles, when it bifurcates, one branch proceeding N. W. to Voss (14 miles) on the Bergen-Kristiania Railway, while the other turns N. E., and, making a big sweep round the mountain, reaches Ulvik (8½ miles) on the western arm of Osa Fjord, a branch of Eidfjord. There is telegraphic and telephonic communication from Eide with the main systems, and Ulvik communicates with Eide by telephone.

The Eidfjord is the most easterly branch of the Hardanger Fjord. The village of Vik stands at its head and is supplied with several jetties; there is anchorage off the village, above which, on the S. E. side, tower a range of mountains. Road communication with the

interior is indifferent, but there are numerous bridle paths through the mountains; there is no telegraph or telephone.

Telegraphic and telephonic communication is kept up across the Hardanger Fjord and its branches in various places; commencing from the sea, there is a telegraph cable crossing the entrance of Bømmelen from Mølstrevaag to Bømmel. Further east, the coastal telegraph and telephone cables cross from Nordhus to Leirvik on Støre Island; an alternative route carrying main cables from Stavanger to Bergen crosses from Herösundet on the south shore to Onarheim and Gjermundshavn; further east again the main cable lines from Odde to Bergen cross the fjord between Vikingsnes and Røirvik, and both telegraph and telephone lines connect Utne, at the junction of the Sør Fjord with Hardanger Fjord, with Eide, on the north shore.

BERGEN.

(See Chart 5, Map 6 and Plates 14 and 15, *Admiralty Charts* 2304 and 2391.)

The approaches to Bergen are described in detail in *Norway Pilot*, Part II., 1915. There are four main approaches from the sea through the mass of islands which protect the entrance to the harbor. The most southerly is that through Korstfjord-Bergen Head-Byfjord; from the channel of Lerøosen in the lead, there are two channels of approach to the Byfjord, of which the more easterly—through Vattestrom—is the most usual track, and is only 24 miles from the open sea, though the passage through Kobbeleden is almost as near, quite as unobstructed, and is used sometimes by shipping. The large island of Store Soterö and its attendant archipelago prevent any direct approach from the westward, and the other three approaches—of which the most usual is that through Feiösen-Hieltefjord-Byfjord—are from the northwest or west. The distance from the open sea to Bergen by the Feiösen-Hieltefjord-Byfjord route is 35 miles, and it should be noted that Hieltefjord can also be entered by the narrow passages between the innumerable islands which enclose the western side of this fjord. An alternative route, which is used by ships approaching Bergen from the north, is *via* Feiösen-Herlöfjord-Byfjord.

The most northerly route is by Feiösen-Radöfjord-Byfjord, but this route is not considered as part of the North Lead, and is seldom used even by coasters. Österfjord and Sörfjord are two deep channels encircling Osteröen, a large island completely shut in by the mainland, to the eastward of Bergen. The south side of Sörfjord is skirted for a considerable distance by the Bergen-Voss-Kristiania Railway.

Anchorages amongst these fjords are few and far between, especially in the northern approaches; they are discussed in the *Pilot*.

THE COMMERCIAL PORT.

(See Plate 15.)

The Port of Bergen possesses two main harbors which are considered ice-free; viz., Vaagen Harbor, on the north side of Nordnaes Peninsula, and Puddefjord, on the south side; also the inner and outer basins, called respectively Lille Lungegaardsvand and Store Lungegaardsvand, to the S.E., the last named being connected with Puddefjord by a narrow shallow channel, crossed by a driving road and the present railway bridge. In addition, there are the neighbouring harbors of Nyhavn, Sandvig, and Skudevigsbugten to the north of the port, and Laxevaag on the south-west side of Puddefjord.

Men-of-war and yachts are berthed in Puddefjord, between Frederiksberg and Laxevaag in not less than 10 fathoms and good holding ground; smaller warships are sometimes berthed further in about Jaegteviken or even, in case of torpedo boats, alongside Möhlenpris Quay. Before reaching the naval station at Marineholmen, near the end of Puddefjord, Messrs. Mjellem and Karlsen's Patent Slip and Engineering Works are passed. Further progress to all but quite small boats is at present barred by the entrance under the railway bridge to Store Lungegaardsvand, where there is sometimes a strong current. At Solheimsviken are situated the yards of the Bergen Engineering Works.

There are extensive mooring facilities and numerous buoys in the two harbors, and dredging is constantly being undertaken.

The shore southwards from Sandvig to the saluting fortress of Bergenhus is fringed with fish and other warehouses and small quays of little importance. The entrance to Vaagen Harbor is protected from N.W. winds by the new Skoltegrund Quay, and partially also by the Customs Quay.

Quayage.

Skoltegrunds Quay, the new quay built west from the northern end of Faestnings Quay, is now nearly completed. Ships drawing 30 feet can come alongside both sides, but the water shallows on the north side on closing the land. A temporary shed has been run up at the outer end of the quay for the accommodation of passenger's baggage from the Norwegian-American Line steamers. The northern berths are very exposed in a northerly wind.

Faestnings Quay is the principal quay in Bergen. The outer and middle portions are mostly used by coasting vessels and the Newcastle mail steamers. The southern end is taken up by the mail steamers running north.

A temporary single track railway line runs the whole length of this quay and connects up with the station in the town. There are three one-story corrugated iron sheds on this quay, and further covered space could easily be provided by running out a sloping roof from the fort walls.

The 10-ton crane has only an all-round radius of about 12 feet, and the hook when fully up is only about 15 feet above the quay.

Bradbanksbryggen is used only by coast mail steamers running to Kristiania. There is an open shed over most of it. The water front between this quay and Tyskebryggen consists at present of numerous wooden quays, which are occupied as storage area by the owners of the warehouses on the other side of the road. The depth alongside is small.

Tyskebryggen, or German quay, is used by the Stavanger mail boats and other small coasting vessels trading in wood, fish, &c. There is a corrugated iron store shed on the quay. The fish market (*Fiskebryggen*) lies at the end of the bay.

Holbergsbryggen. Between the Holbergs quays and Mure pier there are three large stone six-storied warehouses used for grain storage, and other heavy goods.

Nykirke Quay is used by the "Nordre Bergenhus" steamers. There is good storage accommodation on shore between this quay and the church.

Toldbodbryggen (Customs quays) is being improved. There is a stone warehouse on the north quay. The water space between the north and south quays is taken up entirely by lighters. The Customs house and sheds are situated on this quay, and outside them lie several warehouses along the water's edge.

Public gardens extend round the point of Nordnaes, and a storm signal station is situated on Fort Frederiksberg, close to which the dome of the observatory stands out conspicuously.

In Puddefjord, the Sukkerhusbryggen in Nøstet Bay is the usual landing-place for boats from men-of-war and yachts; ferry boats frequently run thence to Laxevaag, to a point near the Laxevaag Dock and shipbuilding yard.

There is at present indifferent railway communication with the quays, but improvements are in progress (see "Harbor Improvements"). The majority of the quays are lit by electricity or gas.

The following table gives details of the various quays at Bergen:—

TABLE OF QUAYS.

Name.	Length in Yards.	Cranes, &c.	Construction.	Depth alongside in Feet at Normal Water.	Remarks.
<i>In Vaagen Harbor.</i>					
Skoltegrunds Kaien.....	765	One 30-ton fixed.	Masonry.....	30	Being completed.
Faestnings Kaien.....	492	One fixed 10-ton hand, one 2-ton, one 1-ton.	Stone.....	20 to 22	Improvements proposed.
Bradbanksbryggen.....	98	.....	Wood.....	11 to 16	Improvements proposed.
Tyskebryggen (German Quay).	167	Two 1-ton....	Stone.....	13 to 26	Corrugated iron warehouse.
Murebryggen.....	124	One 2-ton, one 1-ton.	Wood.....	8 to 15	
Holbergbryggen (North).....	153	} Two 1-ton....	{ Stone.....	8 to 20	} Good storage.
Holbergbryggen (South).....	153		{	15 to 18	
Nykirkebryggen (North).....	153	} One 2-ton, one 1-ton.	{ Stone.....	26	
Nykirkebryggen (South).....	120		{ Stone and wood.	12	
Toldbodbryggen (North).....	198	} Seven various.	{ Stone.....	17 to 19	Stone warehouse.
(Only about 20 for ships).					
(Toldbodbryggen (South).....	185	} Seven various.	{	11 to 16	Chiefly for barges.
(Only about 27 for ships).					

TABLE OF QUAYS—*continued*.

Name.	Length in Yards.	Cranes, &c.	Construction.	Depth alongside in Feet at Normal Water.	Remarks.
<i>In Puddefjord.</i>					
United Sardine Factory.....	76	.....	.....	20 to 25	Coal site. Improvements proposed.
Nøstebugten.....	65	.....	Stone.....	18	
Sukkerhus (North).....	191	} One 2-ton, one 1-ton.	{ “	15	Good storage.
Sukkerhus (South).....	273		{ “	20	
Møhlenpris.....	120		{ “	16	
Naval Harbor (four quays).....	.....	.....	.....	.....	Length of each quay about that of a T. B.
Laxevaag Coal Wharf.....	166	.....	.....	20	12,000 to 15,000 tons stored here for “Bergenske S. S. Company.”

Berthing operations are sometimes interrupted by northerly or northwesterly winds. For coal wharfage, *see under* “Coaling facilities.”

Harbor Improvements.

Necessity has arisen lately for additional quay accommodation at Bergen, which need was intensified by the great fire in 1916. Plans are under consideration which involve an expenditure of millions of kroner, and a resolution was passed in April 1916 which recommended the construction of large modern quays with electric cranes both at Tyskebryggen and Dokkes-Kjaerne. Work was commenced on Tyskebryggen Quay in March 1917; work also started in 1917 on a new quay to take the place of the storehouses on the Vaagen destroyed by the recent fire. This quay will extend from Muralmenning to the Torv.

The first steps to be taken, for which money has been already granted or for which it will be granted in the near future, consist in the completion of Skoltegrund's Quay, an extension of the Custom House Quay, and for a quay connecting Tyskebryggen and Bradbanks Pier. It has been stated on the best authority that the cost of these undertakings would be about 300,000 kroner. No decision had been taken by December 1916 as to the fittings for Skoltegrund's Quay, but there were two proposed alternatives: (a) with movable electric cranes on either side and warehouses down the center, and (b) to cover the whole quay with one large warehouse, with electric fixed cranes on either side of it. The latter alternative will most probably be adopted. The foundation for a 30-ton fixed crane has been laid at the bend in the southern face.

Some time will probably elapse before the ground has sunk sufficiently, as the material used for filling up between the quay walls was very mixed, stones and rocks in one place and clay elsewhere.

The Custom House Quay extension is being carried out on the north side of the North Quay.

A very considerable amount of dredging will be required to complete the work of building the quay to connect Tyskebryggen with Bradbanks quay. This work will be carried out after the completion of Skoltegrunds Quay. Following these improvements, the next most likely extensions will consist in deepening the entrance to Store Lungegaards Vand and the erection of quays on Dokkeskjaeret, the island in Puddefjord, opposite the gasworks. The idea is to create a large quay space in this locality for oversea trade, and possibly in conjunction with a free harbor.

In addition to the above improvements, work will shortly be commenced on blasting away part of the old fortifications on Faestnings Quay in order to give more quay space. It is at present impossible for ships to discharge direct into railway wagons at this quay, as the lines are laid too far from the edge of the jetty. The Sukkerhus Quay has lately been enlarged, and progress is being made with extensions at the United Sardine Factory's Wharf. The west side of Store Lungegaards Vand is being filled in.

Other projects for the improvements of the harbor have been mentioned and consist of:—

1. Deepening the entrance to Nordasa Vand, situated to the south of Løvstakken Mountain, and the construction of a free harbor in this piece of water. This harbor would be connected by a railway tunnel under Løvstakken with Laxevaag, and thence with Bergen by a long suspension bridge over the Puddefjord.
2. Construction of large silos for grain and salt on either Kristiansholm or Svineryggen.

Railway facilities to the quays are at present indifferent, as there is only a single track from the station to Faestnings Quay. Meanwhile a tunnel is in progress of construction from

the station to the Skoltegrund Quay and Sandviken, but this will not be ready before the end of 1918. Owing to the gradients and curves on the present line a small locomotive only can be used, and at most only three full 12 ton trucks can be taken at a time over the hill past the Fire Station. In case of necessity, however, it is considered that it would not be difficult to sink the line through this hill, and double track large portions of the line, at the same time easing curves in the worst places. A temporary goods station and siding could be quickly arranged along the eastern side of the fortifications on Faestnings Quay where the ground is flat. A temporary line could also be run down Strand Gate to the quays on that side of Vaagen.

Preliminary steps were taken in 1912 to construct a breakwater off Port Sandvig, but beyond the foundation work nothing had been done in September 1914, the work being delayed from want of funds.

Lifting Appliances.

The following list gives the number and type of cranes on the various quays:—

Name of Quay.	Number.	Type.	Lifting Capacity in Tons.
Skoltegrundskaien.....	1	Fixed.....	30
Faestningskaien.....	1	"	10
	1	"	2
	1	Traveling..	1
Tyskebryggen.....	2	"	1
Toldbodkaien.....	7	Fixed.....	Various.
Holbergbryggen.....	2	"	1
Murebryggen.....	1	"	2
	1	"	1
Nykirkebryggen.....	1	"	2
	1	"	1
Sukkerhusbryggen.....	1	"	2
	1	Traveling..	1

There are also several cranes of about 1 ton lifting capacity each at private wharves, &c. The "Bergens Mekaniske Verksted" owns two floating cranes to lift 25 tons and 15 tons respectively, and the "Laxevaags Maskin-og Jernskibsbyggeri" owns one floating crane of 7 tons, one jib crane of 7 tons, and a sheers to lift 70 tons. "Mjellern and Karlsens" have a crane up to 50 tons lifting capacity.

Shipbuilding Capabilities.

Shipbuilding is one of the staple industries of Bergen and comprises the construction of quite large steamers, though men-of-war have not yet been built here. For further details see under "Private Shipbuilding Companies."

The following figures, supplied by Lloyd's surveyor, gives statistics of ships built in 1913 and under construction at the end of the year at the Bergen yards:—

Name of Yard.	Built.		Under Construction.	
	Vessels.	Tonnage.	Vessels.	Tonnage.
Bergens Mekaniske Verksted.....	9	12, 990	2	2, 200
Laxevaags Maskin og Jernskibsbyggeri.....	6	6, 880	2	2, 280
Mjellern and Karlsen's Mekaniske Verksted.....	3	527	2	410

There is a small shipbuilding yard at Gravdal near the entrance to the fjord; it can build ships up to 130 tons.

Repairing Facilities.

The shipbuilding yards and engine factories afford every facility for repairs to hull and machinery both of wooden and iron vessels.

Dry Docks.

There are three dry docks at Bergen, the dimensions of which are given in the Dock Book. They are owned respectively by the "Bergens Mekaniske Verksted" at Solheimsviken, the "Laxevaag Dokkompagni" at Laxevaag, and the "Bergens Dokkompagni." It was reported in August 1915 that the Norwegian Government had placed an order with the "Bergens Mekaniske Verksted" to supply a new floating dock, to be built and run by the company. The dimensions are to be: length 400 feet, breadth 89 feet, and depth 39 feet.

Patent Slips.

There is a patent slip at the "Laxevaag Maskin and Jernskibsbyggeri," which is 700 feet long over all, with a cradle 284 feet long, and a lifting power of 3,000 tons. Messrs. Mjellern and Karlsen own two ships, each of which is 500 feet long; the length of cradle of the

larger is 216 feet, and it will lift a ship up to 1,600 tons dead weight; the cradle of the smaller is 172 feet long, and it will lift a ship up to 500 tons dead weight.

Salvage Appliances.

The "Norsk Bjergnings Kompagni A/S.," which has its head offices in Kristiania, has a branch at Bergen. This company undertakes all kinds of salvage and submarine work, towing, &c., and has several salvage vessels stationed in various Norwegian ports, of which the "Achilles" is stationed at Bergen. This ship is wooden, speed $10\frac{1}{2}$ knots, pumping capacity 2,000 tons per hour, and fitted with portable pumps, a motor launch with electric searchlight, hydraulic jacks for 120 tons, and an 18-inch manila towing line.

Harbor Craft.

The following is a list of the principal tugs, with such particulars as their owners have supplied:—

Name.	Owners.	H. P.	Tonnage.	Remarks.
Argus.....	Engelsen and Sars.....	35	65	Can also supply water.
Rapid.....	".....	30	59	".....
Glimt.....	Captain O. Stavenaes.....	.....	.....	53 feet long.
Hvepsen.....	Kulkompagniet af 1871.....	26	17	Can also supply water.
Bien.....	".....	24	17	".....
Lessing.....	Bergens Buyersbaad Kompagni.....	.....	26	
Kampen.....	".....	.....	24	
Liv.....	Captain M. Nielsen, Nordre Bergenhus } Amts Dampskibe.	65	10	
Lyn.....		39	6	
Stella.....		17	.....	
Titan.....	Captain Ole Michelsen.....	.....	.....	

Besides the foregoing, there are about 27 other tug boats owned by the harbor authorities, ferry companies, milling firms, &c. Lighters appear to be mostly owned by private firms, such as grain and flour-mill owners, coal merchants, &c. Masters of grain vessels have occasionally complained of scarcity of lighters. In 1912 there were 166 lighters with an aggregate registered tonnage of 8,300 tons. A report in 1916 states that Mr. Ottesen of Bergen has purchased 12 lighters of from 185 to 400 tons in Holland; eight of these had been delivered in September, and the others were shortly expected.

Coal and Coaling Facilities.

The following is a list of coaling quays where coal is stored; the method of coaling is by means of tubs supplied by hand labor either from quay or lighters alongside.

Quays.	Length in feet.	Situation.
Engelsen and Sars.....	400	Vaerttet (Evje and Andersen).
Kulkompagniet af 1871.....	350	Solheimsviken.
Bergen Kulkompagni.....	375	Jaegtviken (near gasworks).
Victor Müller.....	.....	".....
A/S. Irgens and Hammer.....	.....	Bontelbo (exposed to N.W.).
Hausen and Hirsch.....	210	Solheimsviken.
Halvorsens Kulkompagni.....	300	Möhlenpris.
Dokkeskjaeret.....	.....	Puddefjord.
United Sardine Factory Quay.....	500	Laxevaag.
Bergenske S/S Company.....	.....	

The amount of coal imported in 1913 was 281,405 tons, most of which was British.

The average stock of coal kept in hand is about 13,000 tons, and large ships must coal from lighters, as the depth of water alongside the coaling wharves is not sufficient for them to come alongside. At the "Bergenske S. S. Company's" wharf there is a depth of water of over 20 feet, and it was stated on good authority that the stores there would hold 12,000 to 15,000 tons of coal, and that in December 1916 these stores were full.

Liquid Fuel.

Nothing is known of any liquid fuel supply existing in Bergen.

Water Supply.

The water is pure and clear and excellent for drinking. The main source of supply is Svartediget Lake. A little water is also obtained from reservoirs above Sandvig. The supply is laid on to the keys, and is also supplied by water tanks (*see under "Harbor Craft"*) to ships lying at anchor.

Trade and shipping.

Bergen is the great center for the arrival of the fishing fleets from the north, and its principal export is fish in various forms; the value of the exports in 1912 was 2,266,161 $\frac{1}{2}$. The chief imports are coal and foodstuffs. A British vice-consul is resident in the town. In regard to

the engineering works and shipbuilding yards were extended and fitted with the most modern machine tools. It is claimed that pace has been kept with the times since 1901, and that improvements and various extensions have been made, including a further increase in the engineering works, a modern compressed air instalment, and an oxo-acetylene plant for autogen welding.

This firm has so far built upwards of 160 vessels, complete with engines and boilers, and has also supplied a quantity of engines and boilers to new vessels built in other yards, and to industrial works. Their manufactures include large turbine pipes and ventilators, and the size of the vessels built has gradually increased from small tugs to ships of 3,000 tons dead weight. Seven new steamers were ordered in March 1916, and the largest previous passenger and cargo steamer built was the "Texas" of 2,293 register tons. Repairs on a fairly large scale can be undertaken, and it is understood that some of the Norwegian torpedo boats are annually overhauled at this yard. The annual output is about four vessels, averaging 2,450 tons each.

The entrance to the yard is on the east side, and directly facing it on entering are the offices; next to the offices on the north side is the carpenter's shop, to the north-east of which is a long building, containing the main boiler shop in the northern half, and the foundry in the southern half. Immediately west of the offices and between them and the dry dock is the coppersmith's shop. Various sheds are situated to the south of the offices on the dock wall; opposite these sheds and to the eastward against the wall of the yard are the main stores, south of which is the old smithery. The machine shop is situated in the extreme south of the yard, and at its western end is the model room, which is practically contiguous with the south end of the dry dock. On the west side of the dry dock from south to north are a coal store, the pumping house, and a small engine shop; immediately north of these are the three main building slips, which are respectively 403 feet, 260 feet, and 246 feet in length. There are also two or three small building slips for tugs, &c. There is a fitting shop on the east side of them, and the main shipbuilding shop is on the south-west side. The gantries are of wood and very old-fashioned.

Details of the dry dock, which is 265 feet long, are given in the Dock Book. The firm owns two floating cranes with lifting capacity of 25 tons and 15 tons respectively, and one jib crane to lift 60 tons. There is also a sheers.

Laxevaags Maskin and Jernskibsbyggeri.

The works belonging to this firm were under the management of a Scotsman, Mr. Bower, in 1910; they are situated at Laxevaag, on the west side of Puddetjord. The company employs about 650 men. The works have turned out about 100 vessels of various types and sizes, both passenger and cargo steamers; the last named have ranged up to 5,000 tons dead weight. The firm, however, specialises in "standard" vessels of 2,450 tons, and turns out about five per annum. The greatest power of engines supplied by this firm is stated to be 2,000 h.p.

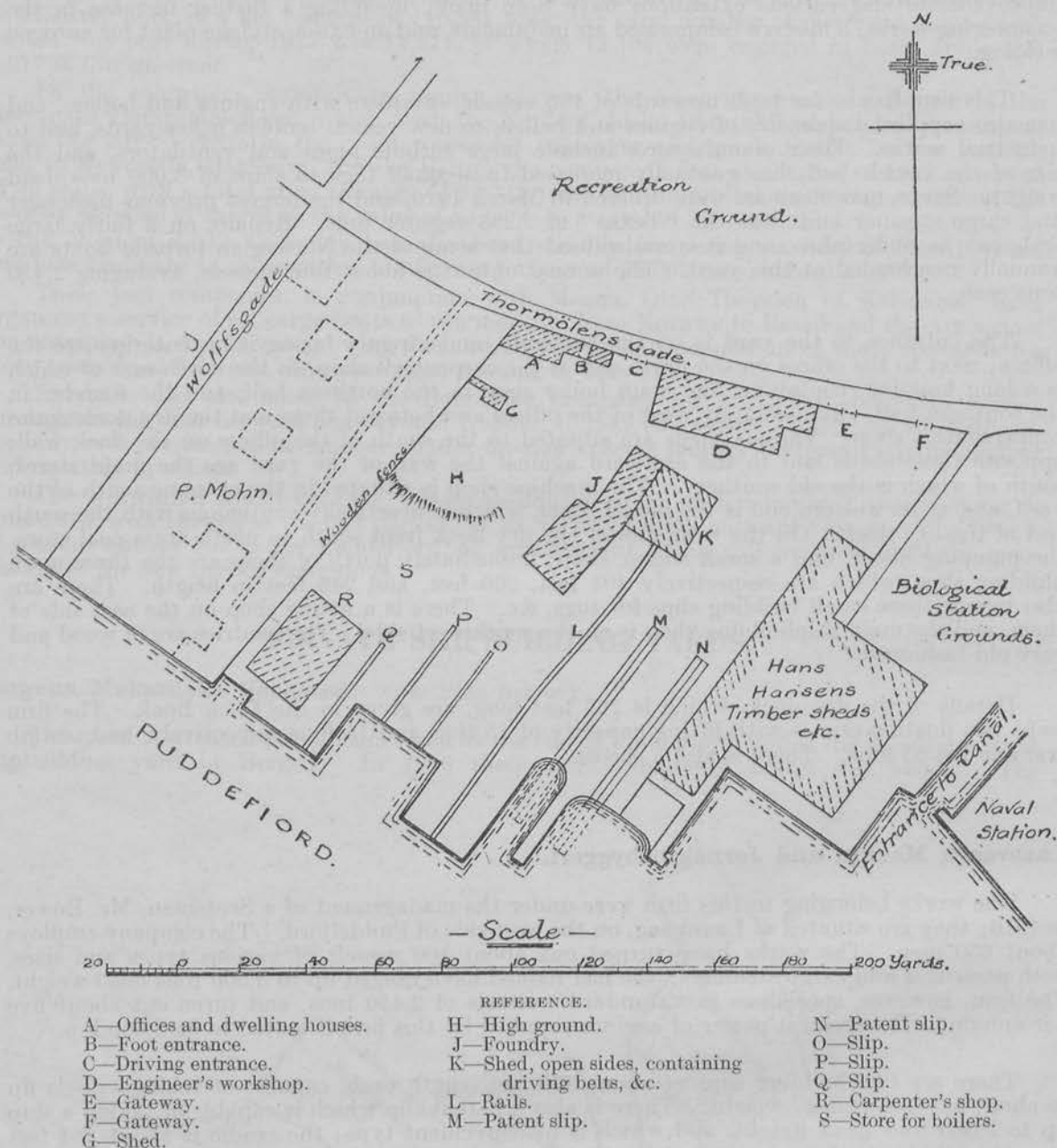
There are two building slips of about 330 feet length each, capable of taking vessels up to about 5,000 tons dead weight. There is also a patent slip which is capable of taking a ship up to 3,000 tons dead weight, and which is of convenient type; the cradle is about 284 feet long, draught on keel blocks, 10 feet 6 inches forward, 18 feet aft.

The dry dock, of which a full description is given in the Dock Book, belongs to the "Laxevaag Dok Kompagni," a different firm to the shipbuilding company, but the dock is controlled by the manager of the latter; it is 365 feet long. A crane of 10 tons lifting capacity operates round it. In 1906 the Government entered into negotiations with the company to extend the dry dock, but so far nothing has been decided upon. There is a pair of sheers to lift 70 tons, a floating crane up to 7 tons, and a jib crane up to 7 tons. In 1913 this company constructed six ships of a tonnage totalling 6,880 tons.

Mjelllem and Karlsens Mek. Verksted and Patent Slipper.

This yard is situated at Möhlenpris just to the N.E. of the naval establishment at Marineholmen. The company makes a specialty of building trawlers and small passenger and cargo boats up to 1,000 tons. They employ about 250 hands, and are able to execute repairs on a fairly large scale; sometimes they overhaul Norwegian torpedo boats. Engines up to 450 h.p. are built, and repairs to engines can be carried out. Up to 1914 the works had built a fleet of 21 ships. There are three building slips, which are situated on the south side of the yard, the largest of which will construct a ship 220 feet long. There is a sheers up to 50 tons lifting capacity. To the east of the building slips are two patent slips, each of which is 500 feet long; the length of the cradle of the larger is 216 feet, and it will lift a ship up to 1,600 tons dead weight; the cradle of the smaller is 172 feet long, and it will lift a ship up to 500 tons dead

weight. In 1913 this firm built three steamers of a total tonnage of 527 tons, and two more were under construction at the end of that year, but these also were very small.



Other Works.

Messrs. "Evje and Andersen's" shipbuilding yard is situated on the west side of the peninsula. This is merely a small repairing yard, but the firm owns a dry dock, details of which are given in Dock Book. "Wingaard's Jernstøberi," situated near the entrance to Store Lungegaards Vand, carries out no shipbuilding, but the work consists of general engineering, and the firm owns a foundry.

THE TOWN.

(See Plates 14 and 15.)

Bergen is one of the oldest and most picturesque towns in Norway, and has a population of about 89,000 inhabitants. The town is situated on a hilly peninsula and isthmus, bounded on the north by the Vaagen and Byfjord, south-east by the Lungegaardsvand, and south-west by the Puddefjord. In the background rise the seven hills which form the cognisance of the city. The climate is humid and mild, and winter frosts are slight and short. The town extends round the harbor, and is now spreading south and east towards the Lungegaardsvand; it also now joins up with the suburb of Sandviken on the N. side of the harbor. The quarter nearest the harbor, with its large warehouses, alone retains a mediæval stamp, and the houses are built of timber and painted white. Bergen has been repeatedly burned down, the last great fire occurring in January 1916, which destroyed the large area lying between Mør Almenning on the N.W. and the street leading from the station to the post office on the S.E., and between Strandgaden and the square, in which stands the new theater. The fire destroyed

the majority of the hotels, the British Consulate, and several banks, but the damage is being rectified, and the water conduit from Svartediget minimises the danger of conflagration. The fish trade has always been the chief source of Bergen's wealth, and continues to be so in spite of competition from other ports, and the town is the center of the Norwegian Sea Fisheries Administration.

The main street is the Strandgade, which runs parallel with the harbor and contains the principal shops and offices; its western prolongation leads to Nordnaes, where there are public gardens. On the south side of Nordnaes, near its extremity, stands the old fortress of Fredriksberg, now used as a fire watch-tower, and on the N.W. side of the fort are the observatory, the Seamen's School, and the hospital—all conspicuous buildings from seaward.

A new quarter with broad, regular streets has sprung up around the Lille Lungegaardsvand, and on the west side of this lake there is the small town park. The post office is situated in Raadstue-Plads, and the telegraph office is in the Exchange and is always open. There is an electric tram service in the town. The town has a military governor, whose residence is situated between Haakon's Hall and Walkendorf Tower on the fortress quay.

The Central Fire Station is situated just north of Lille Lungegaards Vand, and the site of the Town Gasworks is at Jaekteviken, opposite Dokkeskjaeret Island.

The Bergen electric power station is situated at Samnanger, in the Samnanger fjord, about 17 miles from the town, and the power which is 3-phase is brought to a voltage of 47,000 volts overland up the Neston valley to Solheimsviken to the transformer station there, where it is reduced to 5,000 volts, and again to 2,220 at the transformers and auxiliary power station situated between the Store and Lille Lungegaards Vands. At this latter station, the greater part of the power is converted from the alternating to direct current through rotary transformers. There is also a small transformer station at the junction of Fjeldveien and Skreddedalen. There are probably also power stations, either water or steam, in the vicinity of Gravdal and Biskopshavn for the forts in these areas.

There is good housing accommodation in the shape of temporary huts outside Solheimsviken in covered rope walks situated to the west of Solheimsvand. In 1916, those nearest the lake were of two stories, and quite new. Minde Station on the main line is close at hand, and there is abundance of good water near the site. The slope rising from the southern shore of Store Lungegaardsvand towards Solheimsvand is covered with newly-built villas, and to the N. E. of Haukelandsvand there is a large new hospital. Close to the railway shops, and situated between Solheimsvand and Haukelandsvand is the racecourse, with a road from the town leading up to it.

COMMUNICATIONS.

By Sea.

Norwegian coasting steamers leave daily, and there is frequent communication with British and continental ports. Bergen is also the chief port of call of the Norwegian-American Line.

By Railway. (See Map 1.)

Bergen is the west coast terminus of the important single-track railway to Kristiania; its importance as a railway center for international traffic has grown enormously during the war. The new station, which is situated on the north side of the channel connecting Lille with Store Lungegaardsvand, has been greatly enlarged to cope with the increase, but is apparently inadequate to deal with the volume of trade. The journey from Bergen to Kristiania usually takes about 13 hours; night through trains to and from Kristiania are now running regularly.

At Nesttun, six miles south of Bergen, there is a branch from the main line southwards to Os, on the Bjørne Fjord, 16 miles further on; this branch is owned by a private company. The main line is a very important strategic railway, being the southern of the two railways which alone connect the west coast with the capital; at Myrdal (97 miles from Bergen) there is a long tunnel, and a line which is to be continued as far as Flaam in the Sogne Fjord was under construction from Myrdal to Fretheim in 1916. No branch lines connect with this railway between Bergen and Hønefoss (249 miles), which is only 55 miles from Kristiania, so that destruction of railway communication with Bergen would be a simple matter.

The old railway bridge across the entrance to Store Lungegaards Vand has been removed and the line now runs only to Solheimsviken's Station in this direction.

The continuation of the main line to Bergen Station branches off on the north side of Solheimsvandet, when it passes through a tunnel to the eastern shore of Store Lungegaards Vand.

Large repair shops for the railway have been put up between Haukelandsvand and Solheimsvand.

The railway coal stores are situated to the southeast of the station and on the north shore of Store Lungegaards Vand.

By Road. (See Map 6.)

The principal roads approaching Bergen are those from (1) the north, passing to the east of Hellefjeld Battery, and past Langevandet and Munkeboten Lakes. This road is excellent,

but involves a steep and zig-zagging ascent, and, after traversing Munkebotten Pass, descends steeply to Sandvig. (2) The road from the north to the west of Hellefjeld, past Eikeviksvandet, is more level, but narrower. On the west two main roads converge at Laxevaag church; one of these (3) comes from near the naval coaling station at Gravdal, while the other (4) winds between high mountains west of Lövstakken mountain from Nordaas Vand to the southwest of Bergen. This road can be reached from a bridge spanning an arm of the fjord, lying to the south of Lövstakken mountain, and of which Nordaas Vand forms the inner portion. An excellent road (5) winds along the side of Nordaas Vand to Fjösanger, where it joins the high road (6) from Nestun (Nedstun) to Bergen. The latter can be reached by country roads from near Flesland Glass Works on the coast, and the country between Flesland and Nestun was made the subject of special study during combined naval and military maneuvers in 1908. Alternative routes between Nestun and Bergen branch off near Hop and enter Bergen *via* Haukeland. They involve a very steep ascent near Birkelund Hotel, and this hill is apt to be very soft in rainy weather. A good new cross road connects the two main approaches to Bergen from the south at Minde station.

All these roads, except the Nestun-Fjösanger-Solheimsviken road, are rather hilly, and exposed to view from the mountains, but they are well built. An excellent road, called "Fjeldveien," reached by easy gradients from Sandvig, runs almost level along the hillside to the east of Bergen as far as "Bellevue," which commands an excellent view of the town, of the country almost to Fjösanger, and of the fjord as far as Gravdal forts.

Another possible, if arduous, approach to Bergen could be found over the mountains from the railway between Nestun and Garnaes, descending either near Langeli Vand, where a steep moorland path leads down over Borgeskaret, past Harebaktjern, to Isdalsvand Lake; or, over Ulrikken Mountain and along Isdalen to the powder storehouse hidden in a gully on an arm of Isdalsvand Lake.

By Electric Tram.

The excellent electric tramway service belongs to the municipality, but was in 1910 largely controlled by German interests. The system connects up Marineholmen, Sukkerhusbryggen, Haukeland, and Sandvig with the center of the town.

The train lines are of the same gauge as the railway, and the tram depot is at Möhlenpris.

By Telegraph and Telephone.

The main telegraph and telephone lines to Kristiania run in an easterly direction through Laerdal (110 miles).

From Voss (66 miles) on the railway, communication by both runs north to Vik on the Sogne Fjord, while an alternative route to Kristiania joins another main route at Utne, on the Samlun Fjord to the southward. A further alternative route to Kristiania is by means of the coastal lines which connect Bergen with Stavanger to the southward, and to the northward communicate with Aalesund. Telegraphic communication only is maintained between Bergen, Alversund, Radö Island, and Rongevaer Island and Fedje Island, at the mouth of Fens Fjord; also between Bergen and Herlö Island and between Bergen and Askö Island, terminating at Follesö on the west coast of the latter.

To the S. W. there is communication by telephone with Televaagen and Glesvaer on Sartorö Island, and a telephone line runs N. E., crossing the Sörfjord at Rundemanden to Ostereidet and Eknesvaag on the northern shore of the Oster Fjord.

By W. T.

A W/T station was opened in 1912. It is situated on Rundemanden, a hill overlooking Bergen, and is open to the public. It is generally known as "Bergen Radio," and is on the Telefunken system with a radius of about 620 miles. There is also a receiving station at the seamen's school in the town.

By Canal and River.

There are no navigable canals or rivers near Bergen. It is proposed to build a short canal to join Lille Lungegaardsvand with Vaagen harbor, and it will be crossed by four bridges.

NAVAL DETAILS.

Bergen is the headquarters of the third naval district under a Kommandör Kaptein, who is also in charge of the laying-up harbor at Marneholmen, and the third coast signaling company.

The naval laying-up harbor is situated at Marneholmen at the head of Puddefjord; the approach channel varies between 10 and 4½ fathoms, while alongside there is a depth of water of 1½ to 3½ fathoms. The quay space in 1913 was considered to be intolerably confined for the use of the 10 first-class and 2 second-class torpedo boats based on Bergen at that time, and in the extraordinary defense budget of 1914-15 a sum of 47,222*L.* was appropriated to Bergen, part of which was to be spent in the construction of a quay. In 1917 a grant of 444*L.* was allowed to Marneholmen.

In May 1916 work was in progress, and it was anticipated that four new quays would be completed by 1917, with the various storehouses and offices constructed on them. Up to 1916 the Storthing had already granted 1½ million kroner to this station. Each of the new quays is about the length of a T. B.

The staff of the establishment consists of one lieutenant, one naval engineer, one commissariat officer, with gunnery, engine-room, and torpedo P. O.'s, and a few men.

Naval Magazines.

The construction of the naval ammunition magazine at Vallemsviken, near Gravdal, was commenced in 1901, 12,000*l.* being voted for the purpose. There are two stores to contain ammunition for heavy guns, a guncotton store, and two tube and fuze stores. The Estimates state that the buildings can hold sufficient ordnance stores for two first-class, two second-class, and three third-class gunboats and eight torpedo boats.

The quay, built about the same time, is 130 feet long.

Mine Store.

In 1914 the press reported that a large building is to be constructed as a mine store at Vallemsviken, situated near the naval coal store at Gravdal.

Torpedo Station.

A torpedo firing station has been reported to exist between Gravdal and Kvarven, and situated so as to command the approach to Bergen, either from the west or north. This station would appear to consist of a chamber in the cliff at the level of the water, and concealed by doors constructed to resemble the surroundings.

Naval Coal Stores.

Apparently the naval coaling station is at Hestnaeset, near Gravdal; the amount kept in stock is not known. A main road communicates with Laxevaag.

MILITARY DETAILS.

The character of the country around Bergen is so mountainous that communication except by the recognized roads, &c., is almost impossible.

The general positions given below for the forts at Kvarven and Hellen are correct. A committee was appointed in 1899 to consider the question of an attempt to destroy the railway made by an enemy advancing up Öster and Sör fjords, and to report on the most suitable sites for the erection of defenses to prevent such action. The committee recommended the fortifying of certain points, but apparently nothing has yet been done, which leads one to suppose that the existing defenses erected between 1896 and 1904 are now considered adequate to repel an attack of the nature mentioned above.

So far as is known, there are no fixed defenses to the south of Bergen in the neighborhood of the Nordaasvand, and landing could be effected here, though the Norwegian military authorities would presumably have ample warning from the look-out station on the summit of the Lyderhorn, which is connected up by telegraph or telephone.

As regards a landing on the west side of the peninsula, it should be borne in mind that the guns in Kvarven fort have all-round training, and probably cover a considerable area of ground in this direction. Assuming the Kvarven forts to have been captured, it would appear more to the point to consider the fact that the attacking force in possession would come under the fire of the forts on the other side of the harbor. The guns in the latter are similar to those in Kvarven fort, and are situated at about the same elevation. The range is under 6,000 yards, and in both cases the guns are of the same caliber.

The defenses of Bergen may be considered to be adequate so far as an attack by ships is concerned, but the omission to provide defenses on the land side has left the town open to attack by a force landed in any of the numerous bays and fjords along the coast.

The outer defenses are situated at the entrance to Herlöfjord and at the exit of Radöfjord; the inner defenses are in the vicinity of the town, and must be passed by all vessels approaching the port. It is of interest to note that during maneuvers in 1912 the attacking force succeeded in forcing the passage of Det Naue channel during darkness.

A sum of 2,222*l.* was voted in 1916 towards the improvement of the defenses at Bergen.

COAST DEFENSES.

Outer Defenses.

Herlö Position.

According to the Norwegian Army Estimates for 1900-01, by the end of 1900 most of the mine defense material had been provided, and the "flanking battery" completed. The following works, &c., still remained to be added: engine-house (cost 700*l.*); firing station (? one only), 250*l.*; "light station" (? power-house for searchlights), 850*l.*; searchlight

emplacement and shed, 350*l.*; barracks, boat-shed, guncotton store, and magazine, 1,500*l.*; two emplacements for 65-mm. guns, 800*l.*; prepared positions (? how many) for field guns, 700*l.*; quay, 200*l.*; submerged breakwater (Jakobsö-Kalvösund), 1,000*l.*; completing mine-defense material, 1,000*l.*; magazine and gun shed (? for field guns), 250*l.*

The field guns are probably 8.4 cm.'s (12-pdr. Q. F.)

In the extraordinary estimates for defenses in 1914 the sum of 27,778*l.* was appropriated to Bergen.

The original intention in 1896 was to construct a light Q. F. 3-gun battery at Melkevik (marked on Chart), but this project has not yet been realized, and has probably been abandoned.

The defenses at the northern entrance to Herlöfjord are collectively known as the Herlö Position.

Vessels approaching Bergen by Herlöfjord either pass through Herlösund (between Askö and Herlö) or through the channel eastward of Herlö and Agnö. At the junction of the latter channel and Herlöfjord are situated a number of small islands (Lamö, Skarvö, The Parisholms, &c.), through which there are two passages available for the largest vessels, viz., the Lamö-Skarvö passage, and the Det Naue channel. Herlösund is less frequently used by coasters than Det Naue.

Herlösund. (No. I on Chart 5.)

It was originally intended in 1896 to erect a battery of three light Q. F. guns at the extreme N. W. point of Askö, to defend the mine field laid in the channel. Possibly, the two 65-mm. (10-pdr.) guns mentioned in the 1900-01 Estimates (*see above*) have been mounted here.

No sign of the battery, however, could be seen in 1910 from a ship passing through Hielte Fjord, but some buildings and a wharf were visible in the bay on the north side of Herlösund.

Det Naue. (No. II on Chart 5.)

In 1904, a battery was observed at the N. W. end of Ypsö from the deck of a passing steamer. The parapet appeared to be of newly-turned earth. Barbed wire fencing was seen in the vicinity.

The armament is believed to be—

3—65-mm. (10-pdr.) Q. F. guns.

NOTE.—It is probable that this is the "Flanking Battery" mentioned in the 1900-01 Estimates (*see above*).

Battery on N. side of Det Naue. (No. III on Chart 5.)

What was thought to be a battery was observed in 1904 on the north-easternmost of the two Parisholms. Barbed wire fencing similar to that mentioned above was also reported, besides two buildings having the appearance of storehouses.

In 1910, on the north side of Det Naue Passage a short length of well-built road was observed crossing what appeared to be the glacis of this battery.

Searchlight.

The position of the searchlight and engine-house (known to exist) has not yet been ascertained.

Observation Station.

A well concealed hut facing N., with a slightly sloping roof and open in the rear, was observed in 1904 on the islet which lies off the extreme N. W. point of Ypsö. This structure was thought to be an observation station.

Barracks.

Barracks were built on Skarvö in 1900 for six N. C. O.s and 50 men. This is probably about the war strength of the Herlö detachment.

Lillebergen-Hagelsund Position. (See Chart 5.)

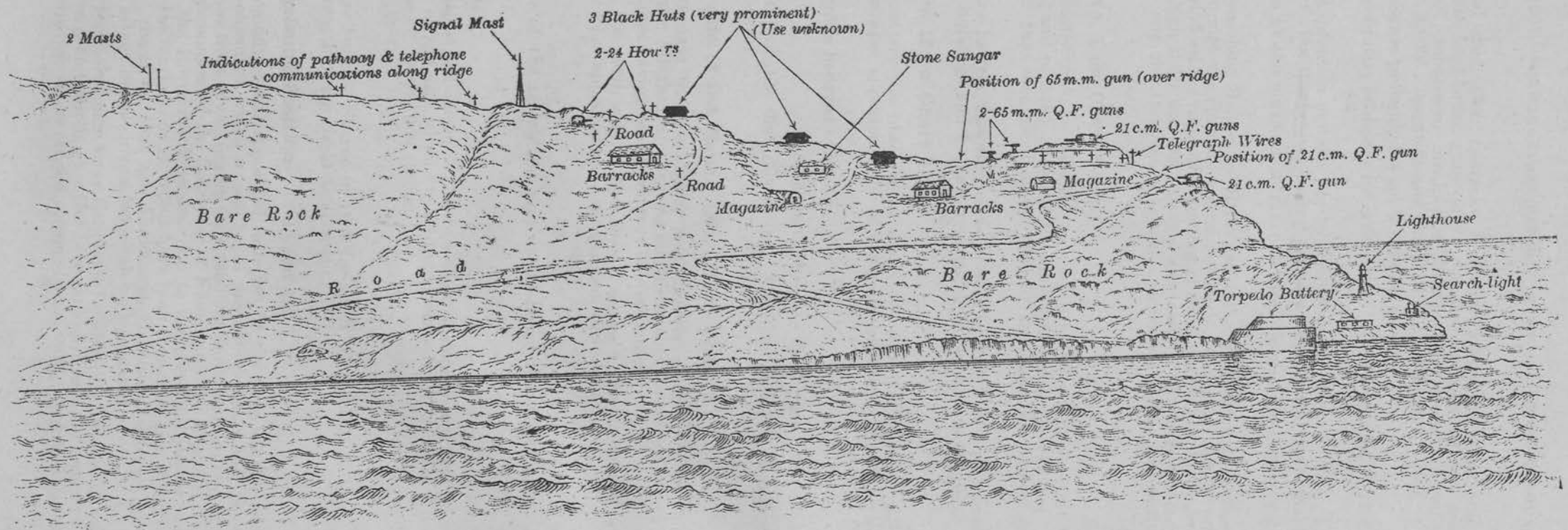
In 1909, a committee was appointed to report on the most suitable sites for the erection of defenses, the object of which would be to prevent vessels which have forced Herlö or Hagelsund positions from advancing up Öster and Sör fiords and destroying the railway. The majority report recommended the fortifying of Klones and the adjoining Telvikaas, while the minority favored the Horviknes Position. Up to the present, however, no further advance has been made in the matter, and no works have been erected at any of the places named. It may be inferred, therefore, that the Herlö and Hagelsund defenses are now considered adequate to repel attack in the circumstances above postulated.

According to the Norwegian Army Estimates for 1900-01, by the end of 1900 most of the mine defense material and searchlights had been provided, and the torpedo battery was ready. The following remained to be added: engine-house, 800*l.*; orograph station, 500*l.*; search-

BERGEN

IKVARVEN POINT FORT

(No. V on Chart 5)



View from E.

light emplacement and shed, 500l.; various buildings, 1,200l.; prepared positions for field guns, 500l.; roads, 1,200l.; magazine, 200l.; gun-sheds, 200l.

It is noteworthy that no mention of the erection of Q.F. batteries was made in these Estimates. A Swedish technical journal (1906), however, makes mention of a light Q.F. battery (No. IV on Chart 5) at the N. end of Flatöen, which was not noticed by a visitor in 1907, as well as one each side of Horviknes (marked on Chart 5).

A visitor in 1907 observed from the deck of a passing steamer several buildings and a landing stage on Flatöen opposite Lillebergen, and lying alongside was a steam mining launch.

A cable is laid from Flatöen to Lillebergen and enters the water near the word "Haaö" on Chart No. 5. At each end it connects up with overhead wires.

Maxim Guns.

Two or more Maxims are believed to be mounted somewhere on the island.

Barracks on Haaö.

Barracks were built in 1900 for six N.C.O.s and 50 men. This is probably about the strength of the Hagelsund detachment in war time.

A report, dated 1913, verifies the existence of defenses in the neighborhood of Lillebergen. During maneuvers in 1912 an attempt to land here was defeated. The Lillebergen passage is narrow and situated at a sharp bend; the fjord steamers have to go dead slow and whistle to warn vessels coming in the opposite direction.

Searchlight.

The position of searchlight and engine house, which are known to exist, have not yet been ascertained.

II.—Inner Defenses.

(See Chart 5.)

Kvarven Point Fort. (No. V on Chart 5 and Plates 16, 17, and 18.)

The Kvarven position extends down the treeless and rocky spur of Ornefjeld; by far the best view of it is from Flöfjeld (marked on Chart).

During maneuvers in 1912, under cover of the mist, the "Eidsvold" and "Tordenskjold" succeeded in taking up a position behind Mathopen, and landing troops, who captured a signal station, but were afterwards driven back. A break in the mist revealed the ships to the look-out on the Lyderhorn, and the howitzers in No. V. opened fire and eventually forced them to retire.

The 21-cm. guns and the light Q.F. guns are very conspicuous, but the howitzers less so. The most prominent objects on this position, whether observed from the E. or W., are three black huts, as shown on Plate 17. The center hut is surrounded by a concrete glacis. The 21-cm. guns are painted dark grey.

The height above the water of the lowest 21-cm. gun is about 360 feet; of the three 65-mm. guns, about 440 feet. The signal station, which marks the highest point of the position, is about 680 feet above the sea.

The guns have all-round training.

The armament consists of—

3—21-cm. (8.2-inch L/45 Q.F. St. Chamond guns, mounted on C.P. mountings with shields.

Note.—A light iron roof, presumably for shelter, has been constructed above the loading platform.

3—24-cm. (9.4-inch) B.L. L/14 St. Chamond howitzers with shields.

3—65-mm. (10-pdr.) or 57-mm. (6-pdr.) Q.F. guns on P. mountings with light shields.

Two field guns were reported in 1904, but were not seen in 1910, nor was the lowest 24-cm. howitzer.

A parapet of considerable thickness has been observed midway between the highest howitzer and the lower signal mast, and in the rear of it is a black object which is possibly the fire control station for the position. The use of the parapet is not apparent, and it was not visible in 1910.

A telephone wire is laid to the summit of Lyderhorn, where there is a look-out station.

Shelter was provided in 1902 for look-out men on Lyderhorn and Kvarven.

Barracks.

Two buildings, identified as barracks, are situated on the E. side of the position, about 400 feet and 600 feet above the water. These can accommodate 82 men. The remainder of the garrison is quartered at Gravdal.

Magazine.

A magazine, hewn out of a rock, and provided with the usual semicircular iron roof, is shown on Plates 16 and 17.

On the E. shore of the island near the Point, two cranes have been erected on the water's edge; as well as a stone building, which is possibly a magazine or store.

Roads.

The military road from Gravdal leads up the E. side of the spur to the 21-cm. guns, and is thence continued upwards to meet another road between the lowest howitzer and the magazine. A third road connects the highest howitzer and the upper barrack building.

Searchlights.

At the Point, between the lighthouse and the water's edge, a small circular emplacement with a conical iron roof 8 feet in diameter has been observed. It is evidently intended for a searchlight. In the center of the roof is an eye-bolt, to which is hooked the tackle of a derrick, similar to the one in Plate 18. A line of rails runs along an embankment for a short distance eastward.

At Florvaagpynt, on Haabsöen, is a searchlight emplacement resembling the above. Near by have been noticed obstructions of the nature of "chevaux-de frise." A second searchlight position is situated in the center of Haabsöen; the light projects across Byfjord in a N.E. direction, and is similar to the other light.

Garrison.

The war strength of the Kvarven artillery detachment is 11 officers and 271 N.C.O.s and men, besides naval ratings for manning the torpedo battery.

Sandvigsfjeld Fort. (No. VI on Chart 5.)

This fort, standing about 590 feet above the water on Upper Sandvigsfjeld, is difficult to distinguish, even from Flöjfjeld. From the Sandvig road it is not visible, and no view of it has yet been obtained from the N. arm of Byfjord.

Sandvigsfjeld is the hill immediately east of Sandvig Port; there is a signal station on the hill.

The howitzers, mounted in concrete emplacements, are distinguishable by their shields. A visitor in 1907 failed to discover the third howitzer, which is probably hidden by the rising ground when viewed from Flöjfjeld.

The two 65-mm. Q.F. guns are placed on Lower Sandvigsfjeld, in the open, about 100 feet above the water line.

The armament of the position consists of—

- 3—24-cm. (9.4-inch) B.L. L/14 St. Chamond howitzers.
- 2—65-mm. (10-pdr.) Q.F. guns.

Barracks.

The two barrack buildings (situated on Upper and Lower Sandvigsfjeld) are together capable of housing the whole detachment.

Magazine.

The position of the magazine has not yet been ascertained.

Roads.

A military road leads from Sandvig and zigzags up the E. slope to Upper Sandvigsfjeld (see Chart 5).

Garrison.

The war strength of the detachment is 4 officers and 94 N.C.O.s and men.

Power Cable.

A cable (? power) lands near Nyhavn.

Hellen Point Fort. (No. VII on Chart 5, and Plates 19 and 20.)

The positions of two of the three guns mounted in this fort are believed to be accurately represented in Plate 18.

It should be noted that when viewed from Flöjfjeld, the westernmost gun is not visible, and from the N. side the easternmost gun is hidden. From the anchorage at Bergen all three guns show up prominently on the skyline.

The command of the guns, which are mounted on platforms cut in the rock and finished off with concrete, has been estimated at 350 feet or thereabouts, two of them being a few feet higher than the third.

The arcs of fire are very wide.

The armament of the position consists of—

- 3—21-cm. (8.2-inch) L/45 Q.F. St. Chamond guns, mounted on C.P. mountings, with shields.

The guns and mountings are in all respects similar to the ones at Kvarven.

The position of a supposed orograph is shown in the sketch between the two easternmost guns.

The black wooden hut shown on Plate 20, east of the signal mast, is a position-finder, which commands an excellent view in all directions. It is connected with Hellen Point by a double telephone wire.

A road leads from the position to a magazine excavated in the rock. The roof is of the usual semicircular pattern.

Road.

The road leads to the position from Sandvig, and is continued up to the conspicuous concrete house mentioned below.

Various Buildings.

The building originally intended as barracks can only accommodate about half the detachment, so that in 1901 the old central telephone and telegraph station was converted into barracks to hold 67 more men.

A new central telephone and telegraph station has recently been built at a cost of 300£, and a "laboratory" (use not apparent) for 350£.

Signalling Arrangements.

Signal masts, capable of being raised or lowered at will, have been observed.

Shelter has recently been provided for look-out men on Hellenfjeld, and the look-out position is connected by telephone with the batteries.

Searchlight.

On the N. side of the Point, and standing about 25 feet above the water, a searchlight emplacement has been observed similar in all respects to the one described at the Kvarven Position, with the exception of the derrick. A line of rails runs along the embankment to a conspicuous concrete building in the shallow valley which lies N. of the Point. The chimneys may be observed above the rocks when approaching the Point from S.

The searchlight can be projected up the N. arm of Byfjord.

Among the rocks, at a short distance above the searchlight emplacement, can be seen a low, rectangular, concrete chimney, or ventilator. This is possibly the power station, excavated in the rock.

Garrison.

The war strength of the Hellen detachment is 6 officers and 148 N.C.O.s and men.

SUBMARINE DEFENSES.

Minefields.

It is believed that a minefield exists for closing the entrance to Herløfjord, but its position is not known.

The position of the minefield closing Det Naue passage can be judged roughly from the following considerations:—(1) The positions of the battery on the S. side and the supposed observation post, (2) The Jakobsö-Kalvösund submerged breakwater.

Jakobsö will be found marked on Chart No. 5. Kalvösund cannot be identified, but it is suggested that it is the channel between Jakobsö and the E. point of Herlø. The object of such an obstruction (if existent) placed in this channel is obviously to oblige vessels to cross the minefield.

A Swedish report mentions the presence of minefields in the channels on the east side of Flatöen. No minefields exist in inner defenses, the depth of water being uniformly too great.

During the war it was officially announced that minefields existed in the Bergen defenses.

Torpedo Battery.

There is possibly a torpedo battery at, or near, Lillebergen.

A torpedo battery, with its three ports 10 feet apart at a height of 5 feet above the water, is situated on the E. side of Kvarven Point, approximately in the position shown in Chart No. 5. It has a masonry face some 15 feet high which projects 4 feet from the face of the cliff. The body of the battery is excavated in the rock. A door in the hillside near by points to the existence of a torpedo store.

The crew is composed of naval ratings.

Store for Explosives.

On Askö, opposite Kvarven Point, there are two white buildings marked "Dynamite." They are 300 yards apart, privately owned, and said to contain blasting powder which cannot be kept in the town.

They are close to the water's edge.

Mining Establishment at Gravdal.

All the mining gear for the Herlø and Hagelsund positions is stored at Gravdal. Up to the present two old hulks have served this purpose, but in the 1907 Estimates a proposal was

put forward for building a mine-store on shore, the hulks having been condemned as rotten. This plan does not appear to have yet been adopted.

A storehouse for explosives (probably guncotton), a boat-shed, and a small wharf for the hulks to lie alongside, have been constructed at Hestvigen, whither a road leads from Gravdal.

A quay has been constructed somewhere at Gravdal, and steps have been taken to improve the berthing accommodation.

Two mining launches belonging to the defenses which cost 2,800*l.* each, were seen in 1907.

Two old 3rd class gunboats (built in 1844-54) were taken over from the navy in 1900, and are now used as minelayers. Their names are "Aasgaardstrand" and "Horten."

The steam-launch "Kvarven" belongs to the Mine Department.

SEARCHLIGHTS.

The positions of searchlights, so far as is known, are discussed above under "Coast Defenses."

LAND DEFENSES.

So far as is known, Bergen possesses no land defenses.

AVIATION.

There is a seaplane station at Bergen. A small grant was made towards it in the 1917 Estimates. Two sheds were under construction in May 1917.

MAGAZINES.

Besides the magazines for the various forts mentioned in "Coast Defenses," there is a powder storehouse hidden in a gully on an arm of Isdalsvand Lake, E. of Bergen.

GARRISON.

The war strength of the Bergen Coast Artillery Garrison is about 22 officers (including militia), 60 N.C.O.s and 650 men, excluding naval ratings for the torpedo battery. They are formed into four companies of the 4th Fortress Artillery Battalion and a signalling detachment. The strength of the detachments stationed at the various works has already been given.

The care and maintenance parties for all purposes number 40 men, including an officer, and are quartered at Gravdal.

Upon mobilization, or when the year's levy is under training, the men live in the barracks near the defenses, which are capable of holding, it is stated, the whole detachment for the position. There is a training establishment at Tvilde, near Voss.

A naval officer and a few ratings are specially attached for service in the torpedo battery.

The 4th Field Brigade is also allotted to this district, and consists of eight infantry battalions (one of which has its headquarters at Bergen), three squadrons of cavalry, four batteries of field artillery, one mountain battery (at Bergen), and details of sappers, tram, &c.

COMMUNICATIONS.

The telephone system in the neighbourhood is excellent, and the fact that most private houses, and even many humbler dwellings possess a telephone, in addition to the forts and look-out stations, renders it almost impossible for a vessel to approach within sight of the coast without ample warning being given. The positions of signal and look-out stations cannot be stated in detail, but there can be little doubt that such exist, both in the fortified area above the Gravdal batteries and also above Sandvig. The summits of Ulrikken and Lövsstakken mountains have also been utilized for signalling purposes, both by day and night, during recent maneuvers.

COAST FROM BERGEN TO KRISTIANSUND, N.

THE SOGNE FJORD.

(See Map 7, Norway Pilot, Part II., and Admiralty Chart 2291.)

The Sognefjord is the longest of all the Norwegian fjords and runs inland for 112 miles, measuring from Sognefest to Skjolden; it has an average width of 3 miles and is very deep throughout. In the eastern branches of the fjord the climate resembles that of inland Europe with short warm summers and long winters, though the inner arms are only partly frozen over. In the inner fjords the mountains rise to a great height on either hand and there are only a very few places throughout its length at which a landing may take place. The

entrance to the Sognefjord is somewhat obstructed by a group of islands called the Sulen Öer on which are hills rising to 1,840 feet, though there is a clear fairway leading into it from the south-west.

Nærø Fjord, which is one of the southern arms nearer the head of Sognefjord, is the grandest of all the branches, and is in many places barely 2 cables wide. The village of Gudvangen lies at the head of it, where there is a pier with deep water alongside; there are two hotels. A road leads over the mountains from Gudvangen *via* Stalheim (7 miles) to Voss (27 miles) on the Bergen Railway, to which also there is telegraphic and telephonic communication. At the entrance to Nærø Fjord, Aurlands Fjord bears away to the S.E. and at its head stands the village of Flaam, where there is an hotel, and from which a road curves through the mountains to Myrdal (9½ miles), the station at the eastern end of the great tunnel on the Bergen-Kristiania Railway; there is communication also by telegraph and telephone with Laerdal and Voss. The proposed railway from Myrdal to Flaam is under construction as far as Fretheim.

Laerdals Fjord is 11 miles further east. At its inner end is situated the small town of Laerdal, where there is good anchorage over a comparatively wide area; there is also a pier and landing steps and two hotels. Laerdal may be considered to be a point of some strategic importance, especially if at any time it was found to be necessary to bring British troops to the assistance of Norway, and the main railways from Bergen and Trondhjem to Kristiania had been damaged to such an extent as to be impassable for their transport to the eastern frontier. Not only is the approach by way of the Sognefjord comparatively easy and the roadstead and landing facilities off Laerdal not indifferent, but there is communication by means of a moderately good, but very narrow, road with Fagernes (83 miles) at the head of an independent railway line to Kristiania. This road forks at Borlo (21 miles) and continues in a south-easterly direction down the Morkedalen Valley to the Bergen-Kristiania Railway which it joins at Gol (77 miles). In addition there is telegraphic and telephonic communication to Fagernes; lines also connect up with Voss on the Bergen Railway and with the various villages which stand on the northern shore of Sognefjord.

The communications on the northern shore of Sognefjord are of no special importance except that the coastal telegraph and telephonic lines from Bergen *via* Aalesund, to Trondhjem, cross the fjord to Leirvik on the north shore near the entrance, and from Vik to Kvamsö, at a few miles west of Nærøfjord. Communication is obtained by road and ferry alternatively from Leirvik and Vadheim to the north near the coast. There is regular communication by motor car between Laerdal and Fagernes during the summer months. At Vadheim there are electro-chemical works.

North of the Sogne Fjord the coast presents much the same appearance as that southward to Bergen, being much indented and fronted by islands. No ports of note are found on this part of the coast until Florö is reached. This thriving little port is situated on Brandsö, on the north side of the entrance to Stor Fjord, and near it there is good anchorage for any class of ship. Most of the larger steamers call at this port, which is an important trading center for the fjords in the vicinity. There is communication by telegraph and telephone inland to the main routes, also northwards to Moldöen on Nord Fjord.

NORD FJORD.

(See Map 8 and Admiralty Chart 2305.)

At the entrance to Nord Fjord is the island of Bremanger, across which runs a telegraph line from Moldöen to the islands lying further south. It is reported that a company has lately been formed to exploit the Svelgvasdrag falls at Bremanger, which will have, it is said, a capacity of 21,000 turbine H. P. It is further proposed to erect a factory there for the manufacture of carbide and cyanamide, with an annual production of 30,000 tons of carbide.

The fjord itself is about 60 miles in length and is deep throughout; in its upper reaches it branches into various fjords, all known by various names. The Eidsfjord, which is one of the nearest branches to the sea, continues almost due east for about 10 miles, and at its head is the township of Nordfjordeid, where there is a steamer pier, and from which communication is maintained by road to the arms of the Rovde Fjord. Near it is a military camp and drill ground. A southern branch off the Nord Fjord is the Gloppen Fjord, at the head of which stands Sandene, or Gloppen, at which steamers call, and from which a road runs south to Vadheim (77 miles) on the Sogne Fjord; the road is hilly, but much frequented. From Utviken, 14 miles beyond the entrance to the Gloppen Fjord, another road leads to the Sandene-Vadheim Road, which it joins after a steep ascent. Near the head of Nord Fjord is the village of Visnaes, where there is a steamer pier and three or four hotels; there is communication by road with Sunelven in the Stor Fjord, and eastward up the Videdalen with Grotlien (31 miles), where it joins the road from Geiranger to Otta on the Dombaas-Kristiania Railway; the distance to Otta is 100 miles, but the road for the most part is fairly good and not excessively steep.

The coastal telegraph and telephone lines cross the Nord Fjord at its mouth, and eastward from Moldöen there is communication by both to Nordfjordeid, whence the telegraph proceeds to Sandene and inland, while the telephone line is continued to Visnaes, where it

joins another which crosses the fjord from above Utviken and proceeds northwards to villages in the Stor Fjord.

At the northern entrance to Nord Fjord stands the small town of Moldöen, which is important for its exports of fish. The channel through Moldösund is part of the Inner Lead northwards, but it is narrow and shallow.

The town of Moldöen is an important center for the coastal telegraph and telephone systems, and besides the main lines proceeding north and south, a line runs eastwards along the northern shore of the Nord Fjord and joins the inland route.

Northwards as far as Stor Fjord there are no ports of special interest; there are numerous fjords of varying sizes which are described in the "Pilot," as well as the islands and channels separating them from the mainland.

STOR FJORD.

(See Map 8, "Norway Pilot," Part II, and Admiralty Chart 955.)

The entrance into the Stor Fjord may be made from the S.W. through the Rövde and Vartdals Fjords, through which there are deep clear channels from 1 to 1½ miles wide; these fjords are reached from the open sea through Sandsfjord, which is also a clear open channel. Its northern entrance from seaward is through the Bredsund, which also has sufficient water for the largest vessels and is the largest and most accessible entrance. It connects with the Sulen Fjord which in turn communicates by a channel free from dangers with the western end of Stor Fjord.

The main telegraph and telephone cables, which follow around the west coast of Norway, cross the Rövde Fjord from near Eidsaa on the south side to Larsnes on the island of Gurskø, whence they cross from Kjelsund on to Hareidland. They then cross the Sulen Fjord from Hareid to Røisen on Sulö and eventually reach Aalesund.

The general direction of Stor Fjord is first east for about 21 miles and then continues in a southerly direction for some 14 miles when it splits into two main fjords—Norddals Fjord to the eastward and Sunelvs Fjord to the south. Precipitous cliffs surmounted by high mountains are conspicuous throughout the length of the fjord and communications both on the northern and southern shores are practically non-existent.

Telephone cables, however, cross the fjord in various places. Near its western extremity from Barstadviken to Furnes for Aalesund, from Sövik on the southern shore to Söholt, and from Stranden on the west side of the entrance to Sunelvs Fjord to Liabygden on the northern shore.

Norddals Fjord possesses no special importance from a military point of view and, with the exception of a telephone wire from Norddalen to Maraak and northward across the fjord to Liabygden and Söholt, there is no communication except by water.

On the other hand, near the head of Sunelvs Fjord and running in an easterly direction is Geiranger Fjord which is nearly 10 miles long, very narrow and deep, and with high mountains rising precipitously from the edge of the fjord. At the extreme end of the fjord stands the village of Maraak; there is limited anchorage in about 19 fathoms, and a pier. There are three or four hotels and a few horse vehicles may be obtained. A moderate road, which is at first very steep in places, winds up over the mountains for a few miles, when it reaches a plateau and gradually descends into the valley of the River Otta, which it crosses in various places, eventually arriving at Otta (103 miles), a station of the Dombaas-Hamar-Kristiania Railway. There is telephonic communication between Maraak and Norddalen, and mountain paths also connect these two villages.

Aalesund. (See Admiralty Chart 1291.)

Aalesund, which is situated on the western part of Nörvö, is a town on the Inner Lead. The principal approach is through Bredsund, but there are several others, though all are intricate and somewhat dangerous even for vessels of moderate draught. The harbour, which is well sheltered, consists of the eastern harbour, where there is 23 feet of water, and the Aspevaagen, to the south of the town, where there is a considerable depth of water.

The Port.

The quays, which consists of the north, west, and south quays, is continuous, with a total length of 1,181 feet, and with from 16 to 24 feet of water alongside at low water, the deepest water being at the north quay.

There is a crane lifting 40 tons. There are no docks, but the "Aalesunds Mekaniska Verksted" owns two patent slips, one of which will take a vessel of 1,000 tons and the other of 100 tons. There is a third patent slip, belonging to the "Ystenacs Skibsværft og Patent Slip Company," which is 350 feet long and will take a ship up to 380 tons gross. Repairs can be carried out by either of the above-mentioned firms, the former of which is a ship-building company, two ships of 150 tons dead weight each being laid down in 1916; they are stated to build a small class of motor ship. Six tugs are available and also a few lighters from 30 to 50 tons. In 1913 the import of coal was 48,258 tons; about 2,500 tons is usually kept in stock, and coaling is carried out as a rule from lighters.

There is considerable trade with Mediterranean ports, as well as with coast ports of Norway. Aalesund is the center of the cod-fishing industry, and fish is its principal export.

The Town.

Aalesund is a busy trading town with a population in 1913 of 15,103 inhabitants. Originally built of wood, the town was entirely destroyed in 1904, and is now built of stone. It is the commercial center of the whole of the Storfjord. The narrowest part of the strait between Aspö and Nörvö is spanned by a bridge. On the Nörvö are the custom house, hotels, etc., and the main part of the town, to the east of which is a park and beyond it a hill called Aalesunds Axla. On the eastern slopes of this hill are four water reservoirs, which supply the town. There are two hotels, Schieldrop's and the Scandinavie, both not far from the quay, and the postal telegraph office is in Notenaes Gade, close to the former hotel.

Communications.

There is considerable steamer traffic at this port, and the coasting mail steamers call frequently. There is no railway communication, but a good road runs eastward along the Stor Fjord as far as Örskog (25 miles), where it turns north to Vestnes on the Romsdals Fjord.

Aalesund is situated on the main telegraph and telephone routes which follow the coast north and south; the town is also in communication by telephone with Godö and other islands lying northward off the coast. A telephone cable crosses the Sulen Fjord from Sulö to Barstadviken on the southern shore.

It was proposed during the war to lay a new cable from England to Norway, and it was suggested to land it in Norway at a point south of Aalesund, to which there was said to be a nice clean run.

MOLDE FJORD.

(See Map 8, "Norway Pilot," Part II., and Admiralty Charts 955 and 1298.)

There are numerous entrances to Molde Fjord, all of which are discussed in detail in the Pilot, but the main channels most in use are through the inner lead for ships of about 20-feet draught from the southward; from the west, outside all dangers, Nogvid Fjord affords fairly easy access for all classes of vessels; and from the north, Hustad Viken, thence through Buddybet between Björnsund and Bud, and through Julsund (the channel eastward of the islands of Gorsen and Otteröen) is generally used. East of Julsund, the fjord begins to widen considerably, and opposite Molde it is about 6½ miles in width. There is a great depth of water in the main channel which here divides into two fjords, known respectively at Romsdals Fjord (which bends to the southeast, forming at its head Ise Fjord and Ind Fjord) and Karlsö Fjord, to the eastward, which in turn subdivides into Fane Fjord and Lang Fjord both continuing in an easterly direction. Karlsö Fjord is bounded on the south by the island of Sackken and on the north by a series of long narrow islands, which form on their northern side a comfortable roadstead for ships lying off Molde. At the entrance to Fane Fjord is Bolsö, where there is a small shipbuilding yard.

A telephone cable crosses Romsdals Fjord from Vikebugt, on the east side of the entrance to Tres Fjord, to the island of Sackken, which it crosses to Nesiakagen on the peninsula opposite, where it joins the lines from Nes and bears to the north across Fane Fjord to Molde. A telegraph line also leaves Vikebugt and crosses the fjord due east to Frisvold on the Rödven peninsula, joining the cables from Nes at Torvik. These telegraph and telephone lines run west from Vikebugt to Aalesund.

The principal branch from Romsdals Fjord is Ise Fjord, which extends about 16 miles southward and eastward of the island of Sackken, and on the south side of Ise Fjord near the inner end is Veblungnes, a village of 40 or 50 houses. The small town of Nes, or Aandalsnes, is situated opposite Veblungnes, northward of the mouth of the river Rauma; it affords anchorage in a depth of from 18 to 20 fathoms at 2 cables off the town. From a military point of view the landing place at Nes is of some importance, as this little town lies at the north-west extremity of the Romsdalen valley, through which runs the road which communicates with railhead at Dombaas (72 miles) on the line to Kristiania; this road is narrow, but suitable for motor traffic and the gradients are not over steep, and Romsdalen is a deep and narrow gorge. Telegraph and telephone lines run alongside the road, and at Nes branch off to Aalesund and Vikebugt, whereas Dombaas is on the trunk lines connecting Kristiania, the central provinces, and Trondhjem.

There is frequent communication by motor car during the summer months between Nes and Dombaas, and Nes and Otta.

A company has recently been formed to dam up the lakes in the mountains between Sundalen and Romsdalen, and bring the water down to Lilledalen, where a factory for the production of nitrogen is to be built.

COAST FROM MOLDE FJORD TO TRONDHJEM FJORD.

The Inner Lead northwards passes through Julsundet and Buddybet; the channel is narrow, but not intricate, and is protected from seawards by the islands of Otteröen and Gorsen.

Bud. (*See Admiralty Chart 2306.*)

This small port is situated on the point on the mainland forming the east point of the entrance to Lyngvær Fjord; it is somewhat exposed to the sea, as there is no protecting "Skärgård." To the south of the small port is Harösund, where there is a good and safe harbor. A road leads eastwards from Bud, and connects with Eide on the northern shore of the peninsula, and with Molde.

There is communication by telephone northwards along the coast to Kristiansund and southeastward to Molde.

The reach of the coast northwards to Kristiansund is much exposed, as it is more open to the sea, but the Inner Lead continues close inshore, being somewhat protected by numerous rocks which lie off the coast; it is called the Stople Leden.

KRISTIANSUND, N.

(*See Plate 21 and Admiralty Chart 3038.*)

The southern approach to Kristiansund, and that most usually taken by shipping is through Fugle Leden, but a better and clearer channel is that from the westward through Ravnegabet. The northern approach is through the Trondhjem Lead or Gripholen, and there are numerous other channels through the rocky islands to the westward, all of which are discussed in the "Pilot." The Inner Lead from the southward lies through Hustad Viken. The three inner approaches are available for all ships.

THE COMMERCIAL PORT.

The Port of Kristiansund is situated on three islands—Kirkelandet, Indlandet, and Nordlandet—encircling a land-locked harbor in which there is ample water for the largest ships in from 10 to 20 fathoms. Vessels usually anchor on both sides of the harbor with their sterns made fast to mooring posts. Communication between the islands is maintained by steam launches.

Quayage.

The construction of extensive harbor works was decided upon in 1913, the cost of which was estimated at 40,000*l*. The new construction includes a quay 2,330 feet long with a depth alongside of at least 25 feet. This new quay extends from Vestre Almenning past Kirke Almenning to the northern extremity of Havnen, and in January, 1917, was completed, with the exception of a short length of 213 feet opposite the customs house, which was expected to be shortly finished.

Lifting Appliances.

There is one crane to lift 10 tons, and three more which will lift from 1½ to 3 tons each.

Shipbuilding Capabilities.

Practically no shipbuilding takes place at Kristiansund. "Storvik's Mekaniske Verksted" is a shipbuilding yard owning a building slip for small vessels up to about 300 tons gross and one fairly large crane. The number of employees at the end of 1916 was about 150 men.

Repairing Facilities.

Small repairs to machinery only can be undertaken at two shops.

Docks.

There are no docks at Kristiansund.

Patent Slips.

"Storvik's Mekaniske Verksted" owns one patent slip, with a cradle 200 feet in length, and capable of lifting a ship up to 2,000 tons dead weight, operated by hydraulic pressure. This slip was in disrepair in January, 1917. Three other patent slips worked by steam are owned by "Ovrevaaens Vaerft," "Mellem Vaerft," and "Bjørnehaugens Vaerft," respectively; the length of cradle of the two last is 110 feet, and of the first 84 feet; they will take a ship up to 120 tons in each case.

Salvage Appliances.

The salvage steamer "Sterkodder," owned by the "Norsk Bjergnings Company," is stationed at Kristiansund.

Harbor Craft.

Four tugs are available, and a few lighters.

Coal and Coaling Facilities.

In 1913 a total of 32,000 tons of coal was imported into Kristiansund. About 3,500 tons is usually kept in stock. Coaling is not interrupted by bad weather. There are numerous coaling wharves and yards, the positions of which are shown on the plan.

Water Supply.

Water is supplied by tank vessel. The waterworks are situated on the Vaardetaarn in Kirkelandet; rain water is collected into the reservoir from the hill side. On the other islands there are also natural reservoirs which supply these portions of the town.

Trade and Shipping.

The principal export of Kristiansund is fish in various forms. Imports are chiefly food-stuffs and coal.

In 1913, 419 vessels of a total net tonnage of 292,887 tons visited the port, of which 67 of 66,955 tons were British.

THE TOWN.

Kristiansund is the capital of the district of Nordmøre, and is a rapidly growing town with an important fish market. The principal part of the town is situated on Kirkelandet, where are the hotels, principal shops, parish church and hospitals. The streets are singularly steep and crooked, and the houses are irregularly built on account of the rocky nature of the surroundings. There are some fine woods on Nordlandet. The principal hotels are the Grand Hotel, in the market place, which has been recently rebuilt; Mölerup's Hotel, Nils Knutsson's Villa, and the Lossin's Hotel; all are close together. The customs house is situated near the fish market. There are gas works and a power station at the north end of Vaagen.

The population in 1913 numbered 16,079 inhabitants.

COMMUNICATIONS.

By Steamer.

The Wilson Line run continuously between Hull and Kristiansund, and a Norwegian line to Newcastle. Mail and other steamers communicate freely between the several ports on the coast.

By Telegraph.

There is direct telegraphic communication with Trondhjem, the cable crossing the entrance to the fjord to Tømmervaag. Southwards the telegraph line proceeds to Molde.

By Telephone.

There is direct communication by telephone following the course of the telegraph as above to Trondhjem and Molde. There is also a telephone line to Bud, crossing the Island of Averö, and northwards *via* Tømmervaag to Smölen and Veiholmen.

NORDMÖRE FJORD.

In the vicinity of Kristiansund the country is intersected by the numerous Nordmøre fjords, which penetrate through the large islands and inland upwards of 30 miles in various directions. There are several channels in from the Inner Lead, but the tidal streams run at the rate of 4 knots at half tide, and with the wind from seaward there is considerable sea. At the eastern end of Bremsnes Fjord are its continuations, Bergsö, Tingvold, and Sundals Fjords, which extend about 35 miles in a S. E. direction to Sundalen. A road runs up the valley of the Sundals river almost due east to Opdal (44 miles), where it joins the main road system to Trondhjem and Dombaas. There is no communication by telegraph or telephone between Sundalen and Opdal.

Further to the north-eastward is the entrance to Halsefjord, which is separated from Tingvoldfjord by a peninsula 25 miles in length and from 2 to 4 miles in breadth.

Besides Stangvik and Surendals Fjords there are several minor branches, and the general appearance somewhat resembles a bird's claw. From the village of Stangvik a road runs in a north-easterly direction to the valley of the River Orkla, where it joins the road from the south to Trondhjem (93 miles). The nearest telegraphic and telephonic communication is in the vicinity of Kristiansund.

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NORWAY: COAST REPORT

PART II THE COAST, PORTS, AND COAST DEFENSES

SECTION 3 TRONDHJEM FJORD TO VARANGER FJORD

JUNE, 1917

FFICE OF NAVAL INTELLIGENCE



FEBRUARY, 1918

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ROGER WELLES,
Captain, U. S. Navy, Director of Naval Intelligence.

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PART II.
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TRONDHJEM FJORD
TO
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JUNE, 1917

The information contained in this book should be verified
and supplemented whenever an opportunity offers.

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TRONDHJEM FJORD TO RUSSO-NORWEGIAN FRONTIER.

TRONDHJEM.

(See Chart 9 and Admiralty Charts 1971, 1972, and 3105.)

APPROACHES.

The principal southern entrance to Trondhjem Lead is through Griphölen, about 7 miles from Kristiansund; it is $2\frac{1}{2}$ miles in width and deep enough for vessels of all classes.

Ramsöfjord is the westernmost of the northern entrances to Trondhjem Lead from seaward; it is about 7 miles in length and 2 in width between the numerous islets on either side of the fairway; there is ample water for the largest ships. Another entrance from the westward is through Frøifjord to Kraakvaagfjord, but the channel is obstructed and difficult to navigate though it has plenty of water for large vessels.

A ship bound for Trondhjem Fjord generally uses one of two main routes from the open sea; the first up Trondhjem Lead and through Skjörn Fjord, entering Trondhjem Fjord as soon as Agdenes is turned; the second route through Frø Havet and Kraakvaag Fjord, and thus into Skjörn Fjord, this being the principal route followed by ships approaching from the north.

From Agdenes, the turning point from Skjörn into Trondhjem Fjord, the distance to Trondhjem City is 23 miles. There is very deep water throughout the whole run from the open sea, the channel being singularly free from obstructions. To the N. E. of the city the fjord extends about 45 miles, and affords ready communication with the sea for the northern regions of Sweden and Norway. The frontier between the two countries is only 26 miles distant, while Sundsvall, on the Gulf of Bothnia, is 180 miles off.

The fjord is never closed by ice.

The channel through the Inner Lead *via* Skjörn Fjord to the north is most intricate and can only be used by those having local knowledge.

From Trondhjem town, the main Trondhjem Fjord, which is here about 8 miles wide, runs N. E. past Levanger to Vaerdalsören, about 40 miles from Trondhjem and at the head of the Vaerdalen; another short branch of the fjord runs due east to Hell, and along this the railway from Trondhjem to the Swedish frontier and Storlien has been constructed. In this branch, Stjördals Fjord, is a deep bay on which stands the village of Hommelvik, about 13 miles east of Trondhjem, with which it is connected by railway and road.

At Hommelvik there is a small shipyard, possessing two building slips for wooden vessels.

At the village are two piers, and a small quay with from 8 feet to 12 feet depth alongside, with railway sidings upon them.

Opposite Rodberg Lighthouse, 11 miles west of Trondhjem, the fjord branches to the southward, forming Orkedals Fjord and Gulo Sen, into which falls the Gulo River. The village of Thamshavn is at the head of Orkedals Fjord, and is the terminus of the electric railway to Lökken mines, *see* "Communications." Vessels of any size can lie alongside the pier, which is built out into the fjord, though is there berthing there for only one ship at a time. The wharf is connected with the station by rails. Several roads lead from Thamshavn in the direction of Trondhjem and the Kristiania Railway.

A small pier (90 feet long with 4 feet depth alongside) is situated between Heg and Agdenes. It has a set of sheers upon it. The beach in the vicinity is suitable for landing purposes, but is commanded by the high ground near Agdenes. Roads and telephone wires are laid to the latter and Selvenes.

THE COMMERCIAL PORT.

(See Plate 22 and Admiralty Chart 2295.)

There is good anchorage in the roadstead in 6 to 20 fathoms of water, and near Munkholmen in about 8 fathoms. The port itself is disposed on both banks of the Nid Elven (Elvehavn) and along the front to the westward of the estuary of the river. The harbor is good, with considerable storage accommodation, and railway lines laid on to all the main quays.

There are dolphins on both sides of the entrance to the river, and the railways crosses by a swing bridge which permits of the passage of ships up to the docks through a channel with 23 feet of water.

The Outer Harbor (Yttre Bassin) is just to the westward of the mouth of the river, and is protected by a long breakwater, between which and the quay wall there is a depth at L. W. O. S. of from 16 feet to 19 feet. Ships may at present enter either from the east or west sides.

The Inner Harbor (Indre Bassin), consisting of the Östre Kanal Havn and the Vestre Kanal Havn, is situated to the north of the town, and is protected from the open sea by two islands, the western of which is connected at its western end with the mainland by a fixed bridge, across which runs a railway track. There are also three fixed road bridges communicating with the town, all of which cross the Inner Harbor. This harbor is narrow, about 7 cables in length, and can be entered either from the river through a swing bridge opposite to the docks, or through a swing bridge from the western end of the Outer Harbor. This harbor is mainly used by small craft, with the exception of berths 19 and 20 in the Vestre Kanal Havn, which are available for large steamers.

Ihlen Bassin, which is situated to the westward of the Inner Harbor in the bight of Trondhjem Bay, is formed by a breakwater about 3 cables long, and running parallel to the shore; additional protection is afforded from the east by a mole built out in a north-westerly direction from the western of the two islands forming the Inner Harbor. The entrance to this harbor is from the west, and the harbor is supplied with mooring posts; it is shallow and has only about 15 feet of water alongside.

At Ilsviken, in the south-west corner of the bay, there are several piers and jetties with mooring buoys lying off them; these piers are principally used for the export of iron ore.

Quayage.

In the Outer Harbor and on the river face of the Eastern Island, north of the railway bridge, there is a length of quayage of about 3,300 feet, consisting of various berths, numbered on Plate 22, 4 to 18. Of these, Quay 12 is about 250 feet long, and has a depth of water at H. W. O. S. of 24 feet, and at L. W. O. S. of 16 feet; Quays 9 to 11 and 13 to 18 have a depth of water alongside at H. W. O. S. of 26 feet, and at L. W. O. S. of 18 feet; Quays 4 to 8 inclusive have from 15 feet to 16 feet of water alongside, as a general rule.

All these quays are well equipped with warehouse accommodation. The Customs Offices are situated just south of Quay 13.

From the end of Quay 18 to the swing railway bridge there is less depth of water, and this part of the harbor is used mainly by fishing craft, or small steamers up to 200 net tons.

Quays Nos. 19 and 20, at the eastern end of the Vestre Kanal Havn, are used for large steamers, and have a depth alongside of 20 feet at L. W. O. S.

The other quays in the Inner Harbor, and in Övre Elvehavn and Nedre Elvehavn, are used only by small steamers, except those in the river in "Rosenborg Bassin," alongside the "Trondhjem's Mekaniske Verksted," and at the "Nordenfjeldske" Company's wharf (Nordre Vaerft), at which all the Company's steamers can lie. The depth of water, both in the "Rosenborg Bassin" and alongside the "Trondhjem's Mekaniske Verksted" quays, is 200 feet at L. W. O. S.

There is about 15 feet of water alongside the quays in Ihlen Bassin, and at Ilsviken the piers have from 16 feet to 21 feet alongside.

The height of the quays above the water at ordinary high water is in all cases 6½ feet.

Harbor Improvements.

Work began in 1913 on the first stage of the projected harbor improvements, which comprise a change of the outlet of the river, construction of new basins, and two breakwaters. Also of a new entrance to the outer harbor and to the Indre Havn. The new construction was to have been completed at the end of 1916, and would thereby increase the quayage space up to a total of 4,810 yards, with a total quay area of about 112,420 square yards. The proposed extensions and improvements are shown on Plate 22, but instead of being completed, only small progress has up to now (December 1916) been made. The work under construction at present consists in the preparation of the outer breakwater off the mouth of the river, and in new quays which are being built out from the shore north of "Rosenborg Bassin" and south of Ladehammer Hill; these two quays will ultimately join.

It has been decided to equip the quays at Ilsviken with modern appliances for the discharge and export of ore from the copper mines at Røros, Foldalen, Killingdal, and Rustvangen.

Lifting Appliances.

In the "Trondhjem's Mekaniske Verksted" there is a sheers to lift 70 tons. In Rosenborg Bassin there is a steam crane to lift 12 tons. On Quay 17 there is an electric crane to lift 17 tons, and on Quay 10 a steam crane to lift 8 tons. In the Östre Kanal Havn there are cranes of 5 tons, and two of 1 ton capacity each; all three are steam cranes.

Shipbuilding Capabilities.

Shipbuilding is not one of the main industries of Trondhjem, though a few ships are annually constructed at the various yards. For further details of construction *see under* "Private Shipbuilding Yards."

Repairing Facilities.

There are three machine shops affording facilities for repairs to hull and machinery for such vessels as can be accommodated in the dry docks. There are also repairing facilities at Hommelvik, situated 13 miles from Trondhjem.

Docks.

There are two dry docks, which are described under "Trondhjem's Mekaniska Verkstad."

Patent Slips.

In addition to a patent slip at Hommelvik, there are four other patent slips at Trondhjem. These are described in detail under "Private Shipbuilding Yards."

Salvage Appliances.

The salvage steamer "Nap," which belongs to the "Norsk Bjergnings Company," is stationed at Trondhjem. Icebreaking tugs are available when necessary.

Harbor Craft.

There are plenty of tugs and lighters.

Coal and Coaling Facilities.

From about 9,000 to 10,000 tons of coal are usually kept in stock; import of coal and coke was on the increase up to 1913, during which year it consisted of 201,212 tons. Vessels up to 15 feet draught can coal alongside the coaling jetties in the Indre Havn, and up to 18 feet in the Outer harbor; deeper draught vessels coal in the roadstead from lighters alongside, but as there is often a heavy swell in the bay, coaling thus is sometimes a difficult operation. About 60 lighters are available.

Liquid Fuel.

So far as is known, no liquid fuel can be obtained.

Water Supply.

Water can be obtained.

Trade and Shipping.

There is considerable trade from Trondhjem, which is facilitated by direct railway communication with Kristiania and across the Swedish frontier to the Gulf of Bothnia. There are a number of mechanical workshops, a steam sawmill, distilling tannery, rope walks, &c.; shipbuilding is indulged in, but only to a small extent, and Trondhjem owns very few vessels. The principal exports are sulphur, pyrites, copper, zinc, and fish in various forms; the chief imports are foodstuffs and coal.

There is a resident British Vice-Consul. In 1913, a total of 621 vessels of a total net tonnage of 440,685 tons cleared the port, of which 66 were British and 405 Norwegian.

PRIVATE SHIPBUILDING YARDS.

Trondhjem Mekaniske Verksted. (See plan on page 6.)

This firm is the largest in the town, and the works are situated on the eastern bank of the river just above the railway swing bridge. Ships are built, docked, and repaired, and engines are constructed. Steel ships up to 1,800 net tons have been constructed, and engines up to 3,000 h.p. Eleven vessels were on order in March, 1916, the largest of which was one of 3,050 tons dead weight. The number of men employed in 1917 was 850, including 150 at the foundry. About 5,000*l.* has recently been spent in fitting motors to run all the machines electrically and in fitting an air service all round the yard, including the docks; the shops are well supplied with machines, though many of them are of old pattern. There is a fair length of wharfage, but the depth of water is inconsiderable, 20 feet at L.W.O.S. In April 1917, three steamers were in hand, the largest being 1,800 tons net.

Boiler Shop.

The largest boiler made is one of 16½ feet in diameter, and the largest cylinder 70 inches in diameter. Hydraulic riveting is employed, but there is no hydraulic flanging press.

Fitting Shop.

This shop is well supplied with lathes, &c., and engines up to 2,500 h. p. can be constructed. Its capabilities admit of the straightening of the stern shaft of a destroyer, and steam cylinders up to 56 inches in diameter have been machined.

Smithery.

This shop is capable of small forgings only.

Coppersmith's Shop.

In the coppersmith's shop pipes up to 8 inches in diameter can be bent by hand, and up to 12 inches in diameter by hydraulic pressure.

Iron Foundry.

The iron foundry called "Trolla Bruk" has two cupolas, which can cast up to 10 and 6 tons respectively. There is a 10-ton crane in the foundry and three steam hammers, the largest being one ton. The number of workmen employed at the foundry in 1917 was 150.

Brass Foundry.

The brass foundry is small and fitted with pot furnaces only. It would hardly be capable of casting a propeller for a destroyer.

Lifting Appliances.

There is a sheers mounted on the wharf with a lifting capacity of 70 tons.

Docks.

There are two dry docks situated at the south end of the yard. They are small, the southern one is 280 feet long, 43 feet wide, and 10½ feet deep; No. 2 dock is 310 feet in length, 44 feet wide, and 11½ feet deep. The approach to them is only about 12 feet in depth.

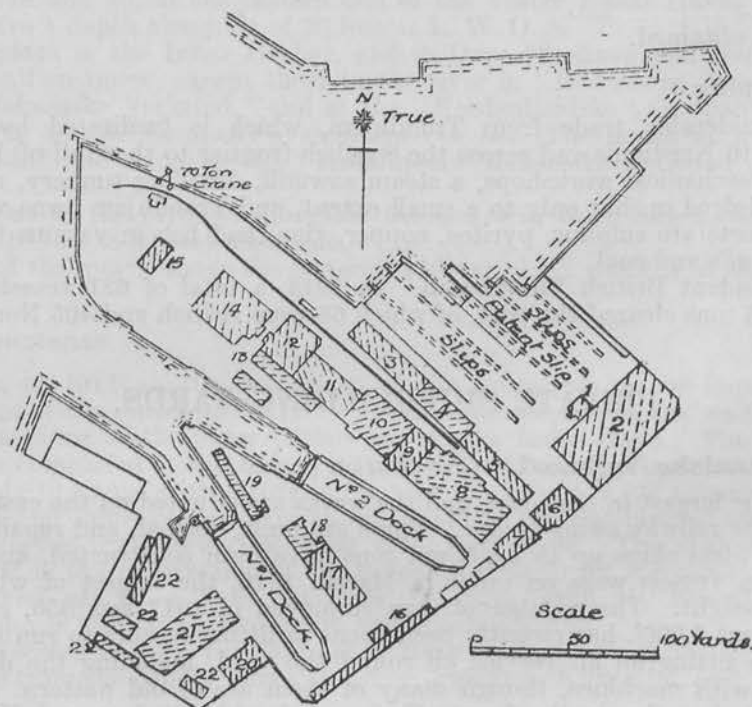
Patent Slip.

There is a patent slip of which the cradle is 112 feet long; it is actuated by steam, and can take a ship up to 150 feet in length, and of not more than 400 tons dead weight.

Building Slips.

There are four building slips varying in length from 150 feet to 300 feet. The ground round about is badly prepared both with piles and concrete, so that all heavy weights, engines, &c., are put in after launching.

TRONDHJEM MEKANISKE VERKSTED.



REFERENCE.

- | | |
|-----------------------|------------------------------|
| 1.—Engine House. | 12.—Smithery. |
| 2.—Shipbuilding Shed. | 13.—Coppersmith's Shop. |
| 3.—Bending Shed. | 14.—Foundry. |
| 4.—Locksmith's Shop. | 15.—Smithery (Steam hammer). |
| 5.—Mould Loft. | 16.—Painter's Shop. |
| 6.—Drawing Office. | 17.—Turbine |
| 7.—Office. | 18.—Pumping Station. |
| 8.—Machine Shop. | 19.—Shed. |
| 9.—Engine House. | 20.—Foreman's Office. |
| 10.—Boiler Shop. | 21.—Timber Stores. |
| 11.—Shed. | 22.—Stores. |

Örens Mekaniske Verksted.

These works are smaller than those of the "Trondhjem Mekaniske Verksted," and are not so well fitted up. The employees number about 140 men. There is a patent slip, the cradle of which is 110 feet in length, with a depth of 11 feet aft. It is actuated by steam and will lift a ship up to 300 tons dead weight, and of a length not exceeding 135 feet. There are two building slips, 100 feet long and 60 feet long respectively, and in March 1916 this firm had an order for five ships, of which the largest was a vessel of 165 tons dead weight. The works are situated between "Trondhjem's Mekaniske Verksted" and "Nordre Vaerft."

Baklandets Mekaniske Verksted and Stöberi.

This small firm owns two patent slips and carries out considerable repair work. The two slips are actuated electrically, and the lengths of the cradles measure 140 feet and 100 feet respectively; the larger has a lifting capacity of 500 tons, while the smaller is used principally for the repair of lighters. The works are situated on the east bank of the river.

Hommelvik Vaerft and Stöberi.

This firm owns a patent slip, situated at Hommelvik, 13 miles east of Trondhjem; the cradle is 122 feet in length and is worked by steam. There is a small shipbuilding yard possessing two building slips for wooden vessels. At the village are two piers and a small quay with railway sidings on them.

THE TOWN. (*See Plate 22.*)

Trondhjem is situated at about the same latitude as the Faroe Islands, and in summer the climate is much the same as in England. The nights are quite light for a couple of months during the height of summer, and the cold is not great in winter, owing to the proximity of the Gulf Stream, which keeps the harbour open all the year round. This city is the most northerly town of importance in Norway, for compared to it Tromsø and Hammerfest are mere villages, and in recent years several handsome streets of stone-built houses have been built. The principal part of the town is situated on the peninsula formed by the last bend in the river, and a number of bridges span the river and provide communication with the important suburb of Baklandet, on the eastern shore. The town is spreading towards the south-east and east. The valley of the Nidelven runs to the south of the city, which is otherwise surrounded by a circle of picturesque hills, forming the district known as Trøndelagen, the inhabitants of which are called Trönder. Trondhjem is the capital of the stift, or province, of this name, and is the seat of a bishop, and was formerly the royal residence and seat of government. In 1912 the population numbered 47,577, and is increasing. The town has been partially or entirely burned down no less than 15 times.

In the centre of the town is the Market Place (Torvet) where the Munke Gade and Kongens Gade, the two main streets, cross. In the former, a little north, is the residence of the provincial governor, and used as the Royal Palace during coronation festivities. The Munke Gade, in which the new red building of the Technical School is conspicuous on the left, leads southwards to the Cathedral (Dom Kirke), which is the most important building in the city, and of great age and historic note. Other buildings of municipal importance are the Central Fire Station on the west side of Kjöbmandsgaden, opposite the Norges Bank; the Central Power Station, at the western end of the inner harbour, which supplies the trams with power; the Town Gasworks, almost opposite the Gangbro Bridge, and a second gasworks N.E. of the town; the Post and Telegraph Office, in Nordre Gade, close to the Fruekirke; the Theatre, in Prinsens Gade; and the Observatory, on the western bank of the small stream Hølvæn entering the sea opposite the western mole. There are numerous hotels, of which the principal are the Britannia, in Dronningen's Gade, the Angleterre, the Grand, the Scandinavie, and others. An electric tramway maintains communication through the principal streets. The railway station lies to the north of the town on the Eastern Island; the locomotive and carriage works are south of the town and on the west side of the river. To the east of the town, and dominating Baklandet, is a hill on which stands the old fortress of Kristiansten, now disused. On the west side of the town is the small suburb of Hølvæn, in which there is a hospital, and to which the tramway runs from Torvet. There are important sulphur mines at Hølvæn at the northern end of Ytterø, in Trondhjem Fjord. Magnetic separating works have recently been started at Fosdalen in the Beitstad Fjord, an arm leading N.E. from the head of Trondhjem Fjord.

COMMUNICATIONS.**By Sea.**

There is regular communication by steamer with Hamburg, Hull, and Copenhagen. The "Bergenske S.S. Company" run steamers regularly northwards, calling at ports as far as Kirkenaes, and the "Romsdals S.S. Company" connect southwards with coast ports and fjords.

By Railway. (See Map 1.)

Trondhjem is the western terminus of two main single-line railways, one narrow gauge running S.E. to Kristiania, and the other normal gauge running eastwards up the Stordalen to the Swedish frontier (62 miles) near Storlien, and meeting the Stockholm-Haparanda-Petrograd railway at Bräcke, 149 miles from the Norwegian-Swedish frontier.

The railway from Trondhjem to Storlien follows the fjord to the eastward as far as Hell Junction (20 miles). Here it throws off a branch line to the north, *viâ* Vaerdalen (59 miles), at the head of the important valley of the same name leading to the Swedish frontier, to Sunnan (95 miles); this railway is in process of extension to Namsos on the Namsen Fjord.

From Hell Junction the main line follows the Stordalen Valley to Storlien without throwing off any further branches.

The Trondhjem-Kristiania line runs almost due south as far as Stören, when it bends to the eastward, and then southward within about 20 miles of the Swedish frontier. There is a short mineral line branching from Tyvold (87 miles) up to the copper mines at Kongens Grube. At Elverum (253 miles), the main line turns west to Hamar and Kristiania, and a branch continues south to Kongsvinger, near which it crosses the Swedish border and proceeds to Gothenburg and Southern Sweden.

The proposed branch from Storen to Dombaas on the Dovrefjeld (90 miles) is now under construction; it is a normal gauge (4 feet 8½ inches) railway, and it is expected to be finished at the end of 1919, when it will probably be the main route from Trondhjem to Kristiania.

In the neighborhood of Trondhjem, an electric railway connects the little port of Thamshavn at the head of Orkedals Fjord with the copper mines at Lokken (15½ miles); there are tourist cars on this line, but it was built originally to bring copper ore down to the port.

Between Svorkmo, 12 miles from Thamshavn, and Lokken the line ascends abruptly, rising 325 feet in 1¼ miles. The station is on the sea shore.

By Road.

A network of roads connects Trondhjem with the surrounding country. Of these, the two principal roads follow the railway lines, the southern through the valley of the Guldalen, and the more northerly down the Stordalen to the Swedish frontier. The latter has a main branch proceeding to the north, near the coast from Hell Junction as far as Vaerdalen, when it bends eastward and follows the course of Vaerdalen Valley across the Swedish frontier, and is generally known as Karl Johan's Vei; this road is a poor one for military purposes, being only about 13 feet wide with 9 feet of inferior metalling.

At Sulstuen, near the frontier, a second road branches N.E. into Swedish territory.

To the south of Trondhjem the main road branches west from Leinstranden and splits up into several branches, which find their way by various and devious routes to the valley of the Orkla River, one of which continues south to Dombaas, and another S.W. to Molde Fjord. Motor cars can run over most of the roads, but ascents are often very steep, the road surfaces are never very good, and the roads are always narrow.

By Post, Telegraph, and Telephone.

There are general arrangements for communication by these in each case. The main telegraph and telephone lines communicate with Kristiania *viâ* the Guldalen.

The coastal lines run northward along the fjords to Stenkjaer, when they cut across the peninsula to Namsos, proceeding thence to the far north.

Southward they follow the coast line to Thamshavn, on the Orkedals Fjord, whence they proceed to Kristiansund and the south. There is direct telegraphic and telephonic communication also with Sweden *viâ* the Stordalen, and a telephone line runs up the Vaerdalen to Sandvik on the frontier. Both telegraph and telephone lines leave Trondhjem westward, *viâ* Thamshavn, for Agdenes, eventually crossing the fjord, the telegraph cable to Beian, and the telephone cable to Hasselviken on the opposite shores; these lines join at Ophaug and follow the coast northwards, when they bend back from Hokstad to join the main trunk to Namsos.

Trondhjem is also in direct communication by telephone with the northern shore of the fjord; the cable crossing from the west of the town to the opposite side. There is telephonic communication with Mosviken and other villages on the upper reaches of Trondhjem Fjord.

The main telegraph line from Trondhjem to the north eventually continues through the Norwegian coast towns into Russian territory at Jakobselv, whence there is communication by telegraph with Petrograd.

This line along the Norwegian coast is connected with the Swedish telegraph system, but it does not at any point run through Swedish territory.

By W/T.

There is no W/T station at Trondhjem itself, but at Halten, or Troan Island, situated off the northern entrance to Trondhjem Fjord, there is a small power station for the use of the fisheries.

NAVAL DETAILS.

There is a small naval establishment at Trondhjem, shown on Plate 22 as situated on the river between the Bybroen Bridge and the Kongsgaards Bridge, but for some years up to 1912 the Admiralty had paid little or no attention to it.

The 1912 defence law provided for expenditure of 5,556*l.* on the naval establishment at Trondhjem. A committee consisting of two naval officers and an engineer officer visited Trondhjem in 1912, and, according to press reports, they have recommended the purchase from the municipality of some ground at Ilsviken, just to the westward of the town.

An additional grant of 24,450*l.* was made in the extraordinary Defense Budget for the period 1914-16 to the fleet station at this port, and it is believed that this vote has been increased recently. It is not known in what way this money has been spent.

Naval Coal Depôt, &c., at Hysnes.

1,500*l.* was spent a few years ago on building a boat harbor at Hysnes, and later on 3,000*l.* was voted for converting it into a harbor of refuge for torpedo boats, with a coal shed and water supply (Estimates).

In 1907 a small jetty was noticed at the extreme point of Hysnes; the ground for some distance in rear being enclosed by high wire entanglement. Presumably this is the harbor of refuge mentioned in the Estimates.

MILITARY DETAILS.

Trondhjem is commanded by high ground. To the west there is a steep rise from the town by terraces to Mount Graakallen, which is about 1,800 feet high and $4\frac{1}{2}$ miles distant from Trondhjem. To the east and south-east there is also a rise of ground—gradual at first but finally steep—to the ridge $3\frac{1}{2}$ miles distant, which extends from Charlottenlund on the fjord to Bratsberg, and has an average elevation of 850 feet.

In addition to the cables mentioned under "Communications," there is a cable which is probably military, crossing Trondhjem Fjord from Selvenes to Hysnes.

COAST DEFENSES.

Except for an old fort on Munkohlmen, now of no importance, and the old fort of Kristiansten, now dismantled, there are no defensive works in the immediate vicinity of Trondhjem.

Trondhjem Fjord is a cul-de-sac with a single entrance about 2 miles wide between Agdenes and Brettingsnes, which is 23 miles from the anchorage off the town.

By the capture of the forts in this vicinity Trondhjem lies at the mercy of an invader. The forts themselves, three in number, were constructed about 1898.

Each fort consists of a group of guns mounted in single emplacements blasted in the rock. The guns, which are believed to be all of Armstrong make and about 1895 pattern, with the exception of the two 21-cm.'s in Fort No. I., are on V.C.P. mountings, with shields.

The 21-cm. guns have large shields extending back to the breach; the 15-cm. guns have smaller ones.

The elevation of the guns, as given in the sketches, is believed to be accurate.

In spite of their exposed position, the guns, when painted the color of the ground, do not appear to offer an easily distinguishable target, unless mounted on the sky-line.

The arcs of training are large in every case. No rangefinders have been reported so far.

Broad metallad roads connect Forts Nos. I. and II. The single gun emplacements are likewise connected by roads.

Brettingsnes Fort (No. I. on Chart 9 and Plate 23.)

The guns as viewed from the west are in three tiers, the two 21-cm. guns being at the highest level, with three 15-cm. guns below them, and the two 65-mm. guns at a lower level still.

The heavy guns are mounted in single emplacements hewn out of the rock. The slopes in front are of concrete, covered with earth and sods. The entire gun mounting is exposed, no breastwork having been constructed to protect the lower part of the shields or the gun's crew. The guns and shields, which are painted a dark brown or black, show up indistinctly against the background of the hills.

The position is divided in two by a gully, up which a road has been made. The other roads are shown in Plate 23.

The landing-place at the Point below the fort is enclosed with wire entanglement. There is no jetty.

One searchlight is known to exist, and it is possible that there is also a second one.

The armament consists of—

- 2—21-cm. (8.2-inch) Q.F. L/45 Armstrong guns, with shields.
- 3—15-cm. (5.9-inch) Q.F. guns on V.C.P. mountings, with shields.
- 2—65-mm. (10-pr.) Q.F. guns on P. mountings, with shields.

Hysnes Fort (No. II. on Chart 9 and Plate 23).

The relative positions of the guns, and their heights above the sea level, are shown in Plate 22.

Each gun, mounted on a concrete platform, occupies a separate work. They offer very much the same appearance as those above described, but are more easily distinguishable, being mounted on the crest of a ridge.

Two magazines are situated as shown on Plate 23.

Large barracks and storehouses are situated south of the ridge occupied by the emplacements. A road leads to them.

A military road leads to Fort No. 1. The emplacements are likewise connected by roads.

Telephone and telegraph systems exist.

A saluting battery of seven field guns on field carriages is drawn up between the flagstaff and the upper 21-cm. gun.

What is believed to be a position-finding station is situated between the two 21-cm. guns, nearly on a level with the most easterly gun. Several buildings have been erected along the roads leading to the two 15-cm. guns.

It was reported in September 1912 that the two 21-cm. guns had not then been mounted; the shields only were in position.

The details of the gun positions are shown on Plate 23, and the armament consists as follows:—

- 2—21-cm. (8.2-inch) Q.F. L/45 Armstrong guns on M. 1897 mountings.
- 2—15-cm. (5.9-inch) Q.F., probably L/45 Armstrong.
- 3—65-mm. (10-pr.) or 57-mm. (6-pr.) Q.F. guns on P. mountings.
- 7 field guns, for saluting purposes.
- All have shields.

It is important to note that all the emplacements are practically in line from a point W. by S. from the fort.

A searchlight has been reported to have been seen on the south side of Hysnes Point.

Fort on Selvenes (No. III. on Chart 9 and Plate 23).

The disposition and height of the guns above the sea level are shown on Plate 23. In 1897 the guns, which are mounted on concrete platforms, were much exposed; but the opinion was expressed that when painted the color of the ground they would be with difficulty distinguished from seaward. The two single emplacements are connected by a broad road cut in the hillside and extending to the sea shore.

The armament is—

- 2—15-cm. (5.9-inch) Q.F. guns on V.C.P. mountings, with shields.

No searchlight has been observed, but it is thought one may exist in one of the various fissures in the rocks.

SUBMARINE DEFENSES.

It is reported that the entrance to Trondhjem Fjord can now be closed near Agdenæs by a cable with mines attached.

The uniform depth of water in the fjord is too great for the general laying of mines.

SEARCHLIGHTS.

The following searchlights are known to exist:—

At Brettingsnes.—A cove has been filled in with rubble at a height of about 30 feet. A tramline, along which the light travels, has been laid along the top of the rubble for about 50 yards. The housing station is behind the rock at the N.W. end of the line, where a large door is visible from the south; the top is strengthened with concrete. The position is protected by wire entanglement.

At Hysnes.—The position is on the south side of the point and surrounded by wire entanglement. The light is run out from an artificial passage cut in the rock, which is visible from the W.S.W.

In addition to the above, searchlights may be mounted at the following points:—

At Agdenæs point there is a small excavation with a door and porch supported by pillars. It is possible that it may contain a searchlight.

At Selvenes, although no searchlight has been observed, there is wire entanglement halfway up the rock forming the point. There are deep fissures in the rock which might contain a searchlight.

LAND DEFENSES.

The two main railway lines, described under "Communications" are of the utmost strategic importance to Trondhjem, and the valleys through which they run have been the object of special consideration by the Norwegian military authorities.

The direct distances from the sea in the neighborhood of Trondhjem to the Swedish frontier are:—Along the Vaerdalen to Sandvik, about 27 miles, along the Stordalen from Hell to Storlien, about 40 miles. The latter is the route followed by the railway into Sweden, whilst along the former there is a road to the frontier. The advance of a Swedish force down these two valleys would isolate that part of Norway which lies to the north, as far as communication by land is concerned. Further, as the Reitan-Roros section of the railway, which connects Trondhjem with Southern Norway, lies within 20 miles of the Swedish frontier, it would be an easy matter for the Swedes to cut it, as there are four roads available for the purpose.

Recognizing the danger to which the land communications are exposed, the Norwegian Government have adopted measures for the defense of the Vaerdalen and Stordalen and a new railway is to be built which will branch from the existing line at Stören and follow a route more remote from the frontier.

The new work closing the Vaerdalen is said to be within 12 to 18 miles of the Swedish frontier. An old work, probably of no value under modern conditions, is said to exist at Steine, about 9 miles from the sea at Vaerdalsören.

The position of the new work which closes the Stordalen is not known. It is not visible from the railway, but is believed to be about the same distance from the frontier as the work in the Vaerdalen. There is an old work close to the railway near Hell Junction, which commands the fjord end of the valley. It is on the summit of a large rock about 100 feet above the river, affords a conspicuous mark, and is commanded at easy range from the hills on either flank of the valley.

In 1916 a vote of 2,000*l.* was made for additions to the Vaerdalen works, and also a vote of 1,400*l.* for improvements to works in the Stordalen.

MAGAZINES.

It has been reported that there is practically no soil near the forts, and in consequence of the difficulty experienced in excavation in the rock, the magazines have been built above the ground.

GARRISON.

The 15th and 16th Artillery Companies (5th Coast Artillery Battalion) are stationed at Trondhjem. There is also a signaling, but no mining, section.

A lieutenant-colonel is commandant of the defenses. Under him are four captains, including one in charge of the signaling section, and one lieutenant. These officers belong to the permanent cadre of the corps.

There is only one small steam launch belonging to the defenses.

The war establishment for the Trondhjem defenses, according to a report dated 1912, was as follows:—

5th Fortress Artillery Battalion (2 companies)	} Total 466, all ranks.
1 signaling detachment.....	

The 5th Field Brigade was at that time also allotted to the district. It consisted of 12 infantry battalions, four squadrons of cavalry, five batteries of field artillery, and details of sappers, train, etc.

BARRACKS.

There are barracks close to Hysnes Fort, and also at Hambaarnes, near Selvenes Battery. The latter are large enough for the accommodation of up to 2,000 men. There are artillery barracks on the east side of Smaabergene Park in Baklandat suburb. (*See Plate 23 and Chart 9.*)

CAMPING GROUNDS.

There is a military camping ground at Oisanden, close to the mouth of the Gulo River, where it enters Gulosen Fjord.

There is also a camping ground used by the military at Vernaes, close to Hell Junction, where there are wooden huts to accommodate troops of all arms. It is generally only in use during the summer months.

A grant of 1,400*L.* was made in 1916 for the erection of barracks, etc., at Stenkjaersanden at the western entrance of Vaerdalen.

COAST BETWEEN TRONDHJEM AND VEST FJORD.

The coast immediately northward of Trondhjem Fjord is dangerous and intricate. There are considerable depths of water in the various fjords which split up the coast line, but their entrances are so hampered by the presence of rocks and islets, that expert local knowledge is absolutely indispensable for their successful navigation.

Namsen Fjord. (*See Admiralty Chart 3494.*)

This fjord extends in a S.E. direction from the entrance to Folden Fjord for a distance of about 20 miles, where it receives the waters of the Namsen Elv. Near its head, Lyngen Fjord branches off to the S.S.W. about 8 miles, and the village of Aasneset at its head is less than 15 miles from the northern extreme of Trondhjem Fjord and the Trondhjem-Sunnan Railway, with which it is connected by road. Opposite the entrance to Lyngen Fjord the Lökkaren channel, which can be used by small vessels, leads from Namsen Fjord into the fjords branching south from Folden Fjord, and separates Otterö from the mainland.

The approach to Namsen Fjord is not difficult, and there is ample water for deep draft vessels; its average width is 1 mile.

Namsos.

This port, which lies at the head of the Namsen Fjord, is available for vessels of any draft. The principal trade is in timber, and there are several sawmills in the vicinity. There is also a shipbuilding yard at which vessels up to 200 tons can be built. The shipbuilding company owns a small patent slip for the use of ships up to 300 tons register, and there are good repair shops for small work. The two quays are respectively 400 feet and 770 feet in length, of which the former has a depth of water at low water of 20 feet and the latter of 18 feet. From 300 to 400 tons of coal is usually kept in stock and is brought alongside in lighters.

The town is small, with a population in 1914 of 2,600 inhabitants; a British Vice-Consul is resident. The town was rebuilt in 1872 and 1897 after destructive fires.

An important new mining enterprise was established in 1913, called the "Grong Mining Company," to work the copper mines near the Swedish frontier, making Namsos the port of export.

The capital is chiefly French, and the annual output is expected to be about 200,000 tons.

Communications.
There is regular communication by mail steamer with Trondhjem, and small steamers ply from Namsos to the Folden Fjord and its branches. The river is not navigable above the town. There is no communication by railway, but a road follows the course of the river to Overhalven, where it branches, one branch proceeding north to Kongsmoen (57 miles) on the Indre Folden, while the other continues up the river valley to Grong, where a further branch proceeds southwards to Snaasen Lake, which it follows to rail head at Sunnan (74 miles). Namsos is a station on the main telegraph and telephone system to the north. There is also telegraphic communication with the Vigten Islands, and there is communication by telephone with Murumoen on the Swedish frontier.

Folden Fjord. (*See Admiralty Chart 2308.*)

The so-called Folden Fjord comprises the wide inlet north of Namsen Fjord as far as the southern boundary of the Vigten Islands. It is very deep and generally clear of dangers, and is split up into several fjords, most of which lie to the southward. Its extension eastwards is called Indre Folden Fjord, which is very narrow and runs at first in an E.N.E. direction for 15 miles, after which it bends to the S.E. for another 13 miles. This fjord is not of great importance and is fully described in the Pilot.

Northwards from Folden Fjord the Inner Lead passes through Nærosund, separating Indre Vigten from the mainland; the channel is comparatively free from dangers, but a strong current runs through it. There are numerous anchorages and a few small ports, which are described in the Pilot. The channels through the Vigten Islands can not be attempted without local pilots.

The Inner Lead crosses the Risvaer Fjord and continues between Edö and Langö, to Leka Fjord, whence it runs inside the "Skärgård" to Donnäsö, 60 miles further north. The passage presents no great difficulty; to seaward there is a conglomerated mass of islands, the majority of which are mere rocks, while the coast is much indented by fjords of various length.

There are no ports on this part of the coast of any particular note, except Mosjöen, and communication ashore is practically reduced to a telegraphic service; a telephone cable

connects the island of Vega with the mainland, and a second cable maintains communication between the coast and the islands of Alsten and Donnæsö.

Mosjöen. (*See Admiralty Chart 3529.*)

This little port is situated at the head of Vefsen Fjord and at the mouth of the Vefsen Elv. The harbor is available for the largest vessels, and at the Halsöen wharf, 3 miles north, there is a quay 670 feet in length with 15 to 25 feet at low water. At Halsöen there are steam sawmills, but the chief export of the district is silver ore. About 300 coasting vessels, amounting to the aggregate tonnage of 74,000 tons, visit the port annually. The population is about 1,800.

Communications.

The coastal mail steamers call frequently at the port, which has no communication by railway. A good road leads N. E. to Elsfjord (28 miles), a southern branch of the Ranen Fjord; another road leads south and east to Hatfjeld Dalen (50 miles), whence various tracks proceed to the Swedish frontier a few miles beyond. The main north and south telegraph and telephone communications pass through Mosjöen.

Ranen Fjord. (*See Admiralty Chart 2310.*)

Opposite Donnæsö, the Ranen Fjord penetrates inland for a distance of about 30 miles; several rivers empty themselves into it, some through wide estuaries, but none are navigable. The Ranen Fjord is the most richly timbered of all in the Nordland, and timber is a staple export.

Mö (Guldsmedvik).

This little town is situated at the head of Ranen Fjord, and is the shipping port of the Dunderland iron ore mines; it is also the center for the Swedish trade in Nordland. The harbor is natural and safe, open all the year round, and has sufficient water at low tide all over for large, but not the largest, ships.

Shipping arrangements are of the most modern type. Two loading berths, each 400 feet in length, with the same depth of water alongside as elsewhere in the harbor, are on one side of the 40 feet wide loading stage. The discharging stage is 90 feet wide, with two railway tracks. The latter has ample cranes and derricks, including one of 25 tons, which delivers on to a rail alongside. The discharging berth is 364 feet long.

The large boat-building firm of "Lars Meyer" is situated at Mö, and turns out from 700-800 boats annually. The iron ore mines, which are British owned, are situated about 19 miles away, near Urtvand. Buildings for magnetic separation have been built at Storfoshei near the mines, as well as an electric power station of 6,000 h. p. driven by steam. The number of men employed is about 600.

On the north side of the fjord, about 3 miles from Mö, are the copper mines of Bosmo, which employ 200 hands; the ore washing works are on the shore; the production of pyrites in 1913 from these mines was 20,000 tons. The Rödfjeld copper mines in the neighborhood produced 13,600 tons in the same year. Coal is imported, but it is not known how much is kept in stock.

Communications.

The usual mail steamers on the coast call here. A short line of railway, owned by the Dunderland Mining Company, connects the port with the mines at Storfoshei (9½ miles). Two main roads leave the town, one of which follows the line of the River Dunderland to the mines, and beyond them to the Swedish border, which it crosses at Sölygruber (about 30 miles); the other road follows the valley of the Tver Aa, and also crosses the frontier at Umbugten (25 miles), near Umavand, a lake 1,742 feet above sea level.

Mö is situated on the direct route by telegraph and telephone; communication is also maintained by telegraph northwards along the coast, joining the main route again at Bodö.

The Trænen Islands are situated in this part of the coast about 24 miles from the mainland and in the Arctic Circle. There are two good harbors in the archipelago; they are described in the Pilot. The Inner Lead proceeds northwards from Ranen Fjord, and there is choice of various routes between the islands as far north as Bodö; this part of the coast is mountainous and barren, and the populated districts become less evident.

Bodö. (*See Admiralty Chart 2311.*)

The harbor of Bodö is well situated on the south side of a bay and on the north shore of the entrance to Salten Fjord. There are two entrance channels, that from the north through Nyholm Sund by which ships approach from Vest Fjord; the most usual approach is from the southward between the islands of Fleinvær and Fleina, which is free from danger. In the western part of the bay there are depths of 6 to 9 fathoms over clay, but the inner end is shallow. There are no public docks or wharves, but vessels up to about 2,000 tons can discharge alongside various warehouses. The depth of water in the harbor is sufficient for all ships, and a breakwater has been built to protect the anchorage. The quay is 656 feet in length, with a depth of water alongside of 16 feet at lowest ebb. There is a patent slip for small vessels only; it is 130 feet long and able to take vessels up to a length of 145 feet. The

import of coal in 1913 was 38,446 tons, which was less than in previous years. About 4,000 tons is usually kept in store, and Bodö is the usual coaling station for vessels traveling up or down this part of the coast. Lighters are employed for coaling large vessels, but small steamers can coal alongside a wharf at which there is about 12 feet of water at low tide. It is reported that a small shipyard had been opened in 1907, but no details are known of it, and there are at present no known facilities for repairs. The principal exports are sulphur pyrites, copper, and fish; imports consist principally of coal and coke.

The Town.

Bodö is the seat of the administration and is the chief town of Nordland. The productive herring fisheries in the neighborhood have materially tended to further the prosperity of the town, which had a population in 1914 of 4,688 inhabitants.

The town is built on modern lines, and there are two reservoirs to the N. E. of the town.

Communications.

Local steamers call regularly at Bodö, but there is no railway communication. A good road runs along the coast to the northern end of the peninsula, and eastward to Ilstad and other places on the Salten Fjord. A telegraph line runs northward, across the numerous fjords, and keeping along the coast to Hamarøy on the Vest Fjord, where it joins the main northern lines; southwards a cable crosses the entrance to Salten Fjord to Sandvik on the opposite shore, and proceeds along the coast southwards. The main trunk telegraph and telephone lines run eastward inland to Fanske, whence they communicate northwards to Hamarøy and southwards to Trondhjem. There is also telephonic communication with Sulitjelma. There is a W/T station at Bodö for the use of the fisheries.

Salten Fjord.

The Salten Fjord, with its continuations the Skjaerstad and Saltdals fjords, penetrates about 40 miles inland. There are rich mining districts at the head of this fjord; Valnesfjord, which is noted for its rich deposits of iron ore, and Sulitjelma for copper. The port of export for the latter is Fineidet. During 1916 the Sulitjelma Mining Company were producing 3,000 tons of copper per week, and the stock at hand was stated to be 30,000 tons.

Furulund is where this company has its headquarters, and the mines, which are the largest copper mines in Norway, employed 860 hands in 1916. A short narrow-gauge railway connects Sjønstaa on the Nedre Vand with the mining district at Hellarno. The electric power station is on the River Balmi Joki, at east end of the Lang Vand. In 1913 it was reported that this railway was to be widened and extended another 7 miles into the mine district. A good road runs southward from the head of the fjord up the rich valley of the Saltdalen River, eventually crossing the frontier into Sweden.

NARVIK.

(See Chart 10 and Admiralty Chart 2311.)

The main approach to Narvik is by way of the Vest Fjord and Ofoten Fjord, both of which are conspicuous for their great depth of water; both are unobstructed by islands. At its entrance the Ofoten Fjord is less than 2 miles wide, and although it begins to broaden out farther east, the Fjord never attains a greater width than 4 miles over its whole length of about 45 miles. At its head the Ofoten Fjord throws off three arms, the Beis Fjord and Rombaksfjord, between which is the promontory on which Narvik is situated, and to the N. E. the Heriangs Fjord. With the exception of the channel through the Vest Fjord, there is only one other approach to the Ofoten Fjord, viz., from the north, through Tiel Sund, which has deep water in a narrow channel, but is dangerous and intricate. Before reaching the Ofoten Fjord, Tiel Sund bifurcates, the main channel continuing in a southerly direction to Vest Fjord, while Ram Sund breaks away to the S. S. E. to enter the Ofoten Fjord. The latter is a dangerous and shallow channel.

THE COMMERCIAL PORT.

(See Plate 24 and Admiralty Chart 2312.)

The port of Narvik, or Victoria Havn, which has only been in existence for a few years, was developed entirely to facilitate the export of iron ore from the Swedish mines at Grangesberg and Kiruna, and consequently really for the benefit of Sweden. The harbor is well sheltered and affords anchorage in the roadstead for the largest vessels, and it is never

closed by ice. With steamers averaging 7,000 tons dead weight and with continuous working under normal conditions, there are facilities for loading about 85,000 tons of ore weekly. The shoots and appliances for working the iron ore are run by electricity.

Quayage.

The quays and wharves at Narvik are much scattered (*see* Plate 24) running from north to south; they comprise:—

- (a) A masonry ore quay of recent construction, about 300 yards long, fitted with shoots and other appliances used to discharge ore into vessels alongside. The quay is connected up by a double line with the railway. The depth alongside is about 30 feet. This quay has no cranes.
- (b) A stone jetty at the east end of the masonry ore quay, about 300 feet long and 90 feet wide. There are no cranes or railway sidings.
- (c) An old ore quay, built of timber and adjoining the stone jetty at its east end. It has a depth of 30 feet alongside and can accommodate one vessel at a time.
- (d) A coal quay, built of timber and provided with a railway siding and an electric crane. One vessel only can use this quay at a time. The depth alongside is 20 feet.
- (e) The commercial quays, built on timber piles at the south end of the town. The larger, used by the post boat, has a frontage of about 60 yards and two small cranes; the smaller, just east of the other, has only 30 yards of frontage and one fixed crane. A railway siding runs down to these quays. The harbor authorities have decided to resume work on a considerable extension of this quay. This extension was commenced some years ago, but was temporarily abandoned on account of the unexpected expense connected therewith.
- (f) Two private coaling wharves adjoining.
- (g) "Matthisen and Jacobsen's" timber wharf, built on piles and somewhat dilapidated.
- (h) A new quay in course of erection.
- (i) The State railway quay at Fagernes about 1½ miles from the town. The quay is about 600 feet long and is built on timber piles. The depth alongside is about 20 feet. A double line of rails has been laid on the quay, and the station alongside has five sidings. A fixed crane, worked by hand to lift 20 tons, is mounted at the east end of the quay, and two 30-cwt. cranes, mounted on trucks, are also available.
- (j) "Matthisen and Jacobsen's" timber quay for loading.
- (k) "Laxforsen's" timber quay, which will take large steamers.
- (l) A light jetty in course of erection.
- (m) "Berg's" wharf at Ankenes on the west side of the harbor, which is used chiefly for bunkering and storing transit goods.

Harbor Improvements.

The new quay (h) in course of erection in December 1916 is situated at Kleven, and is being constructed for a box factory. A new wooden jetty (l) was also being built out into Beisfjord on the south side of Fagernes Point.

It has been proposed to build out the State Railway quay (i) so as to give an additional width of 6½ feet.

Land is being reclaimed, presumably for the construction of a new quay, near the old ore quay (e) in the north-east corner of Narvik Harbor.

Lifting Appliances.

One large wharf crane to lift 20 tons on the quay at Fagernes, length of beam about 40 feet; one floating crane, belonging to the L.K.A.B. Company, capable of lifting 13 to 15 tons; the float is constructed of steel. Two or three light cranes mounted on railway trucks and owned by the L.K.A.B. Company; these have a lifting capacity from 30 cwt. to 5 to 6 tons. There are also various small wharf cranes of insignificant lifting capacity.

Repairing Facilities.

There is a patent slip for the repair of small vessels, but no dock. The "Luossavaara-Kirunavaara Aktiebolaget (L.K.A.B.)" own extensive repairing shops, which are situated near the old ore quay S.W. of Narvik, and are principally engaged in repairs to railway wagons, and in repairs and construction of machinery in connection with ore storage and shipping. There is up-to-date machinery in all the shops, which include a large machinery shop fitted with travelling cranes, a smithy, and a small foundry. The electric power station belonging to the works is built to the west of the other buildings.

Salvage Appliances.

A powerful steam tug, owned by the "Norske Bergnings Company," is stationed at Narvik for salvage or other work in the harbor and neighborhood.

Coal and Coaling Facilities.

There are coaling jetties, as described under "Quayage."

In 1913 a total of 80,582 tons of coal was imported into Narvik, but it is not known how much is reserved for the use of shipping. The greater part of the coal comes from the United Kingdom, but lately there has been a growing tendency to import coal from Spitzbergen. A large proportion of the coal imported is used on the Norwegian section of the Ofoten Railway.

Trade and Shipping.

Practically the only export from Narvik is the iron ore procured from the Swedish mines at Gellivare and Kiruna. Trade is principally with the United Kingdom, the U.S.A., Germany, Sweden, and Belgium.

According to the Norwegian Chamber of Commerce the normal annual shipments exceed 3 million tons of ore, and, provided large ships are employed in the carrying trade, as much as 4½ million tons could be shipped.

There is a British Consul at Narvik. In 1913 the number of British ships which entered and cleared from the port totalled 70, of a total net tonnage of 185,236 tons.

THE TOWN.

(See Plates 24 and 25.)

The town owes its importance to two main factors: its proximity to the Swedish iron-ore mines, with which it is connected by railway, and the fact of its being an ice-free port. Narvik was founded in 1902 and is gradually extending. There are two hotels, the "Grand" and the "Fenix," both of which are good, and not far from the quay.

The town consists of two main streets and a few scattered houses built on the rocky slope under Fagernes Mountain. The houses are chiefly built of wood. The population is about 5,800. The town is equipped with electric light and a telephone exchange. The water supply is from a reservoir situated about half a mile east of the railway station.

In 1916 it was proposed to establish some ironworks near Narvik, which were estimated to be able to extract 50,000 tons of pig iron annually from Kiruna ore. About 125,000 tons of coal per annum would be required for this enterprise. There are magnetic separating works at Bogen on the north side of the Ofoten Fjord.

COMMUNICATIONS.

Narvik is badly situated for communication, which is only permissible by sea or eastwards to the Swedish frontier: high mountains preclude the use of roads either northwards or southwards.

By Sea.

The Vesteraalen S.S. Company's boats usually call at Narvik twice weekly on their way to Hammerfest, the Lofoten Islands, or Trondhjem. There is also communication with Bodø twice weekly by the Bodø-Lofoten-Ofoten steamers. There are no other regular passenger steamers.

By Rail. (See Map 1.)

Narvik is the North Sea terminus of the single line normal gauge (4 feet 8½ inches) railway, which runs to Luleå on the Gulf of Bothnia (294 miles), of which only 26 miles lie within Norwegian territory. The railway traverses a very mountainous district for 170 miles from Narvik eastwards, and the various tunnels on the Norwegian section of the line are reported to be mined for strategic purposes. The principal bridge is at Nordalen, 19 miles from Narvik, which is 220 yards long, and where the rail level is 85 feet above the river bed.

The line is exceptionally well built, and the Swedish section has been lately electrified, the power station being at Porjus, about 52 miles S.S.W. of Gellivare, and it has been proposed also to electrify the Norwegian section, using the same source.

The bulk of the rolling stock is Swedish, but the Norwegian Government own 23 locomotives and as many trucks and carriages on the railway, but as these run also on the Swedish section of the line, even this small number cannot be counted upon to be always present west of Riksgränsen on the frontier. Only one iron-ore train and one passenger train were running daily during the spring of 1916 from Sweden to Narvik. There are double lines at the junctions, but in 1913 it was reported that the railway would be doubled as far as the frontier owing to the increased ore traffic. This project had not been carried out in 1916.

By Road.

A single mountain road leads from Narvik eastwards, *via* Rombakbotn (14 miles) at the head of Rombak Fjord, and the Swedish frontier town of Riksgränsen to Fjällassen, midway between Gällivare and Kiruna. This road runs practically parallel to the railway and in places is very steep, and near the head of the fjord passes through a defile 5 miles long. A road from Oijord on the northern shore of Rombak Fjord communicates with the military camp at Elvegaarden, situated at the head of Heriang Fjord. Otherwise there are only a few paths and mountain tracks in the neighborhood, but it is stated that in most cases these are practicable for the passage of small field or mountain guns.

There is a road from Liland on the northern shore of the Ofoten Fjord through Evenes to the eastern shore of Tielsund, a branch breaking off to Ramsund from Lavangen on Tielsund.

By Telegraph and Telephone.

There is telegraphic and telephonic communication along the Ofoten railway, and by way of the north shore of Ofoten Fjord to Sandtorv on Tiele Sund, where the lines branch to the Lofoten Islands, or to Tromsø and other northern ports. There is telegraphic communication also by way of the north to Alexandrovsk on Kola Inlet and to Petrograd. In addition to the coast lines southward there is communication by telephone through the mountains southward to Trondhjem, joining the main line at Korsvik on Sagfjord. A telephone line also crosses to Oijord and, *via* Elvegaarden, proceeds by direct route to Solöy, where it joins the northern line.

NAVAL DETAILS.

The capture of Narvik by Russia with the object of ensuring an ice-free port and a naval station on the North Sea has been for some time a "bogey" to Norway; this fear, however, seems to have disappeared with the opening of Murmansk on the Kola Inlet, only to reappear with the thought that it might be seized by Sweden in league with Germany. The question has been much discussed amongst Norwegian officers, the military officers being of opinion that such a danger existed, whereas naval officers have always upheld that the capture of this port was not to be expected as its use as a naval base could never be seriously entertained on account of the difficulty of erecting suitable defences and communications in a locality so mountainous; a further ground for argument on the side of the Navy was that the depth of water in both the Vest Fjord and the Ofoten Fjord excluded entirely the possibility of employment of minefields. On the other hand, it has been decided that the Ofoten Fjord might be of value as a small naval base for the Norwegians themselves, and in August, 1915, it was decided to expend the sum of 80,000*l.* on various coast defense measures, comprising, amongst other things, the construction of a naval base at Ramsund, for which 21,000*l.* was appropriated. Previous votes with this object in view had already been made in 1912 (41,666*l.*) and in 1914 (5,550*l.*). Narvik is not yet considered to be a naval port.

MILITARY DETAILS.

It was stated in March, 1916, that the Norwegians were prepared in case of attack by Sweden to prevent the capture of Narvik. From its peculiar position and local conditions this might have been so, as the only practicable route from this direction was by way of the railway, and this was stated to be prepared for demolition—the tunnels having been mined. About 2,000 men formed the local garrison, with headquarters at Elvegaarden, the military training ground of the district, situated at the head of Heriang Fjord.

A small force of infantry equipped with machine guns was reported in March, 1916, to be occupying successive lines of entrenchments along the railway, particularly at Bjornefjeld, Hundalen, and Sildevikfjeld, and the authorities were of opinion that this force was sufficient to hold its own in a country so suitable for guerilla warfare.

COAST DEFENSES.

At Ramsund, near the entrance to Ofoten Fjord, and which it connects with Tielsund, progress has already been made on the construction of five works for the protection of the naval base to be situated there. Their approximate positions are shown on Chart 10, but it is not known what armament will be used, though, in 1914, Armstrong's were reported to have secured the contract for three 6-inch guns for the defenses of Narvik, but it is believed that so far these have not been delivered.

In the Extraordinary Estimates of 1914 granted for defense measures, a sum of 33,333*l.* was appropriated to "defensive works in Northern Norway," which probably means those for Narvik and Ramsund.

Lofoten Islands. (*See Admiralty Charts 2311 and 2312.*)

The Lofoten Islands, which form the S.W. prolongation of the Vesteraalen group, consist of a chain of mountainous islands, and form the northern boundary of the Vest Fjord. The

four main islands lie close together, and the straits between them are much encumbered by rocky islets. They are fully described in Norway Pilot, Part III. In places the land is flat, with lakes, swamps, meadows, and a few arable fields, and the winter climate is very mild. The Lofoten Islands are principally famous for the cod-fishery industry, which is carried on from mid-January to mid-April in the Vest Fjord, on the banks, which lie at a depth of from 30 to 110 fathoms. Some 9,000 fishing craft, with a population of up to 40,000 fishermen, distribute themselves at this season over the mouth of the Vest Fjord. At the close of the fishing season most of the fishermen go north of Finmarken for the summer fishery there. Coasting steamers call at most of the island ports, of which the principal use the fishing stations of Henningsvaer and Svolvær, whereas Örsvaag is considered the best harbor for vessels of moderate draft, and Brettesnes, the principal port of trade, and at which a British Vice-Consul resides. Svolvær imports a considerable quantity of coal, the total in 1913 being 42,316 tons. The various passages and channels through the islands are described in the Pilot; in the majority of cases they are narrow and intricate, though deep, and require local knowledge.

Between the Vøsteraalen and the Lofoten Islands is the Hassel Fjord, which is a usual steamer route to the north, and the more easterly channel through Tiesund forms the Inner Lead from Vest Fjord to Harstad and Tromsø.

There are W/T stations for the use of the fisheries at Röst and Sorvaag in the Lofoten Islands.

Harstad.

Harstad is situated on the N.E. side of Hindö and on the Vaag's Fjord. It is a trading station with a quay, and boasts a small hotel. A small supply of coal is usually obtainable, and there are two patent slips, with a lifting capacity of 700 and 400 tons respectively, and small steamers are built. There is telegraphic communication southwards with Sandtorv, where it joins lines to Narvik and the Lofoten Islands; northwards Harstad communicates with Tromsø by telegraph *via* the islands.

Harstad is the military station for this district.

The Inner Lead now runs through Solberg Fjord, and across the entrance to Malangen Fjord and Bals Fjord to Tromsø, passing several small stations and various fishing villages.

Tromsø. (See Plate 26 and Admiralty Chart 2313).

The approaches to Tromsø, through Malangen Fjord from the south, or Kvalsund or Grötsund and Tromsösund from the north, are narrow and intricate, and local knowledge is necessary.

The town and port are situated on Tromsø Island and well protected from the sea by Kvalö Island; there is protected anchorage in the roads, but the currents are usually very strong.

The Port.

Two moles protect the harbor from the strong currents, one of which is abreast the town, the other being about 3 cables to the south. There is considerable silting up in the harbor, which is available only for vessels of moderate size drawing not more than 10 feet. Deeper draft vessels should anchor southward of the entrance, or northward of the harbor altogether. Ships of about 500 registered tons can be berthed at the main wharf on the western side of the harbor, and alongside which there is 28 feet of water.

Loading and discharging are carried out by lighters, and in the northern harbor there are private quays for the discharge of coal. There is a hand crane on the main quay.

Some facilities exist (including foundry) for the repair of iron vessels and machinery, etc. There are 4 patent slips having lifting power from 150 to 1,000 tons net, and three other smaller slips and pontoons. In 1916, 100 men were normally employed at the yard, which deals generally in repairs to sailing ships.

About 5,000 tons of coal are usually stocked, and there are about 20 lighters, between 20 and 30 tons; the coaling wharf has a depth of water alongside of 14 feet at low water.

In 1913 there was an import of 33,292 tons of coal. There is considerable commercial activity at Tromsø, especially in the preparation of fish, while there is a lucrative trade with Archangel.

The Town.

Tromsø has a population of about 10,000 inhabitants, and is the seat of an Amtmand and of a bishop. There are several churches and schools, a hospital, a training college, and a museum, and it is the most important town north of Trondhjem. There are regular streets, with large private houses and good shops, and the town presents a thriving appearance.

Communications.

Mail steamers communicate three times a week with other Norwegian ports; there is no communication by railway or road. There is telegraphic and telephonic communication *via* Sandtorv or Narvik, with the south by way of the islands, or inland down the valley of the Maals Elv; northwards, the telegraph and telephone lines connect with Hammerfest and beyond, and telephonic communication is maintained with the islands south of Fuglö Sæet.

Skibotn (or Skibotten). (*See Map 1 and Admiralty Chart 2314.*)

North of Tromsø, Ulfsfjord and Lyngenfjord are separated by a wild mountainous peninsula, which opposite Lyngen is only 2 miles wide. Near the southern end of Lyngenfjord is the small market town of Skibotn, situated at the mouth of a river of the same name. A road leads from Skibotn to Silostrovo on the Norwegian-Russian frontier, and then follows the Muonio River outside Swedish territory to Torneö on the Gulf of Bothnia, a distance of about 500 miles. In the winter of 1915-16 this road was used by sledge traffic for the transport of munitions and other stores from Great Britain to Russia; this road would probably be of no value during the summer. There is a small quay, and the harbor will accommodate two ships at a time, but they must be loaded or discharged by means of lighters. There is communication by telegraph with Lyngen and Tromsø, or south-westwards across country to the Maals Elv.

Finmarken.

The district of Finmarken extends from Brynild, on the N. E. side of the entrance to Kvænangen Fjord, and southward of Alten Fjord to Jakobs Elv in Syd Varanger. The population consists of about one-half Norwegians, one-third Lapps, and the remainder a half-caste race known as Quains. Fishing is the principal industry. There is scarcely any vegetation near the coast, and most of the mountains rise precipitously from the sea. There are several fishing and whaling stations on the coast, which is deeply indented. Inland there are few roads, and these are usually only practicable in winter.

Alten. (*See Admiralty Chart 2315.*)

From the head of Alten Fjord, where there are important copper mines, there is communication across country by an indifferent road to Palojoensu on the Muonio River, and thence to Torneo and Haparanda on the Gulf of Bothnia, a distance of about 430 miles. The journey in a sledge will take from 11 to 13 days. The main telegraph and telephone lines connecting Southern Norway with Hammerfest, the Arctic ports, and Russia pass through Alten, and one telegraph line runs almost due east across country to the valley of the Tana Elv, which it follows to Tana Fjord.

The Inner Lead passes through Varg Sund northwards to the approaches to Hammerfest; in the northern portion, towards Hammerfest, the channel is intricate and dangerous. An inner channel passes to the east of Kvalö.

Hammerfest. (*See Admiralty Chart 2315.*)

Sörösund is the direct approach from the westward to Hammerfest; there is considerable current, but the channel is otherwise free from dangers. Temporary anchorage may be found in almost all the small fjords on the south side of Sörö, eastward of Hasvig. The approach passing north of Sörö is not often used, while that from the north through Rolfsösund is the best entrance from that direction.

The Port.

The excellent, almost land-locked, harbor is fully described in the Pilot, and a plan of it is shown on Admiralty Chart 2315. The utmost rate of discharge is about 500 tons a day, and it is well supplied with warehouses; the piers, of which there are several, are wooden, mostly privately owned, and have a depth of 15 feet alongside. The steamer quay is 250 feet long with 25 feet alongside. Only small repairs can be effected, but vessels are strengthened here for ice navigation, and there is a patent slip for vessels under 200 tons.

The average quantity of coal in stock is about 5,000 tons, and one of the coaling wharves has a depth of 15 feet alongside, otherwise lighters are used. The chief trade is the result of the Finmarken fisheries; one of the principal imports is coal, of which 34,803 tons were imported in 1913, partly from Spitzbergen. A British Vice-Consul resides in the town.

The Town.

Hammerfest is the most northerly town in Norway and is situated on the N. W. side of Kvalö. The population in 1915 numbered about 2,800 inhabitants. The houses are entirely built of timber, but there is electric light throughout the town. The principal industry is fish curing and the manufacture of cod-liver oil, of which there is an ever-pervading smell. The harbor is skirted by the Grönnevold Gade, in which are the principal warehouses, the residential quarter lying further to the S.W. There are no defenses.

Communications.

Local steamers of the Nordenfjeld Company ply regularly to Hammerfest, and there is communication three times weekly to the south of Norway. There is no road or railway communication in the vicinity. Telegraphic and telephonic communication by several lines is maintained with Southern Norway, and four telegraph lines cross the peninsula to Kistrand on the Porsanger Fjord, whence there is communication with Russia. There is also communication by telegraph only with Honningsvaag and Ingö *via* Kistrand, the cable crossing Rolfsösund

to Ingö, on which there is a W/T station for coastal use, having a radius of action of about 550 miles, and communicates with the Norwegian W/T station at Green Harbor, Spitzbergen.

COAST FROM NORTH CAPE TO THE RUSSO-NORWEGIAN FRONTIER.

North of Hammerfest the landscape is entirely Arctic and vegetation scanty; the coast is deeply indented, and on the island of Magerö is the North Cape. On the S.E. side of this island is the small fishing harbor of Honningsvåg, at which the mail steamers call; the harbor is good, though small, and there is a telegraph station. There are several harbors between the North Cape and Vardö, but they are small and exposed, though easily approached. The coast is rugged, precipitous, and irregular, and human habitations are few and far between. The Porsanger Fjord penetrates 65 miles inland in a S.W. direction, at the head of which is Kistrand, which is regularly visited by coasting vessels, and where there is an important telegraph centre. Further east is Laxefjord, which is unimportant except for the telegraph station at Lebesby, a small port on the eastern shore near its head. The third great fjord running in a southerly direction from the Arctic is Tana Fjord, which is on the west side of the Varanger Peninsula. Several branches extend in a westerly and south-westerly direction from the main fjord, and they are surrounded by rugged mountains. These fjords are all important fishing stations during the summer months. The Tana Elv empties itself into the S.E. arm of Tana Fjord, and on the west side of the mouth is the trading station of Tana, which is in telegraphic communication with Hammerfest, and by telegraph and telephone with Vardö, Vadsö, and other parts on the Varanger Fjord. The Tana Elv is the third longest river in Norway, and runs through a richly wooded but sparsely inhabited valley. It is not navigable, except by quite small craft, and by these only as far as Marienlund—3 miles from the mouth—as the estuary is occupied by extensive banks of sand and mud. The telegraph line to Alten and Tromsö follows the valley from Tana for a distance of about 112 miles, when it branches westward over the mountains.

Six miles east of the entrance to Tana Fjord is the fishing station of Berlevaag, which is a well sheltered and much frequented harbor. The village is in telegraphic communication with Lebesby and Tana by a cable crossing the entrance to the Tana Fjord, and eastwards with Vardö.

VARDÖ.

(See Admiralty Chart 2317.)

The islands of Vardö are situated off the eastern extreme of Finmarken, and on the north side of the entrance to the Varanger Fjord. There are two harbors (Vest Vaagen and Öst Vaagen) which are separated by a narrow peninsula on which stands part of the town. Busse-sund, between Vardö and the mainland, affords good anchorage in 10 to 14 fathoms. The harbors, of which Vest Vaagen is available for large vessels, are fully described in the Pilot. Loading and discharging is carried out by lighters; there are no loading quays, but the Government pier is available for ships of moderate size, with a depth alongside of 20 feet at high water; the pier is connected by a tramway with the level ground outside the fort. There are also some private jetties at which small vessels can lie. There is a crane to lift 3 tons.

There is no coal wharf and coaling is carried out from lighters; from 8,000 to 10,000 tons of coal is said to be kept in stock; in 1913 there was a great increase in the import of coal, the total for that year being 65,631 tons against 15,958 tons in 1912, and less previously. There are no facilities for repairs other than those of the smallest dimensions, and there are no docks or slips. The fisheries constitute the chief resources of Vardö, but the harbor is used by steamers bound for other White Sea and Arctic ports. There is a British Vice-Consul.

The Town.

Vardö is the principal fishing station in Finmarken, with a population in 1914 of about 3,600 inhabitants. In the vicinity are countless "Hjelder" for drying fish. The town is built on the isthmus and the shores of both harbors.

Communications.

Norwegian mail and trading steamers run regularly to Hamburg, and Russian mail steamers communicate with Arkhangel during the summer months; the Nordenfjeldske Company started in 1915 to run steamers from Bergen to Alexandrovsk, calling at Vardö. There is an indifferent road running round the north coast of the Varanger Fjord to Vadsö. There is telegraphic communication westward along the coast to Berlevaag, and southward to Vadsö and along the northern shore of the Varanger Fjord. There is also telephonic communication between Vardö and Vadsö.

Military Details.

The fort of Vardöhus, situated on the W. side of the island on which the town stands, was originally built as a frontier fort against Russia. It is a star-shaped fort faced with stone and

with an earth parapet; the ditch is roughly dug. In 1900 it was reported in fair condition, well kept, and by no means obsolete.

In 1909 new breech-loading guns were sent to fort Vardöhus. A committee was appointed, in August 1909, to consider the desirability of retaining the fort or not. It was reported later in the year that the committee had concluded their work, and recommended that the fortress should not be abolished, but removed to some other position in the neighborhood. So far as is known, no steps have as yet been taken to carry out the proposed recommendation.

The detachment on a war footing consists of a Major, who is Kommandant of the Defenses, and 100 men. The care and maintenance party in peace-time numbers 30 men. Vardö is officially one of the five war stations of Norway.

THE VARANGER FJORD.

(See Admiralty Chart 2317.)

KIBERG.

The fishing station at Kiberg is much frequented by Russian coasters, and is a fair harbor. It is in communication with Vardö and Vadsö along the coast by road, telegraph, and telephone.

The northern shore of the Varanger Fjord is rocky and foul, and there are a very limited number of harbors; there is an anchorage under the lee of Store Ekkerö.

VADSÖ.

This is a town of about 2,000 inhabitants, half of whom are Finns. There is a tidal harbor which is available for vessels of moderate draft, and it is believed that dredging operations are in progress to improve the anchorage. There are no loading quays, and lighters have to be employed, but even their use is difficult owing to the strong currents. A British Vice-Consul is resident in the town, which is mainly involved in the fish trade. Vadsö is the residence of the prefect of Nordland. A considerable quantity of coal is kept here by the Bergenske and Nordenfjeldsk S. S. companies; coaling is performed from lighters.

Communications.

There is regular steamship communication weekly with southern Norway and Hamburg, and Russian mail steamers call. A good road leads westward from Vadsö along the shores of the Varanger Fjord to the valley of the Tana Elv, which it follows to Tana (65 miles).

There is communication by telegraph and telephone to Vardö, and along the road to Tana; a telegraph cable crosses the fjord to Bugönes on the southern shore, when the line proceeds to the head of the Bugö Fjord, and eastwards, *viâ* Kirkenes, to the Russian frontier.

SYD VARANGER.

The whole of the southern shore of Varanger Fjord is commonly termed Syd Varanger. The coast, which trends east-south-eastward for about 50 miles from Karlbotn to Jacob Elv, is intersected by several deep inlets, and the cliffs are steep, bold, and rocky; the absence of outlying islands and rocks is a notable feature. The forest growth is especially remarkable for so high a latitude; even near the coast, the bare rocky hills are relieved by birch, scrub, and heather, while within the fjords the trees rapidly increase in size and number, until at no great distance from the sea the hills are covered with birch, aspen, and alder, with luxuriant grasses and heather. About 15 miles farther inland, the birch begins to disappear, and is gradually lost in the dense forests of fir, the area of which, in Syd Varanger alone, may be estimated at not less than 800 geographical square miles. The surface of the country is hilly and undulating, the thickly wooded slopes being interspersed by numerous lakes and tarns. The principal rivers are the Neiden, Pasvig (Kloster), and Jacob. Granite appears to be the prevailing rock on the coast.

During the last 50 years the population of Syd Varanger has greatly increased, owing to the improved means of communication and other conditions favorable to colonization.

Ice.—In winter the fjords of Syd Varanger generally freeze to a distance of 3 to 7 miles from the inner ends.

KVALNES.—North-westward of Kvalnes, an important fishing station on the south side of Karlbotn, there is anchorage opposite the houses in a depth of 3 fathoms.

VEINESBOTN (*Lat.* 70° 5' N., *Long.* 28° 50' E.), the inlet south of Kvalnes, has a small but very good harbor on the west side of the projecting point three-quarters of a mile west of Nyelv; the depth is 10 to 12 fathoms, over sand, and there is deep water close up to the shore. There is also anchorage in 5 fathoms at the head of the inlet.

KVALNES TO BUGÖ.—From Kvalnes to Bugö, a distance of 19 miles, the coast is desolate, barren, and generally more mountainous than that to the eastward; it is free from dangers, with the exception of a few scattered rocks lying within 2 or 3 cables of the shore, but affords no anchorage except on the west side of Latnaering.

BUGÖHAVN (*Lat.* 69° 58' N., *Long.* 29° 40' E.).—The first harbor in Syd Varanger, eastward of Veinesbotn, is between the mainland and Bugö, a low island lying 6 miles southward of Vadsö. It may be entered either from the northward or south-eastward, but the northern entrance is narrowed by rocks off the west side of Bugö, and is also rather shallow; the south-eastern entrance is deep and clear. Vessels may bring up either opposite the houses or off the south-west point of Bugö, in 3 fathoms. The depth decreases to 15 or 16 feet towards the shore, and as a swell sets in during easterly winds the latter anchorage is indifferent.

BUGÖFJORD.—Eastward of Bugö is the entrance to Bugöfjord, which extends 8 miles inland between Bugöfjeld and Brasfjeld. At the inner end of the fjord is a settlement. There is a telegraph office here.

KJÖFJORD (*Lat.* 69° 54' N., *Long.* 29° 46' E.) lies about 3 miles eastward of Bugöfjord, and close westward of Skogerö, which island attains a height of 1,541 feet. This fjord extends 17 miles in a southerly direction, and is connected with Bögffjord by Korsfjord; the inner part, into which the Neiden Elv and Munk Elv discharge, is named Neiden Fjord, and the head Munk Fjord. The shores of this inlet are high, rocky, and barren for some distance inland, but assume a milder character towards Neiden Fjord, where there are several settlements. The banks of the Neiden Elv and Munk Elv consist of huge sandhills. The Neiden has a course of 40 miles and has numerous rapids. There is a loomery (cliffs abounding in sea fowl) in the outer part of the fjord.

Kjöfjord is free from dangers with the exception of Halvarskjaer, which lies close to the mainland 1½ miles south of Brashavn, and a patch of 2½ fathoms in the approach, situated half a mile north-west of Kjö. At about 5 miles within the entrance is a narrow strait named the Ström, which sailing vessels can only pass through with a commanding breeze if the tide is adverse. Immediately south of the Ström there is good anchorage in Stensnesvaag, on the west side of the fjord, and at Buholm, at the junction with Korsfjord, there is anchorage in a depth of 15 fathoms, over clay.

Off the mouth of the Meiden, about 3 miles from the head of the fjord, are extensive sandbanks, which dry at low water, and as banks have also been thrown up by the Munkelv, the inner part of the fjord will only admit vessels of very light draft.

BRASHAVN, situated just within the west side of entrance to Kjöfjord, is a small land-locked harbor with a depth of 6 fathoms over sand; the proper entrance is southward of the islet forming the harbor, as the boat passage on the north side is only 15 to 20 yards in breadth, with a depth of 3 feet at low water.

Brashavn has good holding ground, black mud, but the water is deep for any but very small craft; moderate-sized vessels would require to anchor in a depth exceeding 30 fathoms.

KORSFJORD (*Lat.* 69° 46' N., *Long.* 29° 56' E.).—Eastward of Buholm there is anchorage in Korsfjord at Junkereld, in a depth of 5 fathoms over clay; vessels may also bring up in almost all the coves and bights on both sides of the fjord, and wherever the land is not very high or steep.

Ellinghavn, westward of Tommaerneset, at the south-east end of Korsfjord, has a depth of 5 fathoms over sand.

There is a telegraph office in Korsfjord.

BÖGFJORD (*Lat.* 69° 51' N., *Long.* 30° 6' E.).—Eastward of Skogerö is the entrance to Bögffjord, which, with its continuations, Klosterelv and Lang fjords, is the largest and most important of the fjords of Syd Varanger. It extends 12 miles in a southerly direction to the mouth of the Pasvig (Kloster) Elv, and 17 miles to the inner end of Langfjord. The hills are of inconsiderable altitude on both sides of the fjord. Vegetation consists chiefly of birch and luxuriant grasses.

KIRKENAES.

Kirkenaes, or, as it is also termed, Piselones, is situated at the head of a promontory at the junction of the Lang Fjord and the Pasvig Elv with Bög Fjord. The anchorage covers an area of about 8,000 square yards, and is excellent. The town, which owes its importance to the Syd Varanger iron mines, had a population, in 1916, of about 1,500 inhabitants, with an additional 1,000 at the mines, which are situated at Elvenaes, close to the frontier and about 4½ miles to the south-east. A short light railway connects the mines with the town. Navigation to Kirkenaes is ice-free during the whole of the winter. This is the last port visited by Norwegian mail steamers on this coast. A road runs south to Kyrö (90 miles) and Rovaniemi (280 miles) at rail head of the Finnish railways, and is used a good deal by sledge traffic in the winter. Sledges take about 25 days to do the double journey between Kirkenaes and Rovaniemi and back. *The Syd Varanger iron mines export large quantities of iron pyrites and briquettes. In 1913, considerable construction work was carried out, and the mines were brought into full working order for an annual output of about 800,000 tons, of

*Telegraphic communication is maintained westward to Bugö Fjord and Vadsö, and eastward across the Russian frontier to Alexandrovsk.

which 200,000 tons were in the form of briquets. The company is said to have about 27,000 tons of coal in stock. There are three landing places or piers at Kirkenes, of which the most easterly belongs to the town, but is small and weak; a little farther west is a larger and more solid pier provided with rails and a 1-ton hand crane. This pier and the warehouses attached belong to the Nordenfjelske Steamship Company. About 200 yards farther to the S. W. is a fine pier belonging to the Syd Varanger mining company, which is provided with excellent steel cranes and all kinds of modern appliances for loading and discharging pyrites.

ANCHORAGES IN BÖGFJORD-KJELMESÖ.—There are several small harbors on the west and south sides of Kjelmesö, that near the northwest end of the island being the best; it has a depth of 3 fathoms over fine sand, but is very narrow. The coves on the south-west and south sides of Kjelmesö are only suitable for very small coasters.

SÖLVFARBUGT.—Within the southeastern point on the north side of Sölvfarbugt, the inlet on the west side of Bögfjord, is a good harbor protected from all winds, and vessels might safely lay up there; it is frozen in winter. The entrance, which opens directly the point is passed, is through a sound $1\frac{1}{2}$ cables in length and half a cable in breadth in the narrowest part. The harbor extends 2 cables northwestward from the west end of the sound, and is $1\frac{1}{2}$ cables in breadth. The least depth in the sound is 18 feet, but in the harbor there are 18 to 19 fathoms, decreasing regularly to 4 fathoms near the shore; the bottom consists of clay.

RENÖ ROAD (*Lat.* $69^{\circ} 46\frac{1}{2}'$ N., *Long.* $30^{\circ} 9'$ E.), on the south side of Renö, affords good anchorage to all classes of vessels. On the south side and in the middle of the bay there are depths of 30 to 33 fathoms, decreasing to the north, east, and south-east. Vessels may also anchor at the south end of the narrow sound between Reno and the mainland.

KLOSTERELVFJORD.—Anchorage may be found at several places on both sides of Klosterelv-fjord, and large vessels may anchor in a depth of 15 fathoms off the east end of Skögöen, a low island east of Kirkenes. On the mainland westward of Skögöen is the small settlement of Syd Varanger.

The entrance to the inner part of Klosterelv-fjord is eastward of Skögö, the narrow sound on the west side of that island being partially dry at low water.

ELVENES (*Lat.* $69^{\circ} 41'$ N., *Long.* $30^{\circ} 6'$ E.).—In the cove at Elvenes, on the east side of the entrance to the Pasvig Elv, there is good anchorage for yachts or coasters in depths 5 to 7 fathoms; the best berth is right opposite the house of the bailiff of Syd Varanger.

PASVIG ELV.—The Pasvig rises in Lake Enaro. A noticeable feature of the Pasvig is that it forms a chain of narrow lakes, which are connected by reaches of river that seldom exceed 1 mile in length, and generally consist of rapids. It is said that there are about 12 lakes and 29 fosses or falls on this river; the whole length of the Pasvig is navigable by boats poling, but no vessel can ascend above Elvenes. The mouth of the river has a depth of 9 feet.

The country bordering on the Pasvig is well suited to settlers; there are extensive pine forests interspersed with patches of birch of sufficient size for building purposes, and the river offers an easy means of transport for timber; the soil is in places rich and fertile, and naturally produces good pasturage, while the river abounds in fish and its banks in game.

LANGFJORD, the western branch of Klosterelv-fjord, extends 3 miles in a southwesterly direction, and then bends abruptly south-southeastward for 5 miles; these portions are connected by a narrow channel, through which the tidal stream runs with considerable velocity; its passage is attended with danger, even for boats, as it is obstructed by large boulders.

COAST.—Eastward of Bögfjord the coast around Holmengraafjeld is foul to the distance of about 3 cables.

In Holmengraafjord, southeastward of it, there is boat anchorage within the islet on the north side, in $2\frac{1}{2}$ fathoms. The depths in the fjord are from 20 to 40 fathoms.

JARFJORD (*Lat.* $69^{\circ} 50'$ N., *Long.* $30^{\circ} 25'$ E.) is a narrow inlet extending 11 miles in a southerly direction eastward of Holmengraafjeld; the inner part is inhabited. Anchorage may be found at Hindö, southward or eastward of the island, in depths of 8 to 10 fathoms, mud, with less water farther in; there is no passage east of the island (named Zelery by the Russians). Vessels under 10 feet draft could winter in the head of this bay, as the ice remains quiet.

There is also anchorage at the head of the fjord in a depth of 10 fathoms, mud, sand, and rock. The inhabitants here are engaged in raising cattle, and so possibly can supply fresh meat. There is fresh water in the brook at the southeast head of the bay, and a tolerable amount of firewood is obtainable.

PASVIG (*Lat.* $69^{\circ} 49'$ N., *Long.* $30^{\circ} 35'$ E.), a fishing and trading station $3\frac{1}{2}$ miles eastward of Jarfjord, is the eastern harbor of any importance on Norwegian territory.

There is no passage southwestward of the rocks on the south side of the entrance to the harbor, but the channel between these and the north point, though very narrow, will admit vessels of any draft. Large vessels should anchor on the south-west side of the bay in 20 to 24 fathoms. Small vessels may run in toward a low point, and bring up in the bight between

that and the steep shore to the southward. There are depths of 15 fathoms right opposite a slope of broken rocks and stones, and of 7 to 8 fathoms farther in toward the sands, about three-quarters of a cable from which is a ballast heap with only 11 feet over it.

A bar or reef with 7 fathoms water stretches across the entrance to Pasvig, and forms a natural breakwater, so that although the harbor is open to the westward very little sea runs in.

SMAASTRÖMFJORD is a fishing station 2 miles eastward of Pasvig. In the outer part of the fjord the depths vary from 4 to 7 fathoms.

KOBHOLMFJORD (*Lat.* 69° 48' *N.*, *Long.* 30° 45' *E.*), between Smaastromfjord and Jacob Elv, is uninhabited, has no good harbor, and is not suitable for anchorage; the depths being very irregular, and the wind baffling and squally off the surrounding hills. Small vessels may bring up in a depth of about 6 fathoms, close to the north shore of the bay on the west side of the fjord. There is also anchorage off the mouth of the stream at the inner end of the fjord, in 8 to 10 fathoms, and for large vessels in 25 to 30 fathoms, sand. Fresh water is obtainable from the brook here.

JAKOB ELV (*Lat.* 69° 47½' *N.*, *Long.* 30° 50' *E.*) enters Varangerfjord at half a mile eastward of Kobholmfjord. There are a few Norwegian houses on the left bank of the river, and some Russian families live on the opposite side, where there are several fishing huts and salting houses. Russian fishing vessels lie in the mouth of the river during summer.

The Jakob Elv is but a small stream, flowing from lakes and marshes 40 miles inland, passing between hills with considerable declivity and frequent rapids, so that it is not navigable even for small boats more than 3½ miles from its mouth. The width of the entrance is about 23 yards, with a depth inside of about 4 feet; but outside there are sandbanks which dry at low water, and on which the sea breaks without any swell. Small craft under 5 feet draft can enter at half tide, when there is sufficient water over the bar and banks in the approach.

There is telegraphic communication to Kirkenes and eastward to join the Russian telegraph service.

Jakob Elv forms the northernmost section of the boundary between Norway and Finland.

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