時刻表ハ六ケ月毎ニ發行シ出帆日ハ必ズ各地新聞紙ニ廣告スト雖モ時ニ變更ヲ免カレズ然レ𪜈成ル可ク定期ノ時日ニヴァンクーヴァー及ヒ横濱ヨリ發船セシム

航路　香港、横濱及ヒヴァンクーヴァーヲ以テ定寄港トス然レ𪜈一般ニ神戸ニ寄港ス而シテ夏季ノ間ハ時宜ニヨリ厦門、福州及ヒ上海ニ寄港ス神戸ノ往復ニ往々内海（瀬戸内）ヲ航スルコトアリ

本會社ノ滊船ハ横濱神戸ニ於テ日本、朝鮮及ヒ北支那各地ヨリノ滊船ニ接續ス又南支那諸港、海峽殖民地、濠太利、印度及ヒ歐洲（蘇士經由）ヨリノ滊船ニハ香港ニ於テシ米國諸港ニ至ル滊船ニハヴァンクーヴァーニ於テスルナリ

各地船賃表（但シ加奈太太平洋汽船會社ニヨリ）

	香港迄	厦門迄	福州迄	上海迄	長崎迄	神戸迄	横濱迄
香港ヨリ	上等	弗	弗	弗	弗	弗	弗
	下等	弗	二〇	二三	四〇	二五	四〇
厦門ヨリ	上等	弗	弗	弗	弗	弗	弗
	下等	弗	一五	一〇	四〇	二五	四〇
福州ヨリ	上等	弗	弗	弗	弗	弗	弗
	下等	弗	三〇	一八	四〇	二五	四五
上海ヨリ	上等	弗	弗	弗	弗	弗	弗
	下等	弗	四〇	二五	四〇	二五	四五
長崎ヨリ	上等	弗	弗	弗	弗	弗	弗
	下等	弗	四〇	二五	四〇	二五	四五
神戸ヨリ	上等	弗	弗	弗	弗	弗	弗
	下等	弗	四五	二八	四五	二八	五〇
横濱ヨリ	上等	弗	弗	弗	弗	弗	弗
	下等	弗	五〇	三〇	四五	二八	五〇

上等往復切符ハ四ケ月間有効ニシテ其價左ノ如シ

香港ヨリ上海マデ或上海ヨリ香港マデ　六十弗

香港ヨリ長崎マデ或長崎ヨリ香港マデ　仝

香港ヨリ神戸マデ或神戸ヨリ香港マデ　七十弗

香港ヨリ横濱マデ或横濱ヨリ香港マデ　仝

船客ニシテ船中ニテ其船ノ主計官ヨリ切符ヲ購求スル者ハ十弗ヲ增加ス

佛蘭西郵便汽船會社所屬汽船表

(Messageries Maritimes)

印度、支那、日本線航海用

船名	總噸數	馬力
シドニー	四〇二一	三四〇〇
カレドニーン	四一七二	三四〇〇
メルボーン	三八四七	三四〇〇
ナタル	三八二九	三四〇〇
サガリエン	三八二三	二九〇〇
オクシエー	三五六二	二九〇〇
ヤンツィー	三五六一	二九〇〇
ジエムナー	三五五二	二九〇〇

船名	總噸數	馬力
コンゴー	三六六六	二九〇〇
イラワーディー	三五四八	二九〇〇
アヴァ	三一二九	二四〇〇
ラブールドンチー	一九一八	一六〇〇
ゴダヴェリー	一四〇九	一六〇〇
ニーマン	一七三二	一四〇〇
ヴォルガ	一五二九	一二〇〇

交趾支那線(シンガポール、トンキン、マニラ、)航海用

船名	總噸數	馬力
メーナム	一三九八	一六〇〇
アレシュース	一一八四	一四〇〇
サイゴン	一〇〇〇	八〇〇
ハイフォン	一四九三	一四〇〇
ペルース	一七四四	一三〇〇

濠太利ニウ、カレドニア線航海用

船名	總噸數	馬力
オーストラリーン	六〇〇〇	七〇〇〇
オセアニーン	四〇三九	三四〇〇
ヤーラ	四〇三八	三四〇〇
サラジー	四〇三七	三四〇〇
タナイス	一七三四	一六〇〇

船賃表

馬爾塞ヨリ	上等		中等		下等	
アレキサンドリア	迄	一四磅 ○志 ○片	迄	一〇磅 八志 ○片	迄	五磅 四志 ○片
ポート、セード	迄	一六 ○ ○	迄	一二 ○ ○	迄	六 ○ ○
スエズ	迄	一八 ○ ○	迄	一三 一二 ○	迄	六 一六 ○
オボック、アデン	迄	三四 ○ ○	迄	二四 ○ ○	迄	一二 ○ ○
コロンボ	迄	五四 ○ ○	迄	三六 ○ ○	迄	二〇 ○ ○

馬爾塞ヨリ		上等				中等				下等			
ポンディシェリー	迄	五六	磅	○	志	三六	磅	○	志	二〇	磅	○	志
		○	片	○	片	○	片	○	片	○	片	○	片
マドラス、カルカッタ	迄	六三		○		四〇		○		二三		○	
		○		○		○		○		○		○	
カラチ	迄	五四		○		三六		○		一八		○	
		○		○		○		○		○		○	
ボンベー	迄	五八		○		三八		○		一九		○	
		○		○		○		○		○		○	
新嘉坡	迄	六三		○		四〇		○		二三		○	
		○		○		○		○		○		○	
バタヴィア	迄	六六		○		四一		○		二三		○	
		○		○		○		○		○		○	
西貢	迄	六五		○		四一		○		二四		○	
		○		○		○		○		○		○	
ハイフォン	迄	七四		七		四八		一四					
		○		三		○		○					
マニラ	迄	七四		○		四八		一		二六			
		○		○		○		○		○			
香港	迄	六八		一二		四四		○		二六			
		○		○		○		○		○			
上海	迄	七三		一六		四八		一四					
		○		○		○		○					
神戸、横濱	迄	七三		一六		五〇		○		二八			
		○		○		○		○		○			
マヘ	迄	五六		○		三六		○		一八			
		○		○		○		○		○			
キング、ジョージ、サウンドアデレード、メルボーン、シドニー	迄	六五		○		四〇		○		二〇			
		○		○		○		○		○			

スミア	迄	七五		○		四六		○		二三		○	
		○		○		○		○		○		○	
サンジバー	迄	五〇		○		三二		○		一六		○	
		○		○		○		○		○		○	
マヨッタ	迄	五二		○		三三		四		一六		一二	
		○		○		○		○		○		○	
ノシベ	迄	五四		○		三四		八		一七		四	
		○		○		○		○		○		○	
ディーゴ、スアレ	迄	五五		○		三五		○		一七		一二	
		○		○		○		○		○		○	
聖マリー	迄	五七		○		三六		○		一八		○	
		○		○		○		○		○		○	
タマタヴ	迄	五八		○		三六		一二		一八		八	
		○		○		○		○		○		○	
レユニオン、モーリシアス	迄	六〇		○		三八		○		一九		○	
		○		○		○		○		○		○	

毎上等船客ハ一人ニテサロン號或バッテリー號ノ一室ヲ含有スルヲ得

上等船客ニシテ二室ヲ特有セント欲スル者ハ全額ノ賃金ノ外ニ其百分ノ五十ヲ拂ハザルベカラズ

減價往復切手

馬爾塞ヨリ	三ヶ月間有効	上等	中等	下等	馬爾塞ヨリ	六ヶ月間有効	上等	中等	下等
		磅志片	磅志片	磅志片			磅志片	磅志片	磅志片
オボック、アデン	迄	五二〇〇	三八〇〇	二〇〇〇	仝上	迄	五五四〇	四〇〇〇	二〇一二〇
コロンボ	迄	八〇〇〇	五〇〇〇	三二〇〇	仝上	迄	九〇〇〇	五五〇〇	三四〇〇
ポンディシェリー、マドラス、カルカツタ	迄	八〇〇〇	五〇〇〇	三六〇〇	仝上	迄	九〇〇〇	五五〇〇	三八〇〇
カラチ	迄	七二〇〇	四〇〇〇	二九〇〇	仝上	迄	八〇〇〇	四六〇〇	三〇〇〇
ボンベー	迄	七六〇〇	四四〇〇	三〇〇〇	仝上	迄	八四〇〇	五〇〇〇	三一〇〇
西貢	迄	八八〇〇	五二〇〇	三六〇〇	仝上	迄	九六〇〇	五六〇〇	三八〇〇
マニラ東京（トンキン）諸港	迄	—	—	—	仝上	迄	一〇〇〇〇	六三〇〇	—
マヘ、レユニオン、モーリシアス	迄	八四〇〇	五六〇〇	三二〇〇	仝上	迄	九二〇〇	五八〇〇	三三〇〇
サンジバー	迄	七六〇〇	四八一六〇	二六〇〇	仝上	迄	七八〇〇	五〇八〇	二七〇〇
マヨツタ、ノシベ	迄	七八〇〇	五〇〇〇	二七〇〇	仝上	迄	八〇〇〇	五二〇〇	二八〇〇
ディーゴ、スアレズ	迄	七九〇〇	五二〇〇	二八〇〇	仝上	迄	八一〇〇	五四〇〇	二九〇〇
聖マリー	迄	八〇〇〇	五三〇〇	三〇〇〇	仝上	迄	八七四〇	五五〇〇	三一〇〇
タマタヴ	迄	八二〇〇	五四〇〇	三一〇〇	仝上	迄	八八〇〇	五六〇〇	三二〇〇

馬爾塞ヨリ	九ヶ月間有効	上等	中等	下等	馬爾塞ヨリ	十二ヶ月間有効	上等	中等	下等
		磅志片	磅志片	磅志片			磅志片	磅志片	磅志片
オボック、アデン	迄	五八八〇	四二〇〇	二一四〇	仝上	迄	六二〇〇	四四〇〇	二二〇〇
コロンボ	迄	九二〇〇	五八〇〇	三五〇〇	仝上	迄	九五〇〇	六〇〇〇	三六〇〇
ポンディシェリー、マドラス、カルカツタ	迄	九二〇〇	五八〇〇	三九〇〇	仝上	迄	九五〇〇	六〇〇〇	四〇〇〇
カラチ	迄	八五〇〇	五〇〇〇	三一〇〇	仝上	迄	九〇〇〇	五二〇〇	三三〇〇
ボンベー	迄	八八〇〇	五一〇〇	三二〇〇	仝上	迄	九二〇〇	五三〇〇	三四〇〇
新嘉坡	迄	一〇〇〇〇	五六〇〇	三九〇〇	仝上	迄	一一〇〇〇	六〇〇〇	四〇〇〇
バタヴィア、西貢	迄	一〇二〇〇	五八〇〇	四〇〇〇	仝上	迄	一一四〇〇	六四〇〇	四〇〇〇
マニラ、東京（トンキン）諸港	迄	一〇五〇〇	六五〇〇	—	仝上	迄	一二〇〇〇	七〇〇〇	—
香港	迄	一〇五〇〇	六〇〇〇	四四〇〇	仝上	迄	一二〇〇〇	七〇〇〇	四八〇〇
上海、神戸、横濱	迄	一一〇〇〇	七〇〇〇	四八〇〇	仝上	迄	一三〇〇〇	八〇〇〇	五二〇〇
マヘ、レユニオン、モーリシアス	迄	一〇〇〇〇	六〇〇〇	三四〇〇	仝上	迄	一〇八〇〇	六四〇〇	三五〇〇
キングジヨーヂスサウンド、アデレード、メルボーン、シドニー	迄	一〇五〇〇	六四〇〇	三四〇〇	仝上	迄	一一五〇〇	六八〇〇	三六〇〇
ヌーミー	迄	一二〇〇〇	七六〇〇	四〇〇〇	仝上	迄	一三〇〇〇	八〇〇〇	四二〇〇
ザンジバー	迄	八三〇〇	五二八〇	二八〇〇	仝上	迄	八六〇〇	五四〇〇	二九〇〇

九ケ月間有効 / 馬爾塞ヨリ	上等		中等		下等	
マヨッタ、ノシベ	迄	磅 八五	志 〇	片 〇	磅 五四	志 〇	片 〇
ディーゴ、スアレ	迄	八九	二 〇	五六	〇	三〇	〇
聖マリー	迄	九三	〇	五七	〇	三二	〇
タマタヴ	迄	九四	〇	五八	〇	三三	〇

出發ノ際往復切符ヲ購求シ能ハザル旅客ニシテ歐洲ヨリ印度、支那及濠太利亞其他ニ至ル全金額ヲ拂ヒ而シテ上陸後六ケ月以内ニ再ビ乘船スル者ニハ一割ヲ減ジ十二ケ月以内ニ歸航スル者ニハ一割ヲ減ズ

太平洋汽船會社 (Pacific Mail S. S. Company.)

本會社ノ桑港、横濱、香港間ヲ航海スルノ滊船ハ左ノ如シ

セテー、ヲブ、ペキン號　噸數 五〇七九、六二
セテー、ヲブ、リオデジヤヂーロ號　三五四八、三〇
チヤイナ號　四九三九、八三

十二ケ月間有効 / 馬爾塞ヨリ	上等		中等		下等	
	迄	磅 九〇	志 〇	片 〇	磅 五六	志 〇	片 〇
全上	迄	九五	四	〇	五八	〇	三二	〇
全上	迄	九八	〇	〇	五九	〇	三三	〇
全上	迄	一〇〇	〇	〇	六〇	〇	三四	〇

東西滊船會社

針路法

鹿兒島東京間

目下右ト同線ヲ航海スル東西滊船會社ノ滊船ハ左ノ如シ

ベルジク號　噸數 四二〇五、五六
ゲーリック號　四二〇五、五六
ヲセヤニック號　三八〇七、九四

日本諸港間並ニ日本ヨリ外國ニ至ル針路法

鹿兒島東京間

佐田岬ヲ經テ東京海灣ニ航スルニ當リ大隅海峽ニ於テ若シ天氣密濛ナレバ針路ヲ東北東ニ轉ズル前能ク船位ヲ確定シ以テ該岬端ヨリ二十里ノ遠キニ達スル迄ハ高陸ニ平行シテ針路ヲ保ツベシ又此海岸ニ於テハ海流一日四十里乃至百里ノ速力ヲ以テ東北東ニ流ルヽヲ心ニ記スベシ

故ニ東方ニ赴ントスル船舶ハ此海流アルガ爲メ距濱三十里以外ニ出デザル樣ニシ且ツ紀伊水道口ノ大島燈臺ハ成可ク之ヲ視認(タイド)センコトヲ勤ムベシ　船舶ハ北方陸地ニ進航スルニ從ヒ漸次北東流ヲ失ヒテ潮力ノ感動ヲ受クルニ至リ流勢ノ不定ナルヲ見ルベシ」

東京海灣ヨリ紀伊水道ニ赴ク船舶ハ神子元島ヲ經過スル後陸地ニ近航シテ御前埼ニ到リ夫ヨリ大島ニ向進セバ乃チ黒潮ノ勢力ヲ避ケ得可シ○此針路ニ從ヘバ船舶ハ海流(漲潮)ニ乘ズルノ利アリ神子元、大島間ノ曲灣中ニハ南西ニ反流スル海流アルヲ屢〻驗セリ但シ此航路ニ由ルモノハ大王埼附近ノ諸岩ヲ避クルニ注意スベシ

東京海灣ニ近ヅクニハ富士峯ハ群山中ニ獨リ屹然トシテ聳立シ其狀倒扇ノ如ク高サ一万二千四百五十呎ナリ即チ是レ下田港或ハ東京海灣ニ入津スルノ一大良標タルナリ晴天ニ於テ先ヅ遙見スル所ノ陸ハ即チ富士ニシテ通例北東ニ方リ時アリテハ百里外ヨリ見ルヲ得可シ石室埼ハ之ヲ北ニ望ムニハ富士ト一線ヲ成ス南方及西方ヨリ來ルモノハ石室埼ヲ視認スル樣勤ムベシ若シ夜中ニ陸岸ヲ認メントセバ御前埼燈ヲ以テ最モ可トス該燈ハ廻轉白色ニシテ十九里外ヨリ見ルヲ得可シ晝間石室埼(燈臺アリ紅光ヲ顯ハシ光達約十里)ヲ視認スルニハ若シ天氣晴爽ナレバ同時ニ東京海灣附近ノ島脈ヲ明ラカニ望見シ得可シ御前埼ハ駿河海灣口ノ西角ニシテ之ト石室埼トハ誤認スルコト無カル可シ御前埼ハ沙濱ト低沙山ニシテ叢樹斑點ヲ顯ハシ地勢低シ(此海岸ノ地勢ハ西方三四十里ノ間斯ノ如シ)　然ルニ石室埼ハ高ク且多岩ニシテ燈臺ハ其麓ニアリ埼頂ハ大抵雲ニ掩ハル○神子元島ハ低クシテ晴天ノ時カ或ハ夜間燈光ヲ見ルニ非ザレハ石室埼及大島(伊豆ヲ)ヲ視認スルノ後久シク見ル能ハズ

紀伊水道ト神子元トノ間ニ於テハ大抵西風ニ遭フベシ但シ此風ハ神子元ヲ經過シタル後輕減ス相摸岬ヲ回(カ)ハレバ北東風ニ遭フコト屢〻ナリ

横濱上海間

凡ソ冬季(又十月ヨリ三月ニ至ル迄)ニ在テ横濱ヨリ上海ニ至ラントスルノ帆走船ハ横濱ヲ出ツルヤ先ツ陸岸ヲ去テ南方ニ航進スヘシ然シテ北緯三十度以南ニ達スルニハ此季ニ於テハ一般ニ北東信風ニ會シ得ヘシ因テ是レヨリ大島(即チ奄美大島下同シ)ニ船首ヲ向ケ北及ヒ北東ニ流ルヽ海流ニ注意シテ該島ノ北方ヲ航過スヘシ夏季ニ在テハ陸岸ニ近ツキ航走スルヲ得ヘク又黒潮強流中ヲモ航走スルヲ得ヘシ而シテ(内海ヲ航過セサ

横濱上海間

ルトキハ）其後ニ大隅海峽ヲ通過スヘシ

蒸帆ノ滊船ハ航路ヲ內海ニ取ルヲ以テ甚タ便利トス就中夏季ニ在テハ最モ宜シ三月ヨリ十月迄ハ大島ニ近接スルヿ甚タ安全ナラス何トナレハ此地方ニハ夏季ニ暴風屢〻起ルヲ以テナリ

函館上海間

函館上海間

函館ヨリ上海ニ赴カントスルヤ偏西風ノ爲メニ時トシテハ津輕海峽ヲ經過シ難キヿアルモ此航路ハ本洲ノ東方ヨリスルノ航路ニ比スレハ近キヿ約三百里ニシテ且ツ大隅海峽ハ津輕海峽ニ比スレハ天氣惡シク逆流强キカ故ニ此航路ヲ以テ遙ニ東方航路ヲ取ルノ船舶ハ多クノ時日ヲ費スヿ勿論ナレハナリ

函館ヲ出帆スルノ後チ矢不來（ヤキナイ）ト藻邊（モヘチ）地ノ間ナル港口ノ西角ニ駛行ス危險ヲ避ケテ成ルヘク此角ニ接近シテ通過スヘシ而シテ後反對ノ海流以內ニ强行シテ該灣岸ニ沿フテ航シ日暮前ニ矢越埼ニ達スルヲ可トス此處附近ニ水深六尋乃至十二尋ノ泊地アリ乃チ該埼ハ

此最好泊地ヲ距ル南一里以內ニアリ顧フニ此處風若シ俄ニ東ニ變スルトキハ船舶容易ニ解纜スルヿヲ得ベク且ツ南東ノ反對海流甚タ强カラサルカ故ニ此處ヲ以テ灣中最モ安穩ナル地トス該泊地ハ英國海軍海圖中ニ載スル所ノモノヨリモ優レルヿ確實ナリ何トナレハ此海圖ニ據レハ此泊地ハ風東方ヨリ吹ケハ解纜シテ强行スルヿ難ク且ツ海底ハ硬沙質ナルカ故ニ保錨ニ宜シカラストスルモノヽ如シ然レ𪜈矢越埼附近ノ海底ハ近地ノ山嶽ノ破碎土ヨリ成レル泥質ナリ

風若シ西方ヨリ來ルトキハ書間ニ其航行ヲ始メ該海峽ノ北岸ニ沿ヒ遠ク松前角ニ至ルマテ直行シ夫ヨリ大埼ニ向ヒ右舷開キニテ津輕海峽ヲ橫ギルヘシ但シ船進ンテ此海峽ノ門口ト相對スル處ニ到レハ通例風位一二點後方ニ退クナラン矢越埼ト松前トノ間ノ海岸ハ穩カナラス然レ𪜈矢越埼以外ハ海流穩カナルヲ以テ此埼ニ接近シテ航スルノ要ヲ見ス津輕海峽ヲ通過シ已ニ北緯三十七度ノ處ニ到ルノ後チ若シ南風アルトキハ中土海岸ニ向テ航行シ隱岐島ノ內側ヲ行クヘシ斯ノ如クスレハ海流ノ强壓ヲ免カレ平戶水道ニ到ル迄ハ順風航過スルノ便ヲ得ルヿアリ

其後ハ朝鮮海峽ニ向テ行走スルヲ可ナリトス（然レ𪜈前記內側地方ノ測

量全成ノ日ニ在テハ船舶宜シク五島ノ内側ヲ航シテ西風強吹時中ノ朝鮮海峽ノ强海流ヲ避クヘシ）朝鮮海峽ヲ通過セシ後ハ信風一般ニ北或ハ南ヨリ吹來ルヲ以テ支那海岸ニ達スル〻難カラス此航線ハ通例三日乃至五日ニ航了シ得ベシ信風時中ハ沙尾山島（シャウェーシャン）或ハアムヘルスト岩ニ近ク進ムヲ可トス何トナレバ若シ無風ニ逢フ時此處ニ水深六七尋ノ一錨地アレバナリ又此地方ニ於テハ一潮若シクハ兩潮ノ順流ノ便ヲ得ル〻アリ馬鞍島ニ近キ處偏南ノ海流及潮流ハ北東信風中多クハ强盛ナリ

自朝鮮海峽至函館

凡ソ帆船ヲ以テ朝鮮海峽ヲ經テ函館ニ赴カントスル者ハ北東信風時ニ會スレハ（或ハ尚ホ六月下旬ニ至ルモ）本洲北西岸ニ沿フテ東行スルヲ甚タ難シトス四月五月及六月ニ於テ航スル者ハ黑潮ノ勢ニ乘シテ對馬ノ東邊ヲ經過スレバ利アルベシ黑潮ハ朝鮮海峽ヲ經テ北東微北ニ向ヒ大約每時二里ノ速力ナリ若シ此信風時ニ南西風起レバ風雨針降下シ東颱之ニ繼ク非サレバ該風ハ唯二十四時間ヲ限リテ止ム冬時北及北西ヨリ來ル所ノ颶ハ屢〻朝鮮海峽ニ起リテ三四日ノ間連吹シ時トシテハ猛烈ナル〻アリ風雨針ノ速ニ降下スルハ其將サニ發セントスルノ報ナリ既ニ此颱起リ水銀ノ上騰ヲ起スノ後ハ風力漸次增加シ二十四時間ヲ經テ始メテ其最盛ニ達ス此ノ如キ天候ニ遭ヒ若シ左航開キニテ長崎ニ進ム者ハ下風大隅海峽ノ方ニ向ヒ漂流セラレザルニ注意スヘシ若シ右舷開ニテ進ム者ハ推レテ五島大瀨埼以北ニ至リ以テ朝鮮海峽ニ駛入スル〻或ハ之アラン此時ニ方リテハ晝間ニ務メテ陸ヲ認メ泊地ヲ索ルカ或ハ船ノ位置ヲ確知スル〻ヲ要ス

冬季北西及西風ノ屢〻吹ク時函館ニ赴カントスル者ハ朝鮮海峽ヨリ直チニ進ミ得ヘシ然レ𪜈若シ函館ヨリ南方ニ赴カントスル者ハ成ルヘク力メテ西行シ且ツ日本海岸ノ方ハ下風ナルヲ以テ遠ク濱ヲ隔テヽ航シ成ル可ク上風ニ依リテ朝鮮海峽ニ至ルヘシ已ニ北緯三十二度東經一百二十五度ニ達セシ時ハ風向漸々變スルヲ見ルヘシ然レ𪜈時トシテハ此風北西ト西南西トノ間ヨリ强吹シ船ヲシテ揚子江ノ下風ニ至ラシムル〻アリ

自横濱至函館

自横濱至函館

嚴寒ノ時ヲ除ケバ冬季ヲ以テ此航海ヲ爲スニ最モ好時節トス何トナレバ此季節ニ當テ風ハ殆ト常ニ陸ヨリ吹キテ本洲沿岸海波靜穩ナルニ遭ヘバナリ然レ𪜈此季節ニ於テモ亦偶〻北東ノ强颱ニ遭フコアリ朔望ノ日ニ在テハ特ニ起リ易ク若シ此颱風起レバ逆浪烈シク卷起シ唯〻之ニ抗シテ前進ヲ遂ケ得可キモノハ有力ナル滊船アルノミ故ニ此方向ヨリ颱風發スルニ遭フ時ハ最モ近キ避風ノ錨地ニ赴キ風力和ラクヲ待ツヲ以テ可トス

野島岬燈臺ヲ經過スル後ハ川津岬ノ外方三里乃至四里ノ處ニ至ルノ航路ヲ取リ已ニ該岬ヲ經過セバ此ヨリ針路ヲ犬吠埼ノ外方五六里ニ取リ此距離ヲ度トシテ之ヲ繞行スベシ○此季節ニ當テ偏西風アル時ハ海流ノ利アリ然レ𪜈若シ東風ニ遭ヘバ此邊更ニ海流ノ辨ス可キ者ナシ○犬吠埼ヨリ航路ハ豐間岬ヲ距ル三四里ノ處ニ導クヘシ此處海流ハ北方及東方ニ向ヒ其速力一時間一里トス

凡ソ滊船ハ豐間岬ヨリ陸岸ヲ去リ金華山ノ燈臺ニ向テ直行スルノ航路ニ取リ得可シ

金華山ヨリハ綾里岬ニ向テ馳セ而シテ宮古埼ニ至ルマテ陸岸ニ近邇シテ行クベシ此等諸角ノ間ハ親潮海岸ニ順テ南及東ニ流レ時アリテハ一時間二里ノ速力ニ達ス○此邊天候屢〻密濛或ハ暴雪風ニ會スルコアリ凡ソ此地ヲ經行スル船舶ハ親潮ノ疾力ヲ避ケン爲メ安全ノ距離ヲ酌量シ成ル可ク海岸ニ近ツキテ馳行シ屢〻船ノ所在ヲ確定ス可シ

豐間岬ヨリ三埼ニ至ルマテ近岸ニ循行シ宜シク三埼附近ノ淺灘ヲ遠視スベシ已ニ三埼ヲ經過セバ尻矢埼ニ向テ直行ス可シ○此地海流不定ニシテ且暴雪風及密濛ノ天氣屢〻陸岸ヲ隱沒ス故ニ此海岸ヲ航スルモノ須ラク愼戒ヲ加フヘシ

已ニ尻矢埼ヲ視認スルノ後チ津輕海峽ニ入レバ帆走船ハ逆風（偏西風）ニ遭フヲ以テ本洲北濱ニ沿フテ曲折帆走シ已ニ大間埼ニ達セバ即チ汐首埼ニ向テ海峽ヲ横行シ而シテ汐首埼ヲ東ニ視ルニ至ラバ即チ北海道ノ海岸ニ沿フテ曲折帆走ス可シ該海岸函館ニ至ルマテハ浪波平穩ニシテ偏東流ノ勢力ヲ受ケス

右沿岸ハ金華山幷ニ尻矢埼ノ燈臺アルヲ以テ大ヒニ航海ヲシテ容易ナラシム然レ𪜈冬時此沿岸ハ屢〻密濛ノ天氣ト暴雪風ニ遭ヒ且潮流不定ナルヲ以テ宜シク船ノ所在ヲ啀ムル樣ナスヘシ

夏季自横濱至函館

夏季自横濱至函館

夏季モ亦冬季ノ如ク陸岸ニ近邇シテ行カザル可カラズ春季ニ在テハ特ニ然リトス何トナレバ三四月ノ間海方ニ於テハ屢〻偏東強風ニ遭ヒ同時ニ又此海岸ニ於テ輕キ偏北風流行シ且雨ヲ伴ヘバナリ○金華山附近ニ於テハ船舶黒潮（此季候ニ於テ黒潮ハ大ヒニ速力ヲ增ス）ヲ脫シテ親潮中ニ駛入シ濃密ナル霧堆ニ遭フ可シ該霧堆ノ南面ハ陡巖ニシテ宛モ墻壁ノ如シ行キテ此ニ到ル船舶ハ概シテ不意ニ此霧堆ノ内ニ走入シ忽チ照耀タル日光ヲ失シテ暗冥トナルニ遭フベシ凡ソ夏月ノ間此處ヨリ北方ハ此等ノ霧濃密ニシテ且屢〻起リ航海ノ甚タシキ妨碍ヲナス故ニ最モ愼戒ヲ盡シ投錨ニ注意ヲ施スヿ欠ク可カラザルナリ

若シ天色密濛ニシテ尻矢埼ノ燈臺ヲ視ルヲ得ザル時ハ海水ノ温度ニ注意シ能ク之ヲ驗測セバ即チ船舶已ニ尻矢埼ヲ經過シタルヤ否ヤヲ知リ得ベキナリ何トナレバ津輕海峽ノ海水温度ハ必ス其南方ノ海水温度ヨリ較〻高ケレバナリ又尻矢埼ノ北十里該海峽東口ノ中央ニ於テハ必ス烈シキ駛潮ニ遭ヒ且船舶該海峽ヲ流ルヽ所ノ偏東海流中ニ入ル時ハ草樹及浮木ノ如キ雜物浮漂スルニ遭ヒ天色密濛ナル時ハ之ニ依テ以テ已ニ尻矢埼ヲ經過シタル否ヤヲ決定スルノ助ケトナルナリ

海峽口外ニ於テ無風並ヒニ偏東風ニ値ヒ而シテ海峽ニ近ツクニ從テ風向北方ニ傾ク時ハ汐首埼附近ニ於テ晴天ニ逢フヘシ又强キ偏東風吹ク時ハ海峽全部烟霧瀰漫ス

日本海ノ航法

日本海ノ航法

露領沿海州海岸ニ接スル所ノ海水温度ハ距岸ノ海水温度ニ比スレハ低クシテ著シキ變更ヲ生ス是レ黒潮ノ支流朝鮮海峽ヲ經テ日本海ニ入ルニ因ルナリ故ニ函館ヨリ該海岸ノ某港ニ進マントスル船舶特ニ夏月間海方ヨリノ風必ス霧ヲ伴フ時ニ在テハ陸岸ニ近ツク時船ノ所在ヲ決定スルニ此温度ノ變更ヲ以テ大ナル幇助トス○此温度ノ變更タルモルレー浦以北ノ海岸一帶之ヲ感スルモノヽ如シ

來島ノ瀨戸

來島ノ瀨戸ヲ安全ニ航過セント欲スルニハ其潮流ノ强激且不規則ナルニ注意スルヿ甚肝要ナリ乃チ西方ヨリ來ツテ此峽ヲ經過セントスルニハ先ツ武志島ノ北端ト大島山上ノ大樹トヲ一線(其方向南東微東¼東)ニ見テ進航シ而シテジョンク角ヲ小島ヨリ東ニ離レテ南西¼西ニ視ル位置ニ至ラバ直チニ鍼路ヲ馬島ノ西面ニ轉シ海士瀨ヲ避クル爲メ馬島ト陸ノ間中央ヨリ較ゝ島ニ近ヅキテ航過スベシ但シ馬島ハ距岸二鏈ニ於テ航過スルヲ得ベシ又上ニ云ヘル折針點ヨリ馬島中渡島ノ間ニ航路ヲ取リ以テ中渡島ニ近ヅキテ航過スルヲ得ベシ他ノ水道ハ採用セサルヲ善トス

潮汐

漲潮ハ大隅岬ヨリ小島及津島ニ向ヒコノ瀨ヲ洗ヒ馬島ノ北角ニ流レ然ル後本峽ヲ經テ燧灘ニ駛入ス又落潮ハ燧灘ヨリ强大ノ速力ヲ以テ本峽ニ至ル而シテ馬島ノ南角ヨリ小島ノ南西角ニ向ヒ本峽ヲ經過シテ後散流ス又落潮ノ馬島中渡島間ノ水道ヲ直流スルヤ馬島ノ北岸ニ烈シキ渦流ヲ生シ其水勢船首ヲコノ瀨ニ推シ向ケルノ患アレハ宜シク之ヲ防避スヘシ大潮ノ速力ハ一時間四里ヨリ六里ニ至ル

三原ノ瀨戸

三原ノ瀨戸

西方ヨリ來リ三原ノ瀨戸ヲ取ルモノハ東側ニ小大下島ノ圓錐山及數箇ノ白色浪磨石アルト西側ニ樹木繁茂セル大下島アルトニ因テ容易ニ其入口ヲ識別スベシ但シ岡村島ノ南西角下ニモ亦數箇ノ水晶成岩アルヲ以テ前記ノ浪磨石ト誤認セザルノ注意ヲ要ス而シテ該兩島間ヨリ中野鼻ト福島間ノ中央ヲ航過スル後ハ大埼上島ノ濱岸ト横島トノ間ノ中道ヲ横島ノ南角ト並行スルマデ進行セザル可カラズ已ニ此處ニ到レバ横島西方ノ險惡地ヲ避ケンガ爲メ大埼上島ノ濱岸ニ近ク進行スベシ

幸殿島ヲ過ル後島ノ北濱ヲ距ル三鏈半ノ間隔ヲ取リテ島ノ北端ヨリ二鏈ノ處ニ在ル一簀岩ヲ標示セル浮標ノ西ヲ過ギ然ル後北ニ於ケル松島、久野島ト南ニ於ケル大三島トノ間ノ中央水道ヲ航進スルノ針路ヲ取ルベシ已ニ該水道ノ東ニ到ラバ大埼上島ノ樹木アル圓頂(樹叢ニ非ス)ヲ大三島ノボールダー角ト一線(南西微西¼西)ニ望ムヲ要ス該針路ハ大三島ト大陸トノ間ノ中央水道即チアドミラル堆トケピティン堆トノ間ニ導クベシ夫ヨリ小佐木島ニ並行スルマデ北側濱ヲ距ル約半里ヲ度トシテ航シ已ニ並行セ

香港新嘉坡間

バ寧ロ三原ノ南東方松濱村ニ近寄リ小佐木島ヲ繞行スベシ是レ宿根島ト其東ニ在ル立標トノ間ノ沙堆ヲ避ケンガ爲メナリ

夫ヨリ鰯島ト細島間次キニ向島ト因ノ島間ハ孰レモ中央水道ヲ取リテ向島附近ニ在ル一小嶼笹島ヲ北微東ニ望ムマデ進ミ然ルトキ三原灣口ノ東角ナルハチガシ山ノ峻壁ヲ細島ノ北東角ト一線(北西微西一/四西)ニ取ルベシ此目標ハ総テノ危險ヲ避ケテ以テ備後海ニ指導スルナリ

潮

三原ノ瀨戸ノ潮流ハ其水道線ヲ流ルヽガ如ク見ヘ其速率ハ中野鼻ヲ廻クル處ニ於テ二里半久野島ト大三島間ノ水道ニ於テハ三里乃至四里是ヨリ向島ト因ノ島間即チ布刈(メカリ)ノ瀨戸マデハ平均三里ノ速率ヲ以テ駛走ス此ニ到リ一時間三里半マデ速率ヲ増ス又漲潮ハ東方ニ流レ落潮ハ西方ニ流ル」朔望高潮ハ十時三十七分大潮升十一呎小潮升五呎(三原)落潮流ノ滿潮流ニ變ズルハ低潮時ニ於テシ滿潮流ノ落潮流ニ變ズルハ高潮後四十五分時ニ於テス

香港新嘉坡間

香港新嘉坡間ノ航路ハ左ノ三條アリ

甲最大(メーンルート)航路　此線路ハ香港ヨリ直ニ南ニ進ミマクレスフヒールド堆ヲ經過シプロサパタノ東ヲ通行シアナンバス諸島ノ西ヨリ新嘉坡海峽ニ入ルモノニシテ三月四月ニ香港ヨリ新嘉坡ニ航スルトキト南西信風中ニ新嘉坡ヨリ香港ニ航スルトキニ採用シテ利アルモノナリ又北東信風中ニ新嘉坡ヨリスルトキト南西信風ニ香港ヨリスルトキニモ用ユルヿアリ

乙内側(インナールート)航路　海南島海岸ヨリ東京(トンキン)灣口ヲ横キリ交趾支那ノ海岸ニ沿テ航シ然後暹羅灣口ヲ横キリテ巫來半島ノ海岸ヲ下ルモノニシテ北東信風ノトキ香港ヨリスルトキニモ新嘉坡ヨリスルニモ用ヒテ利アリ又南西信風ニ香港ヨリスルニ用フルヿアリ

丙把拉灣(パラワンバッセージ)航路　新嘉坡海峽ヨリ出テナツナ諸島ノ南ヲ過キルコニヤ淺灘ノ北ヲ通リ把拉灣島ノ海岸ニ達シ此島ノ西岸及呂宋ノ南西岸ニ沿フテ北行シ然後香港ニ向フモノニシテ北東信風ニ逆ヒ新嘉坡ヨリ香港ニ航スルニ用ユ

北東信風時自香港至横濱

北東信風時自香港至横濱

香港ヨリ日本ニ赴カントスル船舶ハ臺灣ノ南ヲ過キ其東岸ヲ瀲走シ八重山群島ヲ經過スルノ後大隅海峽ヲ指シ然後東京海灣ニ向フヘシ

北東信風時自横濱至香港

北東信風時自横濱至香港

北東信風時横濱ヨリ香港ニ赴カントスル船舶ハ東京海灣ヲ出テ北緯二十八度東經百三十五度ノ處ニ至ルマテ南西ニ進ムヘシ此處ヨリ黑潮（クロシヲ）ヲ避クル爲メ奄美大島ノ北方ヲ過キ已ニ硫黄島ヲ經過シタルノ後ハ東引島ニ向フテ直航シ此島ヲ認ムレハ香港ニ向フテ支那海岸ヲ進行スヘシ

北東信風時自上海至長崎

北東信風時自上海至長崎

北東信風時ニ於テ風向北ヨリ東ニ偏スルトキハ揚子江ヲ出ルノ後右舷開キニテ北西方ニ進ミ風位ノ北西ヲ見ハ針路ヲ轉シテ長崎ニ直航スヘシ但シ朝鮮海峽ヨリ推シ來ル海流々壓ヲ推算ニ加フヘシ否ラサレ

北東信風時自濠洲至日本支那

北東信風時自日本至濠洲

ハ大隅海峽ニ逸走スルノ患アルヘシ

北東信風時自濠洲至日本支那

十月ヨリ三月ノ間日本支那ニ向ヒ濠洲諸港ヲ出帆スル船舶ハロールド、ホー島トエリサベッス、リーフ間ヲ過キテ、ダントルカストウ礁ノ北ニ進ミニユーカレドニアノ北西ヲ經過スベシ夫ヨリ凡ソ東經百五十九度ニ於テ横過スベキ赤道ニ至ルマデハソロモン島トサンタクルーズ島ノ間ヲ行クヘシ此赤道ヨリ針路ハカロリイン諸島ヲ通過シ指定ノ港灣ニ達スヘシ

北東信風時自日本至濠洲

北東信風時自日本至濠洲

北東信風時横濱ヨリ濠太利ニ至ラントスル帆船ハ横濱ヲ發スル後總テ北方ノ航路ヲ取リ桑港ニ至ルト同一ノ針路ヲ以テ始ムヘシ而シテ三十度（北）緯圈ノ北ニ至ルマテ東行シ東經百六十五度或ハ同百七十二度ノ處ニ達スルマテハ南方ニ向フヘカラス是レラリック列島ノ西邊ヲ過ギウッラ

シ島ノ東傍ヲ行クベシ北緯五度ト赤道ノ間ニ至レハ北東恒風ヲ失フヘシ
但シ赤道ハ通常東經百六十二度ト百六十七度ノ間ニ於テ横過スベシ

南西信風

五月ヨリ十月ノ間信風ハ亞丁ヨリ印度洋ヲ横過スルニハ順風トナル其最モ良キ航路ハ巫來ノ側ヲ取リ麻拉加海峽ヲ通過スヘシ新嘉坡ヲ過クルノ後日本及支那ノ各港ニ向ケ進航スルニハ順風順流トナル

南西信風時自日本及支那至支那海

南西信風時自日本及支那至支那海

南西信風ニ逆ヒ日本及支那ヨリ發船スルキハ勢多少ノ困難ヲ感スヘシ横濱ヨリ發スル船舶ハ東經百四十五度ノ線中ニテ北緯三十一度ノ線ヲ經過スルマテ南東ニ進ミ小笠原島ノ東ヲ過キ東經百四十度ノ線中ニテ北緯廿一度ノ線ヲ經然後針路ヲ呂宋ノ北東角ニ轉シテ航シ之ヲ過キテ支那海ニ入ル殊更ニ如此迂路ヲ取ルハ南西信風ノ強吹スル區域ノ外ヨリ北東トレードドリフトナル海流ニ入リ北西注ノ力ニ依リ西航スルノ目的ナリ

南西信風時自上海至長崎

南西信風ニ逆ヒ上海ヨリ香港ニ赴ク航路ノ困難ハ北東信風ニ逆ヒ北方ニ航スルカ如ク甚シカラス是レ南風ハ北風ノ如ク其方向ヲ持續セス且ツ海陸風ノ助アルカ故ナリ

南西信風時自上海至長崎

揚子江ヲ出ツレハバラヽス岩ト女島及男島トノ間ヲ經過スルヲ要ス女島及男島ハ晴天ニ於テハ三十里外ヨリ望ミ得ヘシ且ツ朝鮮海峽ヲ經テ北東ニ流ルヽ海流ハ此風期中ハ強急ナルヲ以テ注意シテ五島ノ南角大瀨埼ノ北方ニ壓流セラルヽコト勿レアムヘルスト岩ヲ過クレハ東四北三百九十里ニシテ正ニバラヽス岩ト大瀨埼ノ中間ニ至ルコヲ得ルナリ

南西信風時自香港至横濱

南西信風時自香港至横濱

南西信風時香港ヨリ横濱ニ航スルニハ先ツ東引島ニ至ルマテ支那海岸ニ沿フテ進ミ已ニ東引島ニ達セハ土噶喇群島ノ一ナル惡石島ニ向フテ道ヲ

取ルヘシ又長崎ニ至ラントスルモノハ東引島ヲ去ルノ後女島及男島ニ向フテ航シ此諸島トバラヽス岩ノ間ヲ通過スヘシ

南西信風時自濠洲至日本

南西信風中濠洲ヨリ日本及支那ヘノ航路ハ悉徳尼ヲ發シテ北東ニ向ヒ東經百五十七度ノ子午線ニ至リ該子午線上ヲ北ニ駛セ南緯十一度ニ達シ夫ヨリ新愛蘭トソロモン群島トノ間ヲ北西ニ進ミ凡ソ東經百五十三度ニ於テ赤道ヲ横キリ上海又ハ横濱ニ向フテ直航スヘシ但シ香港ニ至ランニハカロリイン列島ノ西部ヲ經テバリンタン水道ニ至ルヲ順路トス

自横濱至桑港

横濱ヨリ米國桑港ニ至ル航路ハ容易ニシテ北緯四十度ノ近傍ニ至レハ偏西風ヲ得ヘク又陸地ノ已ニ眼界ヲ去ル處ニ至レハ則チ海流ニ乘スルノ便ヲ得ヘシ諸船舶ハ夏時（自四月至九月）ニ北緯四十八度冬ノ時（自十月至三月）ニ北緯四十四五度ノ地ヲ航スルヲ善シトセスト雖モ成ルヘク大圏航路ヲ取ルヘシ諸航海ノ便利ノ缺點ハ獨リ四月ヨリ十一月ノ間カリホニヤ海岸ニ霧霧アルノミ船舶ハ其指スヘキノ地ヲ通例北方ニ見ルヘシ

諸要港記事

釜山港

一位置　北緯三十五度六分六秒　東經百二十九度一分三十四秒

二錨地　日本居留地埠頭ノ東二鏈半ノ處ニ深サ四尋乃至六尋底質黒泥ノ最良錨地アリ

三氣候　夏季温度ハ九十七八度冬季ハ二十五度内外ニシテ早春ハ北西風晩春ハ北東風夏ハ南風秋ハ北風多ク冬ハ北西風多シ

四供給品　牛、豚、鷄、鴨、魚類、大根、葱、韮其他菜類アリ野牛羊ハナシ水ハ我領事館ニ依頼スレバ水船ニテ之ヲ送ル其代價ハ一噸ニ付八十五錢乃至九十錢ナリ

濟物浦

元山津

濟物浦

一位置　小月尾島　北緯三十七度二十七分四十秒　東經百二十六度三十五分五十五秒

二錨地　月尾島下邊ニ數艘ノ大船ヲ泊ス可キ安全ノ錨地アリ底質極メテ良シ

三氣候　一月ヨリ三月マデハ北西風四月ヨリ六月マデハ北東及偏東風七月ヨリ九月迄ハ偏南東風十月ヨリ十二月マデハ北西及北風多シ

四供給品　家禽少ク唯ゝ時トシテ少量ノ野菜アリ兩三日前ヨリ注文スレバ牛羊ヲモ得ラル可シ

元山津

一位置　長德島(天城艦實測處)　北緯三十九度十分五十三秒　東經百二十七度二十六分十八秒

二錨地　長德島ノ南西端ヲ南々東ニ東ニ葛麻半島ノ北西端ヲ北東微東ニ四

東ニ望ミ水深四尋半ノ處ニ在リ海底泥質錨爪能ク爬入ス但シ該島ノ南島面ニモ錨地アレド十二月下旬ニ氷結ス

三氣候　暑氣ノ最モ酷ナルハ大約七月ニアリ夏ハ東及ビ南風多ク秋冬春ハ西及北風多シ

四供給品　各種ノ食品アレド冬季中ハ野菜鮮魚ナシ水ハ純良ニシテ飲料ニ適ス石炭ハ我海軍省ノ貯蓄倉ヨリ多少之ヲ得ベシ

ブリスバン

ブリスバン (Brisbane)

位置　南緯二十七度三十一分　東經百五十度二十分

人口　七萬三千

地方時　綠威時前十時十二分

旅館　メトロポリタン (Metropolitan Hotel) インペリアル (Imperial Hotel) 等アリ

流通手形　流通手形ハ總テチャーレス、ヲ、レイレイ氏ニ請求スレバ現金ト引換ユルヲ得但同氏ハ彼阿會社ノ代理人ニシテ海關稅、船舶及其他

輸出ニ關スル諸業務ヲ取扱フ

ブリスバンハクインスランドノ首府ニシテトリス海峽ヲ經ル所ノブリチッシ、インディア會社滊船ノ達ス可キ極端ノ港ナリシドニー　メルボーンホバート及アデレイドニ赴クノ旅客ハ此港ヨリ土地ノ滊船ニ轉乘スルナリ

トリス海峽ヲ經行スル旅客ハクインスランドノ海岸ニ沿フテ堤狀礁即石花礁ノ内側ヲ通行シ其景色ノ絶美ナルヲ觀テ必ス羈旅ノ憂ヲ忘レラルベシ

シドニー (Sydney)

位置　南緯三十三度五十一分　東經百五十一度十四分

人口　三十三万二千七百九

銀行　バンク、ヲフ、ニウ、ジーランド(Bank of New Zealand)

當地ハ濠洲ニ於ケル彼阿及東西滊船ノ發程地ナリブリスバン等ヨリ來レル旅客ハ土地ノ滊船ヲ以テ之ヲ送ル

メルボーン

メルボーンマデノ鐵道旅行ハ大約十九時間ヲ要ス而シテ其滊車賃ハ上等四磅一志中等三磅二志八片

流通手形　手形ハバンク、ヲフ、ニウ、ジーランド銀行ニテ現金ト引換フ

メルボーン (Melbourne)

位置　南緯三十七度四十八分　東經百四十四度五十七分

人口　四十三万八千

銀行　バンク、ヲフ、ニウ、ジーランド(Bank of New Zealand)

碇泊　彼阿滊船會社ノ滊船ハ七十二時間此ニ碇泊ス

旅館　スコッツ(Scott's Hotel)ポート、フィリップ(Port Philip Hotel)等アリ

流通手形　手形ハバンク、ヲフ、ニウ、ジーランド銀行及フレデリック、テート、エンドコンペニー、リミッテット(Messrs. Frederick Tate & Co. Limited)ニ現金ト引換フルヲ得但シフレデリックテートハ當會社ノ代理人トナリテ各商務ヲ取扱フニヨリ、ジーランド及タスマニアヨリノ旅客ハ此地ニテ彼阿會社ノ滊船ニ乘リ替フ

アデレイドマテノ鐵道旅行ハ大約十八時間ヲ要ス其滊車賃ハ上等三磅十五志中等二磅五志

アデレイド

位置　南緯三十四度五十五分　東經百三十八度三十八分

人口　十二万八千三百七十七

地方時　綠威時前九時十四分

碇泊　彼阿會社滊船ハラルグス灣ニ立寄リ日曜ノ黎明ヨリ月曜ノ午後四時マテ碇泊スルヲ例トス（但シ當灣ヨリアデレイドニハ大約四十分間ニ到着ス）

旅館　ニウ、ヨーク（New York）南濠洲倶樂部（South Australian Club）

鐵道　當地ヨリメルボーンマテハ里程五百十里急行列車ニテ要スル時間十八時間滊車賃ハ上等三磅十五志

上海

位置　北緯三十一度十五分　東經百二十一度二十六分

人口　大約四十萬

倫敦ヨリ海上里程　一万六百六十九里

銀行　香港及上海銀行

旅館　アストル、ハウス（Astor House）ホテル、デス、コロニイス（Hotel des Colonies）セントラル（Central Hotel）等アリ

但下宿料ハ一日三弗乃至五弗

流通手形　手形ハ香港及上海銀行ニテ現金ト引換フ

代理　ケルリー及ウアルシ（Messrs Kelly and Walsh）當社ノ代理人トナリ一般ノ商務ヲ取扱フ

電信　歐洲各部ニ發スルノ電信料ハ一語ニ付二弗

香港

位置　北緯二十二度十二分　東經百十四度三分

人口　二十一万二千九百五十一

銀行　香港及上海銀行

碇泊　彼阿會社滊船ハ大約二十四時間當港ニ碇泊シ佛國滊船ハ十二時間乃至二十四時間碇泊スルヲ例トス

旅館　ホンコン、エンド、ヴイクトリア（Hongkong and Victoria Hotel）等アリ

但宿料ハ一日ニ付四弗

艀賃　半時間十仙（セント）　ピークマテノ馬車鐵道落成ス其車賃其外　人力車及轎ハ半時間十仙

賃ハ往三十仙復四十五仙

流通手形　流通紙幣ハホンコン、エンド、シヤンハイ、バンキング、コルポレーションニテ現金ト引換フ

通貨　墨西其弗ノ相場ハ平均三志

電信　歐洲各部ニ發スル電信料ハ一語ニ付二弗

新嘉坡

位置　北緯一度十七分　東經百度五十分

人口　十五万五千

倫敦ヨリ　海上八千三百六十二里

彼阿會社ノ滊船ハ通例當港ニ二十四時間止泊ス

郵便局ハ彼阿會社並ニ佛蘭西郵船會社ノ埠頭ヨリ三里ノ距離ニアリ

滊車アリテ船渠ヨリ發シ市街ニ全通ス其賃甚タ廉ナリ

又人力車アリ車夫ハ支那人ナリ賃錢ハ一人乘ハ一里五錢二人乘ハ一里七錢五厘ノ割合ナリ夜中ハ之ニ半額ヲ增ス

郵便局ヲ通過シカバナー橋（Cavanagh Bridge）ヲ渡レハ左側ニ町會所アリ又前面ニ平野アリテ其一部ハ西洋人ノ運動場ニ當テリ又其中央ニラアフリ伯ノ肖像アリ伯ハ當殖民地ノ起業者ナリ是ヨリ左方ニ向テ行クヒハ書籍舘及博物舘アリテ縱覽ヲ許ス尙數里行クヒハ植物園アリ廣クシテ美ナリ

馬車アリ終日（八時間）雇使シテ一弗二十五仙ナリ然レ𪜈此代價ニテハ

十里以外ニ到ルヲ得ス

旅館　Del' Europe; De la Paix. 等アリ宿料ハ一日二弗乃至三弗ナリ

流通手形　彼阿會社ノ手形ハ John Little 會社ニ於テ現金ト引換ルヲ得ヘシ此會社ハ彼阿會社ノ代理ヲ辨ス

流通貨幣　日本及墨西其弗貨通用ス其價平均英貨三志二片ナリ

白南

白南 (Penang)

位置　北緯五度五十二分　東經百度十九分

人口　約七万五千

倫敦ヨリ　海上七千九百八十一里

地方時　綠威時前六時四十二分

旅舘　Eastern and Oriental.

流通手形　彼阿會社ノ手形ハ印度、濠洲、支那免許銀行ニ於テ現金ト交換スルヲ得ベシ Comrie會社ハ彼阿會社ノ代理ヲ辨ス

通用貨幣　弗、仙貨アリ

解貨　支那人ノサンパンアリ英貨六片ニテ雇フヲ得ヘシ

ラングーン

ラングーン (Rangoon)

位置　北緯十六度四十七分　東經九十六度十分

人口　十三万四千百七十六

倫敦ヨリ　九千百八十八里

地方時　綠威時前六時二十四分

海上交通　British India 滊船會社ノ滊船當地ニ寄港ス

解貨　二乃至四アンナ

クラブ　ビルマ、ペグー等ノ倶樂部アリ

流通手形　彼阿會社ノ手形ハ印度、濠洲、支那免許銀行ニテ現金ト交換スルヲ得ベシ

馬車　一里間十アンナニテ雇使スルヲ得

滊車 (スチームツラムウヤー)　市中ニ全通ス

又内地　Prome ニ至ル鐵道アリ其距離百六十三里ナリ急行列車ハ一週

二回プロームト Mandalay間ヲ駛走ス

カルカッタ

カルカッタ (Calcutta)

位置　北緯二十二度三十三分　東經八十八度十九分
人口　七十六万六千二百九十八
倫敦ヨリ　海上八千零八十三里
地方時　綠威時前五時五十四分
旅館　Great Eastern, Boarding House.
馬車　五時間二ルピー

マドラス

マドラス (Madras)

位置　北緯十三度四分　東經八十度十四分
人口　四十万五千八百四十八
倫敦ヨリ　海上七千三百十三里

地方時　綠威時前五時二十一分
銀行　アーブスノット會社(Arbuthnot & Co.)
彼阿會社滊船ハ商業多端ノ時ノミマドラスニ寄泊ス他時ハ旅客ハ孟買ニテ下船シ夫ヨリ鐵道ニテマドラスニ赴ク
碇泊　彼阿會社滊船ハマドラスニ寄泊スル時ニハ唯ゝ二三時止泊スルヲ例トス
上陸　旅客ハ望ニ從テマスラ艇ニテ波止場或濱上ニ上陸スルヲ得
但シ船荷物ノ陸揚モ亦同樣タリ
馬車　車ハ一日三ルピー半日一ルピー八ニテ雇ヒ得可シ又小旅行ノ爲メ
馬車ヲ雇フ時ハ別ニ一定ノ規則アリ
旅館　Elphinstone; Royal Hotel 等アリ
流通手形　手形ハアルブスノット會社ニテ現金ト引換ユ但シ同會社ハ彼
阿滊船會社ノ代理店ニシテ我社ト商業上ノ取引ヲ爲セル人ノ爲メニ諸
事ヲ辨ス
滊船　ブリチッシ、インデイア滊船會社滊船ハ毎週一回當地ニ寄港スクラ
ン滊船會社ノ滊船モ亦カルカッタニ往復スルノ途上此ニ寄泊ス

公館　海岸ノ郵便電信局及新造警察屯所、議事院、プレシデンシイ中學校
チヤッポーク宮殿、中央鐵道分局等ニシテ何レモ其建築美麗壯觀ヲ極
ム

公園　セント、ジョージ伽藍近傍ノテイナンペツト内ノアグリ、ホルチ
カルチユラル園及中央鐵道分局近傍ノピープルス公園

コロンボ

コロンボ　(Colombo)

位置　北緯六度五十七分　東經七十九度五十六分

人口　十二万

倫敦ヨリ　海上六千七百三里

地方時　綠威時前五時十九分

鐵道　カンディ（里數約七十五里）及ナワラ、エリヤ（里數百四十五里）ト
ノ間ニ鐵道ノ交通アリ

旅館　Grand Oriental, Galle Face Hotels 等アリ

流通手形　流通手形ハ Messrs H. W. Cave & Co. ニテ現金ト交換スル
ヲ得同會社ハ彼阿會社ノ代理人トナリテ各般ノ事務ヲ取扱フ旅客若シ
同會社ニ至レバ錫蘭ニ關セル諸事件ニ付確實ノ報道ヲ得可シ

カラチー

カラチー　(Kurrachee)

位置　北緯二十四度四十七分　東經六十六度五十六分

人口　九万

倫敦ヨリ　海上六千二百八十三里

地方時　綠威時前四時二十八分

海上交通　當港ヨリ British India S. N. Co. ノ沿岸滊船一週ニ二回孟買
ニ向テ解纜ス又同會社ノ滊船二週ニ一回倫敦ニ向テ解纜ス

鐵道　當港ハ北西鐵道ノ極端ニシテバンジヤブ及北西諸州ヨリ來ルニ最
モ費用ヲ要セザル道路ナリ

旅館　Reynold, Long View Hotels 等アリ

流通手形　流通手形ハ Messrs Melver, Mackenzie & Co. ニテ現金ト交換
スルヲ得

孟買

解賃　船ヨリ濱マデ又濱ヨリ本船マデノ解賃左ノ如シ

好時季　信風

旅客一名　一ルピー四　一ルピー

仝　二名ニ付一名　零、一〇ルピー　零、一二ルピー

仝　二名以上ニ付一名　零、八ルピー　零、一〇ルピー

孟買 (Bombay)

位置　北緯十八度三分　東經七十二度四十八分

人口　七十七万三千百九十六

倫敦ヨリ　海上六千二百七十四里

地方時　綠威時前四時五十二分

旅舘　數多ノ旅舘アリ

Messrs King, King & Co. 會社ハ無料ニテ當港ヨリ各滊船ニ乘込方ヲ周旋ス

亞典 (Aden)

位置　北緯十二度四十六分　東經四十五度五分

倫敦ヨリ　海上四千六百十里ブリンディシヨリハ三千七百七十五里

地方時　綠威時前三時

滊船ハ皆石炭積入ノタメニ當港ニ寄泊ス

旅舘　L'Univers, De L' Europe Hotels 等アリ

流通手形　彼阿會社ノ手形ハ Cowasjee 會社ニテ現金ト交換スルヲ得此會社ニハ各新聞紙アリテ衆人ノ展覽ニ供ス

通貨　印度貨通用ス

紅海記事　紅海ハ其長サ千百里幅百五十里ニ亘リ氣候ハ頗ル炎熱ナルガ故ニ暑ニ胃サレザル樣注意スルヿ肝要ナリ已ニ紅海ニ入リ亞典ヲ通過セバ直ニ Perim ト稱スル一島ヲ過ク又紅海ノ他ノ一方ニハ Shadwan ト稱スル島アリ此處ニ至レバ紅海ハ蘇士海灣ニ通ズ此海灣ハ其長サ百八十里幅六里乃至十里アリ其両側ハ高サ三千呎ノ臺地ヲ以テ圍繞セリ

蘇士

ポートセード

蘇士 (Suez)

位置　北緯二十九度五十八分　東經三十二度五十四分
人口　一万九百十三
倫敦ヨリ　海上三千三百二里陸上ブリンディシヲ經テ二千四百六十七里
地方時　綠威時前二時十分
流通手形　彼阿會社ノ手形ハ Anglo-Egyptian 銀行ニテ現金ト交換スルヲ得
蘇士運河ヲ航過スルノ瀛船ハ通例 Ismailia ニ寄港ス此地ハ Timsah 湖ノ西側ニアリ此地ヨリハ鐵道アリテ內地ニ通ズ
彼阿會社ノ瀛船ハ毎週一回此地ニ寄港ス

ポートセード (Port Said)

位置　北緯三十一度三分　東經三十二度二十五分
人口　一万六千五百六十

ブリンディシ

倫敦ヨリ　海上三千五百七十里陸上ブリンディシヲ經テ二千三百八十里
地方時　綠威時前二時九分
石炭　當地ハ世界中最大ノ石炭貯蓄所ナリ毎年瀛船ニ供給スル石炭ノ量ハ百万噸ニ及ブ
艀賃　艀賃ハ日中ハ英貨三片夜間ハ六片ナリ
通貨　埃及其他歐洲諸國ノ貨幣通用ス
旅館　Hotel De France, Hotel Continental.
此市街ハ蘇士運河ニ依テ全ク其繁盛ヲ保ツ此地ハアレキサンドリアヲ距ル百五十里ニアリ此地ノ燈臺ニ至レバ近傍地勢ノ壯觀ヲ見ルヲ得ベシ又此地ニハ各種ノ珍器ヲ有セリ殊ニ日本品ヲ多シトス此地ニテハ最良ノ葉巻煙草ヲ廉價ニ買フヲ得ベシ
小ナル公園地アリ

ブリンディシ (Brindisi)

位置　北緯四十度三十八分　東經十八度零分

人口　二万

倫敦ヨリ　陸上千四百五十里海上二千六百四十里

地方時　綠威時前一時十二分

旅舘　Great East Iudia Hotel, Hotel De Europe 等

流通手形　彼阿會社ヨリ振出セル手形ハ E. Dioniesi ニ請フテ現金ト交換ス可シ同氏ハ當社ノ代理人ニシテ各般ノ業務ヲ取扱フ

鐵道　タラントヲ經テチープルニ直行スル新鐵道線アリ其旅行十三時間ヲ要ス但シ該鐵道線ハ此ヨリ歐洲各地ニ通ズ

モルタ (Malta)

位置　北緯三十五度五十二分　東經十四度三十一分

人口　平民十五万七千百三十四人　軍人五千五百七人

倫敦ヨリ　二千二百八十里

地方時　綠威時前五十八分

艀賃　滊船ニ往復スル艀ノ賃錢ハ一艘ニ付日出ヨリ日沒マデ一志日沒ヨリ日出マテ一志六片ナリ

グランド港ニ碇泊セル滊船ノ旅客ハ艀夫ニ命ジテ稅關近傍ニ上陸ス可シ是レ欺騙ニ遭フ時容易ク警吏ノ保護ヲ得レバナリ艀賃ニ關シ爭論アル時ハ當直ノ海上警察官ニ訴フ可シ

馬車　馬車ハ左ノ割合ヲ以テ雇フコヲ得

二頭馬車　晝間ハ一時間二志二片

仝　日沒ヨリ日出マデ一時間三志五片

一頭馬車　晝間ハ一時間一志六片

仝　日沒ヨリ日出マデ二志三片

流通手形　彼阿會社ノ流通手形ハ Turnbull Junr. & Somerville 會社ニテ現金ト交換スルヲ得

勝地　數時間當港ニ上陸スル旅客ノ遊覽スルニ價値アル場所ハ Governers Palace ナリ此宮殿ノ諸室内ハ何時ニテモ縱覽スルヲ得可シ武器館ハ長サ二百五十三呎廣サ三十八呎ニシテ各種ノ武器ヲ貯藏シ其中ニハ士人(ナイト)ガローデスヨリマルタニ移轉セシ時ノ者アリ聖ジョン禮拜堂ハ近來莫大ノ費ヲ擲チテ修理シタルモノニシテ實ニ廣大ナル建物ナリ

其他旅客ノ一見スルニ價値アル書籍館等アリ

パリス (Paris)

人口　二百三十四万四千五百五十
倫敦ヨリ　二百八十六里
地方時　綠威時前九分三十秒
旅館　Du Louvre; Grand; Continental Hotels 等アリ
流通手形　彼阿會社ノ手形ハ Credit Lyonnais; Munroe & Co. 銀行ニテ現金ト交換スルヲ得

マルセイル (Marseilles)

位置　北緯四十三度十七分　東經五度二十二分
人口　三十七万六千百四十五
倫敦ヨリ　陸上八百二十三里　海上二千四十三里

地方時　綠威時前二十一分
旅館　Hotel De Marseille; Noailles; Du Louvre.
流通手形　彼阿會社ノ手形ハ Bazin 會社ニテ現金ト交換スルヲ得
滊船　佛蘭西郵船會社滊船ハ隔日曜毎ニマドラス及カルカツタニ出帆シ毎月一日ニ濠洲ニ出帆ス　支那及日本ニ出帆シ第四日曜毎ニ孟買及ザンジバルニ出帆ス
郵便　郵便稅ハ十五グラムニ付地方十五仙聯合郵便ノ諸國ヘハ二十五仙ナリ
巴黎ヘハ日々鐵道ノ往復アリ最急行ノモノハ大約十五時ヲ要ス

ヂブラルター (Gibraltar)

位置　北緯三十六度七分　西經五度二十一分
人口　平民一万八千三百八十一人　軍人五千六百十八
倫敦ヨリ　千三百九十九里
地方時　綠威時后二十一分

ジブラルター海峽ヨリ英國ニ至ル間ノ記事

旅館　Royal, Eurupa 等アリ
通貨　西班牙貨通用ス英貨ハ瑣少ノ打歩ヲナサヽル可ラス

ジブラルター海峽ヨリ英國ニ至ル間ノ記事

ジブラルター岩壁ノ高サハ千四百呎ニシテ其砲臺ノ堅固ナルハ世界中第一ニ位ス砲臺ノ階段ハ之ヲ上下二段ニ備ヘリ滊船ニテ此地ニ寄泊スルヰハ此砲臺並ニ近傍ナル St. Michael cave ノ洞門ハ頗ル有名ノ者ナレハ宜シク就テ見ルヘキ者ナリ
當港ハフリーポート即チ自由港ナルヲ以テ烟草ニ稅ヲ課セス故ニ廉價ニ買求ムルコヲ得ヘシ
已ニ此港ヲ去テ海峽ヲ通過セハ右舷側ニ當テ西班牙國ノ市街並ニ Tarifa ノ砲臺ヲ見ルヘシ燈臺其側ニアリテ甚タ顯著ナリ而シテ左方ニ見ユルハ Tangier ノ市街ナリ
是ヨリ少シク進行スルヰハ Spartel 岬ノ屹起スルヲ見ルベシ此岬ニハ白色ノ燈臺ヲ置キ燈光亞非利加大陸ノ北西角ヲ照映ス

プリマス

又右方ニ見ユルハ Trafalgar 岬ニシテチルソン將軍ノ古戰場ナリ
船已ニツラファルガー及カヂズノ市街ヲ過キ十六時ノ航走ノ後セントヴィンセント岬ニ達シ是ヨリ北向シテ葡萄牙ノ海岸ヲ沿航ス是ヨリ順次ニリスボン、ヲポルト及ヴィゴ等ノ有名ノ市街ヲ過キ尙一百里ヲ航走シテフィニステール港ニ達ス
是ヨリ滊船ハ北東ニ向ヒビスケー灣ヲ横過スルナリ此間ハ大約三十四時間ヲ要ス此時船正ニ Ushant 島ノ近傍ニアルヘシ是ヨリ尙一百里ヲ航走シテ終ニ英國ノ Plymouth Sound ニ達スルナリ

プリマス (Plymouth)

人口　七万三千七百九十四
倫敦ヨリ　海上二百九十五里
鐵道線路　二百四十六里
旅館　Royal, Duke of Cornwall, 及 Grand Hotel アリ
滊車　當地ヨリ倫敦ニ至ル間ノ滊車賃ハ

上等四十六志六片　中等三十二志十片　下等十八志八片
流通手形　彼阿會社ノ手形ハ Fox 會社ニ於テ現金ト交換スルヲ得ヘシ

英吉利海峽ニ於ケル諸燈臺

名稱	形質	光達距離
Ushant	〔一回轉	〔十八里
Start Point.	白自不動	二十四里
Port land.	白色回轉	二十五里
St. Catherine's point.	白色二不動	二十七里
Beachy Head.	白色閃光(電氣)	三十里
Dungeness	白色回轉	二十五里
South Foreland.	白色不動	十五里
North Foreland.	白色二不動	二十五里
Nore light ship.	白色閃光	十九里
	白色回轉	十里

ポーツマス (Portsmouth)

人口　十二万七千九百八十九
倫敦ヨリ　七十四里
旅館　George; Keppel's head; Totterdells Hotels 等アリ
瀠車　當地ヨリ倫敦マデノ瀠車賃ハ
上等十五志六片　中等十志十片　下等六志二片

アレキサンドリア (Alexandria)

位置　北緯三十一度十二分　東經二十九度五十一分
人口　二十二万七千零六十四
倫敦ヨリ　ブリンジシヲ經テ二千二百七十五里
地方時　綠威時前一時五十九分
旅館　Abbat's; Khedivial Hotel 等アリ
瀠船　リバプールト屢瀠船ノ交通アリ又彼阿會社ノ瀠船ハ二週間毎ニウエニスニ向テ當地ヲ發シ途次ブリンディシニ立寄ル
郵便　聯合郵便ノ諸國ヘハ總テ一ピアストル即二片半

ヴエニス

ヴエニス (Venice)

位置　北緯四十五度二十五分　東經十二度二十分
人口　十三万二千八百三十
倫敦ヨリ　千零四十三里
地方時　綠威時前四十九分
旅館　Danieli's Royal; Oriental; Grand Hotel 等アリ
瀛車　歸國ノ旅客ハ Danieli's Hotel ニテ鐵道切符ヲ購求シ且ツ同館ニテ荷物ヲ登簿シテ停車場ノ混雜ヲ避クルコヲ得可シ
チコーリンヤテノ急行列車ハバヅア、ベロナ、ブレスシア及ミランヲ經テ凡ソ十一時間ヲ要ス

トリエスト

トリエスト (Trieste)

位置　北緯四十五度三十八分　東經十三度四十六分
人口　十五万零百五十五
倫敦ヨリ　千百三十八里
地方時　綠威時前五十三分
旅館　Delorme; Europa Hotel 等アリ
流通手形　當社ノ手形ハ Theodore Sirovich ノ銀行ニテ現金ト交換スルヲ得
當港ハアドリアチック海中商業盛ナル要港ニシテヲーストリアン、ロイド會社瀛船ノ達ス可キ極端ノ港ナリ

ゼノア

ゼノア (Genoa)

位置　北緯四十四度二十四分　東經八度五十四分
人口　十七万九千五百十五
倫敦ヨリ　八百七十五里
地方時　綠威時前三十五分
旅館　Grand Hotel, Hotel de Gines.

流通手形　彼阿會社ノ手形ハ Granet, Brown & Co. ニテ現金ト交換ス」
滊船　ゼノアハイタリアン、メイル滊船ノルヾチノ滊船ノ本店ニシテ地中海ノ諸港ト印度ヲ連絡ス
滊車　ゼノアヨリチューリンマテハ里程百四里ニシテ其時間凡ソ四時半ヲ要ス

チープルス

チープルス (Naples)

位置　北緯四十度五十一分　東經十四度十五分
人口　四十九万四千三百十五
當港ニ上陸スルノ旅客ハ巻烟草若クハ烟草ヲ携フ可カラズ若シ之ヲ携ヘテ上陸セント欲セバ能ク注意シテ其理由ヲ辨明セサル可カラズ
流通手形　彼阿會社ノ手形ハ Turner 會社ニテ現金ト交換ス同會社ハ當滊船會社ノ代理事務ヲ爲ス
通貨　センチムス及リール貨通用ス○貨幣ハ彼阿會社ノ代理人ノ事務所ニテ交換スルヲ得可シ

グアム島（マリアナ列島）

位置
上陸場
錨地

グアム島、マリアナ列島 (Guam I.—Mariana Is.)

此島ハマリアナ（一名ラドローン）群島中最南最大島ナリ北々東至南々西ノ長サ二十七里乃至十里ニシテ草木繁生ス
八十人土地豊饒ニシテ礁脈全島ヲ繞グル島内ノ人口ハ九千六百
西班牙政廳ハ西側ノアガニア市邑ニアリ但シ礁脈ノ爲メ船ヲ寄セ難シ該
市邑ノ東方五里ニ良港アリサンルイス、デ、アプラト云フ是ヲ距ル南方約
十里ニウマタ灣アリ
概位　北緯十三度二十八分　東經百四十四度四十六分
港内アプラ村ニ上陸場アリ
港内水深十八尋乃至十九尋ノ處ニ底質白沙泥ノ安全ナル錨地アリ又サン
タクルーズ嶼砲臺ノ北側ニ水深五尋ノ最良錨地アリ
ウマタ灣内ニ於テモ亦錨地ヲ得ラルベシ水深六尋乃至七尋底質沙泥或ハ
小石ニシテ海草ヲ生ス最良ト稱シ難シト雖モ普通安全ノ錨地トス但シ六
月ヨリ九月マデ南西風時期中ハ高濤灣内ニ寄セ來リ碇泊危險ナリ

食品其外

米穀、雜穀、大薯、馬鈴薯、胡椒、蒜(ニンニク)、葱、椰子實、麵包果實、鳳梨(パインアプル)、瓜、橙、綿、砂糖、煙草、牛(ヤム)、豚、鹿、鷄、鴨等ニシテ椰子實ノ外總テ少量ナリサンルイス、デ、アプラ港内ニテハ飲水ヲ得難シト雖モウマタ灣内ニテ小河ヨリ良質ノ飲水ヲ汲取シ得可シ

水先

ウマタ灣北角ニアル砲臺ノ南方ニ嶮岩アリ岩上ニ西班牙國旗ヲ揚ケ來船ノ水先案内ヲ爲ス之ニ依テ此灣ヲ識別スルヿ容易ナリ

カロリーン列島

ヤップ島 カロリーン列島 (Yap I.—Caroline Is.)

此島ハカロリーン列島中ノ一ニシテ北東微北ヨリ南西微南ニ至ルノ長サ約二十里幅ハ各處同一ナラズ島内山脈連亙シ北方ヨリ遠望スレバ三島ノ如シ島周礁脈圍繞ス

位置

トミル港口 (Entrance of Tomil) 北緯九度二十五分五秒 東經百三十八度六分四十五秒

島ノ南東側トミル灣ハ良港ニシテ西班牙政廳アリ灣口ハ紅白二個ノ浮標ヲ設ケテ標示ス入港者ハ紅浮標ヲ右舷ニ白浮標ヲ左舷ニ見テ進ムベシ

錨地

灣内水深二十五尋乃至十七尋ノ處ヲ錨地トス泥底ニシテ安全ナリ但シ帆船ハ順風ニアラザレバ入港シ難シ

食品其外

椰子實バナヽ、タロー(里芋ノ類美味ナリ)甘蔗其外海産物アリ港内二ケ所ニ便宜ノ汲水場アリ

潮

港内潮候時七時三十分大潮升六呎半、潮流ハ港内ニ於テ靜カナレ𪜈水道中ニテハ其速力大潮ノ時一時間一里半餘ナリ

パラオ(一名ペルー)群島

パラオ(一名ペルー)群島 (Palao or Pelew Is.)

此群島ハ數多ノ島嶼ヨリ成ル就中バベルダツプ島ヲ最大トスコロル島ウラクタベル島ピリノー島アンガウル島其他小島ハ數フルニ遑アラズバベルダツプ島ハ長サ二十里幅平均五一/二里、島ノ北部ニアレモンガン山アリ圓形ノ高山ニシテ目標トナル

此群島ハ西班牙ノ管屬ナレ𪜈政廳ヲ設ケズ土人ハ外人ニ親シムノ風アリ

コロル島ノ西方ニマラカル島アリ其東側ニ良港アリコロル港ト云ヒ又土人ハマラカル港トモ云フ

位置　北緯七度三十分　東經百三十四度三十五分

食品其外　パペルダップ島　概位　パナヽ、鼈甲、チヨー貝、鱶鰭等アリ

錨地水先人等　煎海鼠（キンコ）、雜穀、麵包果實、バナヽ、鼈甲、チヨー貝、鱶鰭等アリ

潮　コロル港ニ入ル水道ナルウラクタベル海峽ノ外側ニ於テ水深十四尋乃至十五尋ノ處ニ假泊所アリ船隻此處ニ假泊シ居レバ水先人來ルベシ但シ水先人ナクトモ檣上ヨリ見テ好路ヲ識別シ得可シ錨地ハマラカル島ノ東側水深十一尋乃至十六尋底質白砂泥ノ處ニシテ安全ナリ

明治廿三年七月南島商會所有船天祐丸ハ三十日間此ニ碇泊セリ

潮候時六時十六分潮升七呎碇泊所ハ潮流緩ナリ（天祐丸ノ實驗ニ據ル）

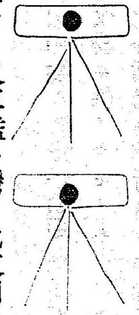
ポヂピ（一名プイヂプト）島（Ponapi or Puynepet I.）

此島ハ東カロリーン列島中ニ於テ最大ナリ北側ニサンチヤゴ港アリ又南東端ニキチ港アリ皆良港ニシテ船ヲ泊スベシ其他二三ノ港灣アリサンチヤゴ港ニ西班牙政廳アリ又寺院殖民地等アリテ乃チ是ヲ開港場トス商船ハ先ヅ該政廳ノ許可ヲ得ザレバ他港ニ入ルヲ得ズ且ツ交易ヲ行フ能ハザルナリ

位置　北緯六度四十七分　東經百五十八度十九分

食品其外　ナーモーア島（Narmaur I.）　椰子實、煎海鼠（キンコ）、鼈甲、アイブルナット等及飲水アリ

錨地其外　サンチヤゴ港口ニハ左圖ノ如キ白塗ノ立標數箇ヲ設ケテ好路ヲ標示ス故ニ入港ノ時ハ黑丸立標ヲ右舷ニ赤丸立標ヲ左舷ニ見テ進ミ水深七尋乃至五尋ノ處ニ至テ投錨スベシ海底泥土ニシテ安全ナリ又軍艦ハ灣ノ北東側ナルラガラ嶼ノ西側ニ碇泊ス廣濶ニシテ最良ノ錨地ナリキチ港ノ錨地モ亦最良ニシテ水深八尋乃至五尋底質泥土ナリ



注意　南洋諸島間ヲ航スルモノハ檣上ニ登リテ俯視ス可シ能ク暗礁及好路ノ所在ヲ識別シ得可シ

南洋諸島ノ通用貨幣

南洋諸島ノ通用貨幣

本編ニ南洋諸島土人ノ用ユル石、貝殼通用貨幣ヲ畧記シタルガ本年（明治廿三年）南島商會所有ノ船天祐丸ニ搭シテ南洋諸島ヲ巡回シタル田口

卯吉氏ニ親シク實話ヲ聞クヲ得タリ氏ハ此行ニ於テ携ヘ歸リタル貨幣ノ實物ヲ示シタルヲ以テ其眞形ヲ寫シ之ヲ附圖ニ掲ケ併セテ氏ノ實話ヲ畧記スルヿ左ノ如シ

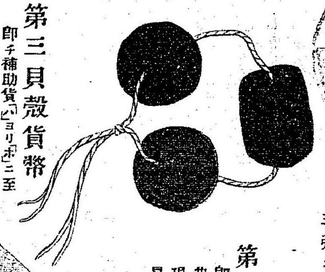
ヤップ島ノ貨幣ハ石及貝殼ニシテ石ヲ本位トシ貝殼ヲ補助トス本位貨幣ノ石質ハ我寒水石ノ如ク其形チハ附圖第二ニ示スガ如クシテ製造極メテ粗ナリ其價格ハ一弗ヨリ五六百弗マデニシテ大ナルヿ實ニ驚ク可シ中央ノ孔ハ捧ヲ貫通シ多人數ニテ之ヲ運搬セン爲メナリト云フ又補助貨幣タル貝殼ハ形チ附圖ノ第三ニ示スカ如クシテ赤色ヲ帶ブ又眞珠貝ノ大ナルモノヲモ用フト云フパラオ島ノ通用貨幣ハ附圖第一ニ示ス其質ハ古製ノ硝子ノ如シ畢竟スルニ南洋諸島ノ通用貨幣ハ石、貝殼等ニ過キズ故ニ物品ヲ購求センニハ此等貨幣ヲ用フルニ非ザレバ物品交易ニ依ラザル可カラズ故ニ彼ノ嗜好ニ適スルモノヲ携フルニ非ザレバ一物ヲモ購求シ難シ物品交易ニ供スルモノハマツチ、小刀、綿布類、斧等ヲ以テ最佳トス船舶若シ此等諸島ニ航行スルトキ此諸品ヲ携ヘ行カババナヽ、パインアップル等ノ如キ食品ヲ求ムルニ大ニ便ナルベシ

南洋通貨

第一ハパラオ島第二第三ハヤップ島ニ用ユルモノ

第一硝子貨幣

青芋三籠（ツリーバスケットタロー）ト稱シ三弗ニ相當ス

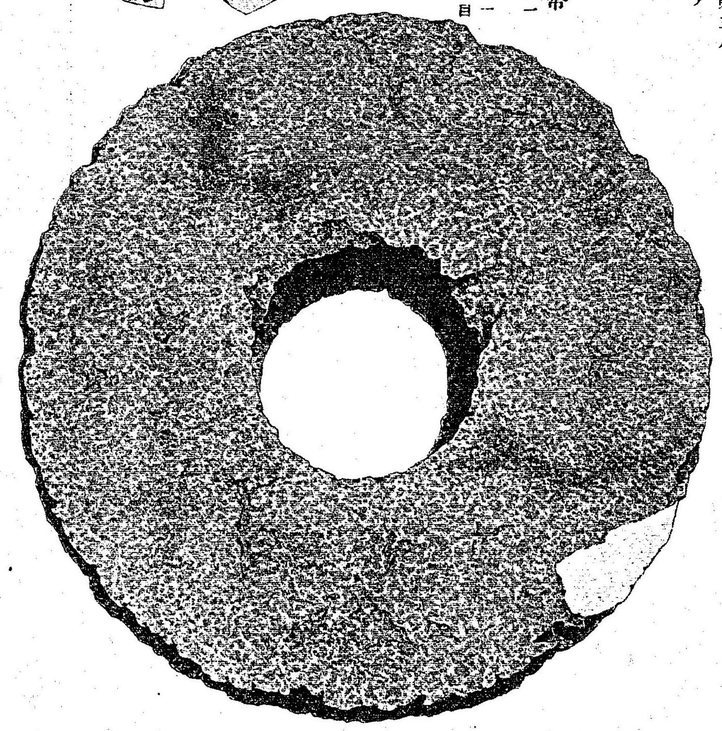


第二石貨幣

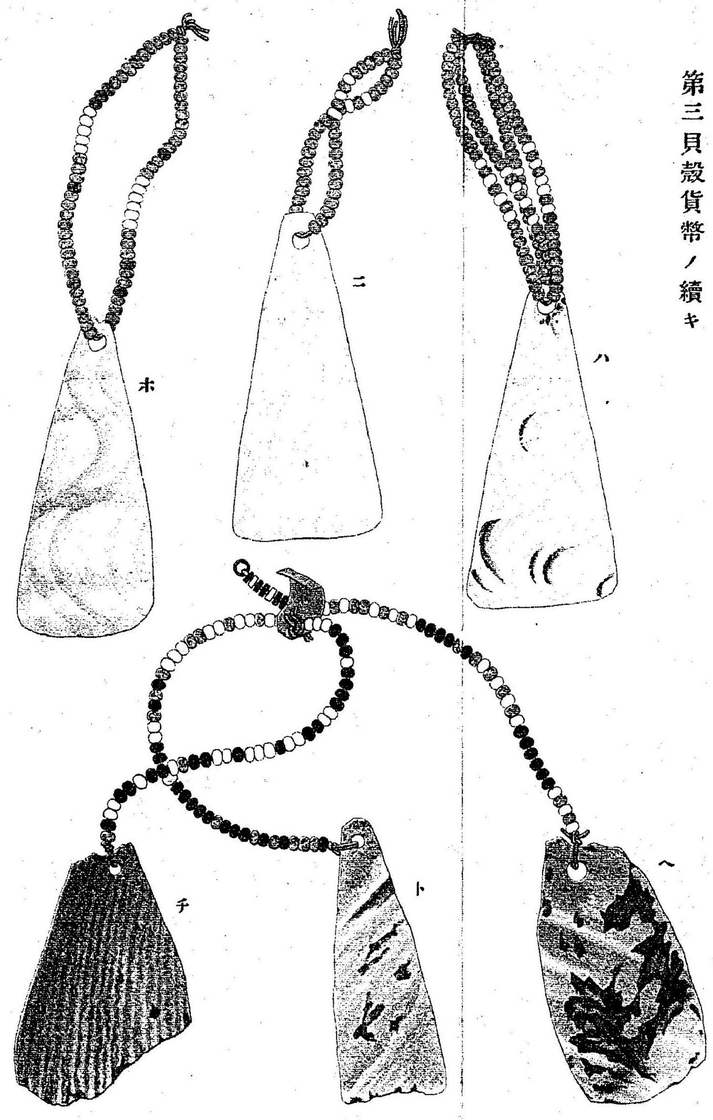
即チ本位貨一弗相當現形五分ノ一量目約八百目

第三貝殼貨幣

即チ補助貨「ヨリホ」ニ至ル三個ハ一個ニ付一弗相當其他ハ次等ノ位置ニ當ル



第三貝殼貨幣ノ續キ



タムソン羅針儀用法略說

第一項

凡此羅針儀ハ磁氣自差ノ改正ヲ實行シ得ヘキモノニシテ鐵製ノ艦船ニ於テハ其生差ノ感動固ヨリ著シキヲ以テ之ヲ使用スルニ殊ニ便利ナルコトハ勿論又裝備必要ノ具トス

第二項

凡此儀ハ艦船ニ搭載シテ磁氣自差ヲ改正スルカ爲メ別ニ附屬ノ改正器ヲ裝置ス其種類左ノ如シ

鐵球（實球或ハ空球）（ルビ：ルヒハ別ニ備フルコトアルヘシ）	十インチ徑	一對
磁氣桿	八インチ徑	一對
圓壔桿	長サ九インチ徑百分ノ八十三インチ	十八本
傾船磁氣桿	徑三インチニシテ長サ十二インチ、六インチ、三インチ、一インチ半、百分ノ八十三インチ	各一個
	長サ九インチ徑百分ノ四十三インチ	四本

（ルビ：大小數對ノ鐵球ヲ要ス）

第三項

改正スヘキ自差ノ種類ハ左ノ如シ

半圓誤差

象限誤差

傾船誤差

俄氏誤差（船内軟鐵、磁氣ニ感動スルノ緩慢ナルヨリ生スル誤差ニシテ當部出板ノ羅針儀自差論ニ詳カナリ）

第四項

磁氣桿ノ中羅經箱ノ内ニ於テ縱横ニ穿チタル地平ノ數孔ニ插入スルモノハ專ラ半圓誤差ノ改正ニ使用ス

第五項

磁氣桿ニシテ該箱内中心ノ黄銅管ニ藏メ鎖ニテ吊下スルモノハ傾船誤差ノ改正ニ使用ス

第六項

鐵球ハ羅經箱ノ両側ニ在ル支板上ニ固着シテ象限誤差ノ改正ニ使用ス

第七項

圓壔桿ハ羅經箱ノ前部或ハ後部ニ据置クモノニシテ半圓誤差ノ改正ニ使用ス

第八項

鐵球及圓壔桿ハ傾船誤差ノ一部ヲ改正スルニ用フルヿアリト雖モ常ニ其全量ヲ改正スルハ難シ唯東西ノ針路ニ於テハ圓壔桿ノミヲ用ヒテ改正ス

第九項

磁氣桿ヲ折半シ青赤ノ彩色ヲ以テ之ヲ區分ス青色端ハ北極ト同質ノ磁氣ヲ示シ赤色端ハ南極ト同質ノ磁氣ヲ示ス

但磁氣ノ定則ニ據リ青色ハ北ヲ攝シ赤色ハ南ヲ攝スルモノト知ルヘシ

第十項

艦船ニ此羅針儀ヲ整置スルニハ先ツ艦内羅針儀ノ位置ニ由リ圓壔桿ヲ前裝若クハ後裝スルヲ要ス即チステヨンポストヲ距ルヿ六呎乃至九呎ノ内ニシテ船體後半部中ニ其位置ヲ占ムルヿハ圓壔桿ヲ後裝スルヲ可トシ其他ハ概ネ前裝ヲ可トス然レトモ其前裝後裝ヲ變換スルモ敢テ難事ニアラサルヲ以テ若シ自差不完全ナルヿハ則チ羅經箱ヲ回轉スヘシ

第十一項

羅針儀ノ位置定リタルトキハ先ツ半圓誤差ヲ改正シ次ニ象限誤差ヲ改正シ後チ傾船誤差ヲ改正スヘシ

第十二項

半圓誤差ヲ改正スルニ當リ磁氣攝引ノ要旨ヲ知ラサレハ之ヲ使用スルモ無功ニ屬ス故ニ其要點ヲ揭クルニ先ツ磁氣桿一本ヲ取リ其兩端ヲ羅針儀ノ中心ヨリ等距シ且之ヲ平地ニ置ケハ此磁氣力ハ其方向ニ平行セル方向ヲ以テ全磁針ノ各端ニ加ヘ各磁針ノ兩端ニ相反スル方向ヲ以テ加フ此力ハ絹絲ニ由テ傳通シ改正磁氣桿ノ青端ノ方ニ羅版ノ北點ヲ攝引ス故ニ左舷(或ハ右舷)ノ方ヘ攝引セント欲セハ一條ノ磁氣桿ヲ橫孔ニ挿入シ其青端ヲ左舷(或ハ右舷)ノ方ニ置クヘシ若シ船首(或ハ船尾)ノ方ヘ攝引セント欲セハ之ヲ縱孔ニ挿入シ其青端ヲ船首(或ハ船尾)ノ方ニ置クヘシ孔內既ニ磁氣桿ヲ挿入シタル後ニ於テ更ニ左舷ノ方ヘ攝引センコトヲ要スルトキハ橫孔內ノ磁氣桿(青端左舷ノ方ニアルトキ)中ノ一ヲ上孔ニ上クヘシ若シ青端右舷ニアルトキハ之ヲ下孔ニ下シ或ハ之ヲ拔キ去リ或ハ之ヲ反轉スヘシ又船首ノ方ヘ攝引センコトヲ要スルトキハ縱孔內ノ磁氣桿(青端船首ノ方ニアルトキ)ヲ上孔ニ上クヘシ若シ青端船尾ノ方ニアルトキハ之ヲ下孔ニ下シ或ハ之ヲ拔キ去リ或ハ之ヲ反轉スヘシ

第十三項

前項ノ理ニ基キ船首ノ方向ニ因リ攝引ヲ以テ磁針ノ方向ヲ改正スルニハ左ノ如ク爲スヘシ

船首北ニ向フトキ偏西ノ差ハ右舷攝引ヲ以テ改正スヘシ船首南ニ向フトキ偏東ノ差モ亦然リ

船首北ニ向フトキ偏東ノ差ハ左舷攝引ヲ以テ改正スヘシ船首南ニ向フトキ偏西ノ差モ亦然リ

船首東ニ向フトキ偏東ノ差ハ船尾攝引ヲ以テ改正スヘシ船首西ニ向フトキ偏西ノ差モ亦然リ

船首東ニ向フトキ偏西ノ差ハ船首攝引ヲ以テ改正スヘシ船首西ニ向フトキ偏東ノ差モ亦然リ

第十四項

象限誤差改正ノ爲メ鐵球ヲ支ヘル支板上粗〻適宜ノ位置ニ据タル後ハ左ノ通則ニ由リ磁氣桿ヲ以テ改正ヲ施スヘシ

通則

第一則　船首ヲ回轉シテ順次ニ北東南西ニ向ハシムベシ但其順序ハ其時ノ便宜ニ從フヘシ

第二則　前項ノ法ニ因リテ船首ヲ北及東ノ二方向ニ於テ改正ヲ施スヘシ

第三則　第二則ニ由リテ已ニ改正ヲ施シタル后チ船首ヲ南及西ノ二方向ニ向ハシメ而シテ尙誤差アルヤハ則チ其誤差ノ半數ヲ改正スヘシ

第四則　第一第二第三則ヲ順次ニ行ヒタル後ハ船首ヲ何ノ方位ニ向クルモ羅針ノ指示スル所ニ誤リナカルヘシ然レトモ此時象限誤差ノ改正ハ未タ不完全ナルノミナラス俄氏誤差ノ感觸モ亦ナキヲ免カレサルヲ以テ更ニ是等ノ改正ヲ精密ニ施シタル后チ尙又此四則ニ因リテ操返シ其改正ヲ施スヘシ

第十五項

凡羅針儀ニ自差ノ改正ヲ行フタルヤハ各改正用ノ磁氣桿ノ位置ハ航泊日誌ニ記入シ羅經箱ヲ閉鎖シ其鍵ハ必ス航海長之ヲ管理シ故ナクシテ妄リニ磁氣桿ヲ動カス可カラス

第十六項

象限誤差ヲ改正スルニハ羅經箱ノ支板上ニ鐵球二個ヲ置キ其距離ハ改正者ノ見込ヲ以テ定ムルモ大差ナカル可シ但各球羅針儀ヲ距ルノ寸尺ヲ等クシ両球心ト羅針儀ノ磁針トヲ同一ノ地平面ニ爲スヲ可トス而ノ両球心ヲ接スル直線ハ正シク船體ヲ横斷スヘシ斯ノ如クシテ后ハ通則ニ因リ東西南北ノ四點ニ於テ改正ヲ行ヒ次ニ北東、南東、南西、北西ノ四點ニ於テ亦改正ヲ施スヘシ此四點ニ於ケル誤差ハ半圓誤差ノ改正完全ニシテ俄氏誤差ノ感ナキヤヽハ其量相等シク且北東、南西ノ誤差ト南東、北西ノ誤差ト其方向相反スベキモノナリ故ニ若シ北東、南西ノ點ニ於テ偏東ノ誤差アリ北西、南東ニ於テ偏西ノ誤差アルヤハ象限誤差ノ改正不完全トス此時ハ両球ヲ少シク相近ケテ改正ヲナスヘシ若シ北東、南西ノ點ニ於テ偏西ノ誤差アリ北西、南東ニ於テ偏東ノ誤差アルヤハ象限誤差ノ改正適度ヲ超過セシモノトス此時ハ両球ヲ相遠ケテ改正スヘシ然レトモ象限誤差ヲ完全ニ實驗セント欲セハ（既ニ改正シタル半圓誤差ニ尙不充分ナル處アリ且俄氏誤差モ亦未脫セザルヤヽ）必ス船首ヲ四分點ニ向ケ北東及南西ノ針路ニ於ケル偏西ノ誤差ト南東及北西ノ針路ニ於ケル偏東ノ誤差トヲ相加ヘ之ヲ四分シテ其平均改正數ヲ求ムヘシ若シ北東或ハ南西ニ於テ偏西ノ誤差アルヤハ又南東或ハ北西ニ於テ偏東ノ誤差アルヤハ各之ヲ負數トシ

テ算スヘシ而シテ四分點ノ各誤差ノ和ヲ相加ヘ(代數記號ヲ用フ)正數ヲ得レハ象限誤差ハ即チ正ナリ負數ヲ得レハ象限差誤ハ即チ負ナリ象限誤差正ナルトキハ両鐵球ヲ相近ツクルカ又ハ大球ヲ代用シテ改正スヘシ象限誤差負ナルトキハ両鐵球ヲ遠ザクルカ又ハ小球ヲ代用シテ改正スヘシ

第十七項

鐵球ヲ支板上ニ移動スルニ當リ之ヲ近ツクルモ限アリ之ヲ遠サクルモ亦限アリ故ニ之ヲ移動シテ充分ノ改正ヲ爲シ得ザルトキハ他ノ球ヲ轉置シテ改正スヘシ若シ又象限誤差ノ量ヲ前知スルトキハ左表ニ因リ直チニ鐵球ヲ適當ノ位置ニ整置スルヲ得ルナリ象限誤差改正器ニ變更アリタルトキハ東西南北ノ四點或ハ少ナクモ其ニ點北或ハ東若シクハ南或ハ西ニ於テ更ニ試驗ヲ行フヘシ若シ又改正磁氣桿ヲ新調シタルトキハ之ニ由テ改正ヲ行フヘシ

羅盤ノ

四インチ半鐵球	五インチ鐵球
inches.	inches.
10.26	11.40
8.68	9.65
7.68	8.53
6.97	7.74
6.42	7.14
5.99	6.66
5.63	6.26
5.33	5.92
5.07	5.64
4.84	5.38
4.64	5.15
4.46	4.95
4.29	4.77
4.14	4.60
4.01	4.45
3.88	4.32
3.77	4.19
3.66	4.07
3.56	3.96
3.47	3.86
3.38	3.75
3.31	3.67
3.23	2.58

中心ヨリ鐵球ノ最近點ノ距離

五インチ半鐵球	六インチ鐵球	六インチ半鐵球	七インチ鐵球	七インチ半鐵球	八インチ鐵球	八インチ半鐵球	九インチ鐵球
inches.	inches.	inches.	inches.	inches.	inches.	inches.	inches.
12.54	13.68	14.82	15.96	17.10	18.24	19.38	20.52
10.61	11.58	12.54	13.51	14.47	15.44	16.40	17.36
9.39	10.23	11.09	11.94	12.80	13.65	14.50	15.36
8.51	9.29	10.03	10.84	11.61	12.38	13.16	13.93
7.85	8.57	9.28	9.99	10.71	11.42	12.14	12.85
7.33	7.99	8.69	9.32	9.99	10.65	11.32	11.99
6.88	7.51	8.14	8.76	9.39	10.02	10.64	11.25
6.51	7.10	7.70	8.29	8.88	9.47	10.06	10.66
6.20	6.77	7.33	7.90	8.46	9.00	9.57	10.15
5.92	6.46	7.00	7.53	8.07	8.62	9.15	9.69
5.67	6.18	6.70	7.21	7.73	8.24	8.76	9.28
5.44	5.94	6.44	6.93	7.42	7.92	8.41	8.91
5.25	5.72	6.20	6.68	7.15	7.63	8.11	8.58
5.06	5.51	5.97	6.43	6.90	7.35	7.81	8.28
4.91	5.35	5.80	6.24	6.69	7.14	7.58	8.03
4.75	5.18	5.62	6.05	6.48	6.91	7.34	7.77
4.61	5.03	5.45	5.87	6.29	6.71	7.13	7.55
4.48	4.88	5.29	5.70	6.10	6.54	6.92	7.33
4.36	4.76	5.15	5.55	5.95	6.34	6.74	7.13
4.25	4.63	5.20	5.40	5.79	6.18	6.56	6.95
4.13	4.51	4.88	5.26	5.63	6.01	9.38	6.76
4.04	4.41	4.78	5.14	5.51	5.88	6.25	6.61
3.94	4.30	4.66	5.02	5.38	5.74	6.09	6.45

	十インチ鐵球
改正スヘキ誤差	*inches.*
°	22.80
1	19.30
1½	17.06
2	15.48
2½	14.28
3	13.32
3½	12.52
4	11.84
4½	11.28
5	10.77
5½	10.31
6	9.90
6½	9.54
7	9.19
7½	8.92
8	8.64
8½	8.39
9	8.14
9½	7.93
10	7.72
10½	7.51
11	7.35
11½	7.17
12	

第十八項

羅針儀ノ位置船體ノ中央縱線ヨリ著シク離隔シタルトキ或ハ船內鐵氣ノ位置縱截面ノ各側ニ於テ甚タ均齊ナラザルトキハ斜向象限誤差ヲ生ス然ルトキハ鐵球ノ位置ヲ船ノ橫截面ニ斜ニシ其羅針儀マテノ距離ヲ等シクシ以テ象限誤差ヲ改正スヘシ其他尙ホ一ノ誤差アレ𪜈其量船首ノ方向ニ係ラスシテ一定ノ數ナレハ鐵球ヲ以テ改正スルヲ得ス

第十九項

羅針儀ノ兩側ニ多量ノ鐵アリテ象限誤差ノ適度ヲ非常ニ超過セシトキカ又ハ羅針儀ノ位置甲板上ニ高ク突出シ殊ニ船體ノ殆ト中央ニ其位置ヲ占メ鐵檣或ハ煙筒ヨリ遠ザカリタルトキニ負號象限誤差ヲ生ス然レ𪜈現今構造ノ艦船ニハ此誤差アルモノ甚タ稀ナリ其高キ位置又ハ船體ノ中央ニ整置スルトキハ其誤差甚タ少ナルヘシ

第二十項

傾船誤差ヲ改正スルニハ先ツ其誤差ノ全部ヲH(1)H(2)H(3)ノ三個ニ區別シ其主トスル所ノ一部ハH(1)ニシテ從來實際ニ改正セシ者ナリ此誤差ハ船首北或ハ南ニ向クトキ多極ノ量ヲ生シ東或ハ西ニ向クトキハ其量全ク零トナル而シテ其原因ヲ索ヌルニ專ラ船鐵ノ上部ニ感シテ生スル者ナリ即チ北磁氣半球ニテ構造シ其後曾テ南半球ニ航行セサル船ニ於テハ其上部ノ鐵ハ眞北極ノ磁氣ト同性質ノ極(即チ靑色)ヲ有シ船底及龍骨ハ皆反對ノ極(即チ赤色)ヲ有ス其他ノ原因ハ船體傾斜ナルトキ地球ノ磁氣力ニ由リ鐵甲板若クハビームニ誘導セシ磁氣ニ感シテ生ス其感動相合シテ眞東眞西ノ針路ヲ取ラサレハ船體傾キテ昂起セル舷ノ方ニ羅版ノ北點ヲ攝引ス海上ニ於テ此差ヲ改正スルニハ傾船磁氣桿ノ南極(赤色)ヲ上ニシ北極(靑色)ヲ下ニシ羅針儀ノ中央羅經箱ノ中心管ニ之ヲ上下シ針路ヲ變スルコトナク船體傾斜ノ度ノミヲ變更ノ之ヲ試ミ磁針ニ著シキ感動ナキニ至リ磁氣桿ノ位置ヲ定ムヘシ

第二十一項

前項ヲ實際ニ施スニハ針路角ヲ北或ハ南ヨリ六十度以內ノトキニ行フヘシ

此角度ノ內ニ於テセハ天體ノ南北方向ノ測量ニ於テモ頗ル便益アリ而シテ船體徐々一方ニ傾キ羅針儀ノ北點船體ノ上邊ノ方ヘ自差ヲ生スルㇳキハ傾船磁氣桿（赤色ノ端上ニアルㇳキ）ヲ少シク引揚クヘシ若シ青色ノ端上ニアルㇳキハ少シク引卸スヘシ若シ又之ニ反シテ羅針儀ノ北點船體ノ下邊ノ方ヘ自差ヲ生スルㇳキハ赤色ノ端上ニアルㇳキ傾船磁氣桿ヲ下ケ青色ノ端上ニアルㇳキ之ヲ揚クヘシ艦船南方ニ航行シ磁氣赤道ヲ越ヘタルㇳキハ傾船磁氣桿ヲ管中ヨリ取出シ之ヲ轉倒スヘシ即チ南磁氣半球ニ於テハ眞北極（青色）ヲ上ニシ眞南極（赤色）ヲ下ニシテ管內ニ納ムヘシ

第二十二項

羅經箱ノ外部ニ小攜器ヲ備フ之ヲ驗傾器ト云ヒ以テ船體ノ傾キヲ驗スルノ用ニ供ス

第二十三項

傾船誤差ヲ改正スルニハ磁氣垂直力ヲ測ルヲ要ス故ニ磁氣觀測ノ器械ヲ備フル艦船ニ在テハ出船前ニ必ス此測量ヲ施スヘシ

第二十四項

象限誤差及半圓誤差ノ改正既ニ終リタル後チ傾船誤差ノ改正ヲ施スニハ左ノ理ニ因リテ之ヲ定ムヘシ

艦內羅針儀ノ位置ニ於ケル垂直力ト海岸ニ於ケル垂直力トノ比ハ艦內同位置ニケ於ル地平力ト海岸ニ於ケル地平力トノ比ニ相等シ

艦內羅針儀ノ地平力ト海岸ノ地平力トノ比ハ殆ト百分ノ九十ニ當ル故ニ傾針器ヲ用ヒ海岸ニ於テ垂直力ヲ測リ其百分ノ九十ヲ以テ艦內ノ垂直力ト定メ（若シ海岸ニ於テ地平力ヲ測リ艦內ノ垂直力ヲ知リタルㇳキハ其儘ニ從テ之ヲ定ム）之ニ依テ傾船磁氣桿ノ上下如何ヲ定ムヘシ

第二十五項

傾船誤差ノ主ナル一部ハ第廿項ニ於テ已ニ其改正法ヲ說明セリH(2)H(3)ノ兩誤差ハ正當ノ位置ニアル原基羅針ニハ其量少ナリト雖モ航用羅針ニ於テハ或ハ多量或ハ少量ニメ幾分カ其誤差ナキヲ得スH(2)ハ地平力ヨリ誘導シテ甲板ニ直角ナル磁氣力ヨリ生シH(3)ハ甲板ニ垂直ナル磁氣力ヨリ生ス而メH(2)ハ北及南ノ針路ニ於テ多極ニシテ東及西ニ於テハ零トナル之ヲ改正スルニハ粗大ナル軟鐵桿ヲ縱置シ其前端若シクハ後端ヲ羅針下ニ在ラシメ以テ之ヲ改正スヘシ然レㇳモH(2)常ニ多クハ少量ナルヲ以テ未タ曾テ其改正ヲ施シタル者ナシH(3)ハ東及西ノ針路ニ於テ多極ヲナシ北及南ノ針路ニ

於テ零トナル東ノ針路ニ於テ羅針高キ舷ニ引カルヽトキハ西ニ於テ低キ舷ニ引カレ東ノ針路ニ於テ低キ舷ニ引カルヽトキハ西ノ針路ニ於テ高キ舷ニ引カル此誤差ハ圓墻桿ヲ以テ盡ク改正スルヲ得ル若シH(2)H(3)ノ一若シクハ兩ナカラ其量著大ナルトキハ傾船磁氣桿ヲ以テ施シタル改正ハ甚タ充分ナラス何者船首方向ヲ變スルニ從ヒ傾船磁氣桿ヲ上若クハ下ニ轉置セザルヲ得ザレバナリ故ニ傾船磁氣桿ハ傾船誤差ヲ適當ノ量ニ減少スルカ爲メニ必要ナレ𪜈之ヲ以テ完全ノ改正ヲ爲シ得ヘキモノニアラス宜シク時々傾船誤差ノ測量ヲ施シ船體正平ナルトキ充分ノ改正ヲ受ケタル羅針ノ方向ニ之ヲ加減スヘシ

圓墻桿ノ說明

第二十六項　圓墻桿ハ軟鐵ノ桿ニシテ之ヲ組合シテ至當ノ長サヲ得ル爲メニ長短ノ數桿アリ之ヲ組合スルニ當リテハ常ニ長キモノヲ上ニ置キ短キモノヲ下ニ置ク中間ノモノハ亦皆其長短ニ從テ重累ス羅經箱ニ固定セル脚臺ノ上ニ木桿ヲ置キ木桿上ニ圓墻桿ヲ置ク木桿亦各種ノ長サニシテ圓墻桿ノ上端ヲ至當ノ高サニ爲スヿヲ得セシムル而シテ黃銅ノ管ヲ以テ之ヲ蓋フハ雨水等ノ注射ヲ防禦スルカ爲メナリ

第二十七項　圓墻桿ノ主用ハ地球ノ垂直力ヨリ誘導セル船ノ地平力ニ抵抗スルニアリ而シテ艦船內ノ鐵氣ハ縱截面ノ各側ニ均齊ニアルヘキモノナレハ羅針儀ハ此截面ニアルヲ常トス故ニ圓墻桿モ亦此截面中ニアルヲ要ス即チ羅經箱ノ前(或ハ後)ノ中央ニアリテ傾船誤差中H(3)ナル全部ヲ改正スルニ用フルモノナリ第二ノ用ハ地球ノ垂直力ヨリ誘導シテ艦船ノ磁氣ニ感觸シ其甲板上ニ垂直ナル力ニ抵抗シ以テ傾船誤差ノH(1)ナル一部ノ幾分ヲ改正スルニ用フ其第二ノ用ニ於テモ亦其適當ノ位置ハ羅經箱ノ前(或ハ後)ノ中央ニ於テ上下スルニアリ但シ桿長ヲ變セスシテ羅針上ニ最大ノ地平力ヲ加フヘキ位置ノ少シク上或ハ下ニアルヲ適當トス圓墻桿ヲ傾船誤差改正ニ用ヒザルキハ其上端ハ羅版ノ平面上凡二インチニアルヲ宜トス

第二十八項　艦船北磁氣半球ニアルトキハ地球ノ垂直力ハ磁針ノ赤端ヲ下ニ引キ青端ヲ上ニ引クヘシ而シテ此垂直力ハ鐵ノ上部ニ青磁氣ヲ誘導シ下部ニハ赤磁氣ヲ誘導スヘシ故ニ北磁氣半球ニ於テ圓墻桿ハ青端ヲ上ニシ赤端ヲ下ニセル磁氣桿ニ等シキ作用ヲナスヘシ而シテ艦船磁氣赤道上ニ至レハ桿ハ磁

氣ヲ失ヒ尙ホ進テ南磁氣半球ニ至レハ北半球ニ於ケルトキニ反セル磁氣ヲ有シ赤端ヲ上ニシ青端ヲ下ニシタル磁氣桿ニ等シキ作用ヲ爲スヘシ艦船一ノ半球ヨリ磁氣赤道ヲ越テ他ノ半球ニ移ルトキハ圓壔桿ノ磁氣ハ漸々減シテ零トナリ又漸々反對ノ方向ニ增加スルモノナリ此桿ヲ羅經箱ニ附着スルノ目的ハ右ノ漸變スル磁氣ヲ利用スルニアリ桿ノ磁氣漸變スルヲ以テ桿ハ艦ノ軟鐵ノ磁氣亦漸變シ從テ其羅針ニ加フル力モ漸變スルヲ以テ桿ハ能ク改正ノ効力ヲ保チ曾テ增減セザルナリ若シ船ノ磁氣力北磁氣半球ニ於テ船尾ノ方ニ羅針ヲ引キ南磁氣半球ニ於テ船首ノ方ニ羅針ヲ引クトキハ圓壔桿ノ位置ハ羅經箱ノ前面ニアルヲ宜シトス若シ此力ノ方向之ニ反スルトキハ其位置羅經箱ノ後面ニアルヲ宜シトス

第二十九項

圓壔桿ヲ以テ爲スヘキ改正ノ量ヲ確知セザル間ハ東及西ノ針路ニ於テ誤差全部ノ約半ヲ改正スヘシ殘餘ノ誤差ハ縱孔磁氣ヲ以テ精密ニ改正スヘシ

北磁氣半球ニ於ケル某地ニ於テ初メテ修整ヲ行ヒタル後漸々垂直力ノ弱キ地方ニ航行シタルトキ羅針ノ東點或ハ西點ノ改正ニ要スル縱孔磁氣ノ力ヲシテ此航海ノ初メヨリ減シタリトセハ此磁氣ヲ以テ爲シタル改正ノ幾分ハ圓壔桿ニ因テ爲シタル者ト知ルヘシ然レトモ實際ニ於テハ垂直力ノ弱キ地ニ進航スル間ハ磁氣桿ヲ以テ縱ノ攝力ヲ減スルノ外他ノ事ヲ爲スヘカラス若シ磁氣赤道ヲ越ユルト無クシテ垂直力ノ强キ地ニ歸ヘルトキ及ヒ縱ノ攝引ヲ增加セント要スルトキハ磁氣桿ヲ用ヒズ單ニ圓壔桿ヲ增加シテ之カ改正ヲ爲スヘシ艦船磁氣赤道ヲ越ユルト否トニ拘ラス垂直力甚タ異ナル地ヲ航行スルトキ縱ノ改正ニ關スル通則ハ左ノ如シ

半球ノ南北ニ拘ラス垂直力弱キ地ニ航スルトキハ東或ハ西ノ針路ニ於テ發見セル誤差ハ縱孔磁氣桿ヲ以テ改正スヘシ若シ垂直力强キ地ニ航スルトキハ圓壔桿ヲ以テ改正スヘシ又磁氣ノ感動緩慢ナルトキハ新シキ羅版ト帽ト ヲ羅針儀ニ裝置スヘシ此二者ハ概ネ四五年間ハ實用ニ堪ユルモノナレトモ外國ニ航行スル艦船ニ於テ豫備品ヲ貯フルヲ良トス

第三十項　修整法

第一　天體若クハ陸標ノ方位ニ由リ以テ船首ヲ磁氣北或ハ磁氣南（此北或ハ南ト云フハ磁氣子午線ニシテ即チ眞方位角ニ偏差ヲ改正シタル者ヲ云フ）ニ向ケ橫孔磁氣桿ヲ用ヒテ羅版ノ北或ハ南ヲ正シク指サシム

ヘシ

船首北ニ向フ時偏東ノ誤差アル時ハ青端ヲ左舷ニ向ケテ磁氣桿ヲ橫孔ニ挿入シ以テ之ヲ改正スヘシ若シ偏西ノ誤差アル時ハ青端ヲ右舷ニ向ケテ磁氣桿ヲ橫孔ニ挿入シ以テ之ヲ改正スヘシ

船首南ニ向フ時偏東ノ誤差アル時ハ青端ヲ右舷ニ向ケテ磁氣桿ヲ橫孔ニ挿入シ以テ之ヲ改正スヘシ若シ偏西ノ誤差アル時ハ青端ヲ左舷ニ向ケテ改正スヘシ

第二　然ル後船首ヲ磁氣東若シクハ磁氣西ニ向ケ縱孔ニ磁氣桿ヲ挿入シ以テ羅版ノ東或ハ西ヲ正シク指サシムヘシ

船首東ニ向フ時偏東ノ誤差アル時ハ青端ヲ船尾ニ向ケテ磁氣桿ヲ縱孔ニ挿入シ以テ之ヲ改正スヘシ若シ偏西ノ誤差アル時ハ青端ヲ船首ニ向ケテ改正スヘシ

船首西ニ向フ時偏東ノ誤差アル時ハ青端ヲ船首ニ向ケテ磁氣桿ヲ縱孔ニ挿入シ以テ之ヲ改正スヘシ若シ偏西ノ誤差アル時ハ青端ヲ船尾ニ向ケテ改正スヘシ

縱孔磁氣桿ハ二本ッヽ組ミテ用フヘシ即チ各桿其青端ノ方向ヲ同一ニシ羅針ヨリ同一ノ距離ヲ保チ左右各孔ニ分挿スヘシ

北或ハ南及東或ハ西ノ點ニ於テ已ニ正シキ時ハ再ヒ之ヲ變スルヲ要セスト雖モ尙羅針ニ誤差ヲ生シタル時ハ更ニ船首ヲ北或ハ南ニ向ケ橫孔磁氣桿ヲ用ヒテ改正シ船首ヲ東或ハ西ニ向ケ縱孔磁氣桿ヲ用ヒテ改正スヘシ

南西或ハ北西ノ四方位ノ一ニ向ケ一對ノ鐵球ヲ用ヒテ改正ヲ施スヘシ

最初ノ修整ニ於テ鐵球ノ大小位置共已ニ正シキ時ハ左ノ規則ニヨリテ改正ヲ行フヘシ

船首北ニ向フ時橫孔磁氣桿ヲ用ヰ而シテ青端左舷ニ向ク時ハ偏東ノ誤差ニ磁氣桿ヲ上ケ偏西ノ誤差ニ之ヲ下ケテ改正スヘシ若シ又青端右舷ニ向ク時ハ偏東ノ誤差ニ磁氣桿ヲ下ケ偏西ノ誤差ニ之ヲ上ケテ

偏東ノ誤差アル時ハ青端ヲ船尾ニ向ケテ磁氣桿ヲ縱孔ニ挿入シ以テ之ヲ改正スヘシ若シ偏西ノ誤差アル時ハ青端ヲ船首ニ向ケテ改正スヘシ

偏東ノ誤差アル時ハ青端ヲ船尾ニ向ケテ磁氣桿ヲ縱孔ニ挿入シ以テ之ヲ改正スヘシ若シ偏西ノ誤差アル時ハ青端ヲ船首ニ向ケテ改正スヘシ

船首西ニ向フ時偏東ノ誤差アル時ハ青端ヲ船首ニ向ケテ磁氣桿ヲ縱孔ニ挿入シ以テ之ヲ改正スヘシ若シ偏西ノ誤差アル時ハ青端ヲ船尾ニ向ケテ改正スヘシ

縱孔磁氣桿ハ二本ッヽ組ミテ用フヘシ即チ各桿其青端ノ方向ヲ同一ニシ羅針ヨリ同一ノ距離ヲ保チ左右各孔ニ分挿スヘシ

北或ハ南及東或ハ西ノ點ニ於テ已ニ正シキ時ハ再ヒ之ヲ變スルヲ要セスト雖モ尙羅針ニ誤差ヲ生シタル時ハ更ニ船首ヲ北或ハ南ニ向ケ橫孔磁氣桿ヲ用ヒテ改正シ船首ヲ東或ハ西ニ向ケ縱孔磁氣桿ヲ用ヒテ改正スヘシ

南西或ハ北西ノ四方位ノ一ニ向ケ一對ノ鐵球ヲ用ヒテ改正ヲ施スヘシ

最初ノ修整ニ於テ鐵球ノ大小位置共已ニ正シキ時ハ左ノ規則ニヨリテ改正ヲ行フヘシ

船首北ニ向フ時橫孔磁氣桿ヲ用ヰ而シテ青端左舷ニ向ク時ハ偏東ノ誤差ニ磁氣桿ヲ上ケ偏西ノ誤差ニ之ヲ下ケテ改正スヘシ若シ又青端右舷ニ向ク時ハ偏東ノ誤差ニ磁氣桿ヲ下ケ偏西ノ誤差ニ之ヲ上ケテ

改正スヘシ

船首南ニ向フ片　横孔磁氣桿ヲ用ヰ而シテ青端左舷ニ向ク片ハ偏東ノ誤差ニ磁氣桿ヲ下ケ偏西ノ誤差ニ之ヲ上ケテ改正シ若シ又青端右舷ニ向ク片ハ偏東ノ誤差ニ磁氣桿ヲ上ケ偏西ノ誤差ニ之ヲ下ケテ改正スヘシ

船首東ニ向フ片　縱孔磁氣桿ヲ用ヰ而シテ青端船首ニ向ク片ハ偏東ノ誤差ニ磁氣桿ヲ下ケ偏西ノ誤差ニ之ヲ上ケテ改正スヘシ若シ又青端船尾ニ向ク片ハ偏東ノ誤差ニ磁氣桿ヲ上ケ偏西ノ誤差ニ之ヲ下ケテ改正スヘシ

船首西ニ向フ片　縱孔磁氣桿ヲ用ヰ而シテ青端船首ニ向ク片ハ偏東ノ誤差ニ磁氣桿ヲ上ケ偏西ノ誤差ニ之ヲ下ケテ改正スヘシ若シ又青端船尾ニ向ク片ハ偏東ノ誤差ニ磁氣桿ヲ下ケ偏西ノ誤差ニ之ヲ上ケテ改正スヘシ

第三十一項

天體若クハ地上物體ノ方向ヲ測ラスシテ磁針ノ方向ト其力トヲ驗スルノ法アリト雖モ偏針器（デフレクター）（タムソン氏ノ發明ニ係ルモノ）ノ使用ヲ要スルヲ以テ實際施行上或ハ誤差ナキヲ保證シ難シ故ニ偏針器ノ使用法ハ暫ク茲ニ揭ケサルヲ以テ此羅針儀ヲ修整セントス欲セハ宜ク前項ニ因リテ取扱フヘシ

海上衝突豫防規則

總則

第一條　此規則中蒸氣船ト雖モ帆ニテ走リ蒸氣ヲ用ヒザル時ハ帆前船ト看做シ蒸氣ヲ用フルトキハ帆ヲ用フルト用ヒザルトノ差別ナク總テ蒸氣船ト心得ベシ

燈火

第二條　各船日沒ヨリ日出マデノ間ハ天氣ニ拘ラス第三條第四條第五條第六條第七條第八條第九條第十條第十一條ニ記載スル燈火ヲ揭ケ決シテ他ノ燈火ヲ用フ可カラス

第三條　蒸氣船ハ航海中必ス左ノ燈火ヲ揭ケベシ

(甲)前檣又ハ其前面ニ於テ船體上二丈ヨリ低カラザル所ニ亮明ナル白燈一個ヲ掲グベシ若シ船幅二丈ヲ超ル時ハ船體上其船幅ヨリ低カラザル所ニ之ヲ掲グベシ○此燈火ハ常ニ不同ナク亮明ノ光ヲ發シテ鍼盤ノ二十方位ヲ照スベク製造シ之ヲ左右舷外へ十方位ツヽ即チ船ノ正首ヨリ各舷正横後ノ二方位迄光線ノ及ブヘキ樣ニ裝置シ且晴天ノ暗夜ニ少クモ五里(海里ニテ算ス以下之ニ倣ヘ)ノ距離ヨリ見ユベキモノヲ用フベシ

(乙)右舷ニ綠燈ヲ掲グベシ○此燈火ハ常ニ不同ナク亮明ノ光ヲ發シテ鍼盤ノ十方位ヲ照スベク製造シ之ヲ船ノ正首ヨリ右舷正横後ノ二方位マテ光線ノ及ブベキ樣ニ裝置シ且晴天ノ暗夜ニ少クモ二里ノ距離ヨリ見ユベキ者ヲ用フベシ

(丙)左舷ニ紅燈ヲ掲グベシ○此燈火ハ常ニ不同ナク亮明ノ光ヲ發シテ鍼盤ノ十方位ヲ照スベク製造シ之ヲ船ノ正首ヨリ左舷正横後ノ二方位マデ光線ノ及ブベキ樣ニ裝置シ且晴天ノ暗夜ニ少クモ二里ノ距離ヨリ見ユベキ者ヲ用フベシ

(丁)右綠紅ノ舷燈ニハ燈火ヨリ前ニ少クモ三尺出タル扉風樣ノ隔板ヲ其燈火ノ内側ニ當テヽ裝置シ右舷燈ハ左舷ニ在ル船ヨリ見ヘズ左舷燈ハ右舷ニ在ル船ヨリ見ヘザル樣ニナスベシ

第四條　蒸氣船他船ヲ引テ航行スル時ハ兩舷燈ノ外ニ亮明ノ白燈二箇ヲ三尺ヨリ少カラザル間ヲ隔テヽ縦ニ連掲シ獨走ノ蒸氣船ト區別スベシ○此燈火ハ獨走ノ蒸氣船ニ掲グル白燈ト同製ナルヲ用ヒテ同所ヘ掲グベシ

第五條　帆前船ト蒸氣船トノ差別ナク海底電信線ノ布置又ハ引揚ニ從事スル時及事變ノ爲ニ運用自由ヲ得サル時ハ夜間ハ直徑八寸三分ヨリ少カラザル球形ノ紅燈三箇ヲ帆前船ナレハ蒸氣船ニ掲クル白燈ノ位置ニ蒸氣船ナレハ其白燈ノ代リニ三尺ヨリ少カラザル間ヲ隔テ縦ニ連掲スベシ又晝間ハ直徑二尺ノ黑球三箇ヲ前檣ノ前面ニ於テ其頭部ヨリ低カラザル所ニ三尺ヨリ少カラサル間ヲ隔テ縦ニ連掲スヘシ

右黑球及ヒ燈火ハ近寄ル他船ニ於テ運用自由ヲ得ズシテ航路ヲ避クル能ハサル船ノ信號ト看認ムベシ○右ノ船全ク運行セサル時ハ舷燈ヲ掲グベカラストト雖モ運行スレハ必ス之ヲ掲グベシ

第六條　帆前船ハ自ラ走ルト他船ニ引カルヽトノ差別ナク白燈ヲ除クノ外第三條ニ記載スル蒸氣船ノ燈火ヲ掲クベシ決シテ白燈ヲ掲クベカラ

右舷ニ在ル船ヨリ見ヘザル樣ニナスベシ

第四條　蒸氣船他船ヲ引テ航行スル時ハ兩舷燈ノ外ニ亮明ノ白燈二箇ヲ三尺ヨリ少カラザル間ヲ隔テヽ縦ニ連掲シ獨走ノ蒸氣船ト區別スベシ○此燈火ハ獨走ノ蒸氣船ニ掲グル白燈ト同製ナルヲ用ヒテ同所ヘ掲グベシ

第五條　帆前船ト蒸氣船トノ差別ナク海底電信線ノ布置又ハ引揚ニ從事スル時及事變ノ爲ニ運用自由ヲ得サル時ハ夜間ハ直徑八寸三分ヨリ少カラザル球形ノ紅燈三箇ヲ帆前船ナレハ蒸氣船ニ掲クル白燈ノ位置ニ蒸氣船ナレハ其白燈ノ代リニ三尺ヨリ少カラザル間ヲ隔テ縦ニ連掲スベシ又晝間ハ直徑二尺ノ黑球三箇ヲ前檣ノ前面ニ於テ其頭部ヨリ低カラザル所ニ三尺ヨリ少カラサル間ヲ隔テ縦ニ連掲スヘシ

右黑球及ヒ燈火ハ近寄ル他船ニ於テ運用自由ヲ得ズシテ航路ヲ避クル能ハサル船ノ信號ト看認ムベシ○右ノ船全ク運行セサル時ハ舷燈ヲ掲グベカラストト雖モ運行スレハ必ス之ヲ掲グベシ

第六條　帆前船ハ自ラ走ルト他船ニ引カルヽトノ差別ナク白燈ヲ除クノ外第三條ニ記載スル蒸氣船ノ燈火ヲ掲クベシ決シテ白燈ヲ掲クベカラ

ス

第七條　小形船ニ於テ天氣ノ模樣ニ依リ綠紅ノ二燈ヲ掲ケ置キ難キ時ハ綠燈ハ右舷ニ紅燈ハ左舷ニ於テ何時ニテモ標スベキ樣甲板上ニ用意シ置キ他船ノ我船ニ近寄リ來ルカ又ハ我船ノ他船ニ近寄リ行ク時ハ衝突ヲ防クニ充分ナル時間ヲ見定メテ各舷燈ヲ他船ヨリ最モ見ヘ易キ樣各舷ニ標スベシ但此時綠燈ハ左舷ヨリ見ヘス紅燈ハ右舷ヨリ見ヘザル樣注意スヘシ○此綠紅ノ燈ヲ置違ヒナク容易ニ取扱フ爲メ綠燈ノ燈籠ハ綠色紅燈ノ燈籠ハ紅色ニテ外面ヲ塗リ且成規ノ隔板ヲ之ニ備置クベシ

第八條　帆前船ト蒸氣船トノ差別ナク碇泊中ハ最モ見エ易クシテ船體上ヨリ二丈ヲ超エサル所ニ白燈一箇ヲ掲グベシ○此燈火ハ直徑六寸六分ヨリ少カラザル球形ノ燈籠ニテ常ニ不同ナク最モ亮明ノ光ヲ發シ少クモ周回一里ノ距離ヨリ見ユルヤウ備ヘタル燈籠一箇ヲ手近ニ備置キ他船ノ我船ニ近寄リ來ルカ又ハ我船ノ他船ニ近寄リ行クトキハ衝突ヲ防クニ充分ナル時間ヲ見定メテ其燈籠ヲ標スベシ但シ此時綠燈ハ左舷ヨリ見エス紅燈ハ右舷ヨリ見エサル樣注意スヘシ

第九條　水先船其營業場ニ於テ水路嚮導ニ從事スル時ハ他船ニ用フル燈火ヲ掲ケス唯檣頭ニ於テ周回諸方ヨリ見ユヘキ白燈一箇ヲ掲ケ且十五分時ヲ超ヘサル間歇ヲ以テ閃光一箇又ハ數箇ヲ發スベシ○水先船其營業場ニ於テ水路嚮導ニ從事セサル時ハ他船ト同樣ノ燈火ヲ掲クベシ

第十條

(甲)甲板ナキ漁船及甲板ナキ小船航行中ハ必スシモ他船ニ用フル舷燈ヲ掲クルニ及ハス然レ𪜈舷燈ノ代リニ一面ハ綠色ノ硝子板一面ハ紅色ノ硝子板ヲ備ヘタル燈籠一箇ヲ手近ニ備置キ他船ノ我船ニ近寄リ來ルカ又ハ我船ノ他船ニ近寄リ行クトキハ衝突ヲ防クニ充分ナル時間ヲ見定メテ其燈籠ヲ標スベシ但シ此時綠燈ハ左舷ヨリ見エス紅燈ハ右舷ヨリ見エサル樣注意スヘシ

(乙)漁船及甲板ナキ小船碇泊中ハ亮明ノ白燈一箇ヲ標スヘシ

(丙)漁船流網中ハ其檣ニ紅燈二箇ヲ三尺ヨリ少カラサル間ヲ隔テ、縱ニ連掲スベシ

(丁)曳網船營業中ハ其檣ニ紅綠二燈ヲ紅燈ヲ上ニシ綠燈ヲ下ニシテ三尺ヨリ少カラサル間ヲ隔テ、縱ニ連掲シ且他船ニ用フベキ舷燈ヲ掲クベシ若シ舷燈ヲ掲ケ難キトキハ第七條ノ彩燈或ハ本條甲節ニ記載スル紅綠ノ硝子板ヲ備ヘタル燈籠ヲ手近ニ置クベシ

(戊)漁船及甲板ナキ小船ハ便宜ニ從ヒ右燈火ノ外ニ閃光ヲ發スルモ妨ケナシ

(己)本條ニ記載スル燈火ハ一千八百六十八年英國海漁條例ノ附錄佛英條約第十二第十三第十四條ノ燈火ヲ更定スルモノトス

(庚)本條ノ燈火ハ舷燈ヲ除クノ外總テ球形ノ燈籠ニシテ周回諸方ヲ照スヘキ樣裝造スベシ

第十一條　他船ニ追越サレントスル船ハ他船ニ向テ船尾ヨリ白燈ヲ標シ又ハ閃光ヲ發スベシ

霧中信號

第十二條　蒸氣船ニハ必ス濇笛或ハ其他ノ濇聲信號ヲ備ヘ他物ニ其響ヲ妨ケラレサル所ニ裝置スヘシ且又皷鞴或ハ他ノ機械ニ由テ音聲ヲ發セシムル霧中號角及鐘ヲ備フヘシ帆前船ハ同樣ノ號角及鐘ヲ備フヘシ霧中又ハ降雪等ノ時ニ於テハ晝夜ノ別ナク此條ニ記載セル信號ヲ用フヘシ則チ其用法左ノ如シ

(甲)蒸氣船航行中ハ濇笛ヲ以テ二分時ヨリ多カラサル間歇コトニ長聲ヲ一發スベシ

(乙)帆前船航行中ハ號角ヲ以テ二分時ヨリ多カラサル間歇コトニ右舷開ナレハ一聲ヲ發シ左舷開ナレハ二聲ヲ連發シ船ノ正橫後ニ風ヲ受ケタルキハ三聲ヲ連發スベシ

(丙)帆前船ト蒸氣船トノ差別ナク航行中ニ非サレハ二分時ヨリ多カラサル間歇コトニ右舷開ナレハ一聲ヲ發シ左舷開ナレハ二聲ヲ連發シ船ノ正橫後ニ風ヲ受ケタルキハ三聲ヲ連發スベシ

霧中速力

第十三條　帆前船ト蒸氣船トノ差別ナク霧中及降雪中ハ程好キ速力ヲ以テ走ルベシ

航法

第十四條　二艘ノ帆前船互ニ近寄リテ衝突ノ懼アル時ハ一方ノ船ヨリ左ノ如ク他船ノ航路ヲ避クベシ

(甲)一杯ニ開キタル船ノ航路ヲ避クベシ

(乙)左舷ニ一杯ニ開キタル船ハ右舷ニ一杯ニ開キタル船ノ航路ヲ避クベシ

(丙)一杯ニ開カサル二艘ノ船風ヲ受クル舷方同シカラサル時ハ左舷ニ風ヲ受ケタル船ヨリ他船ノ航路ヲ避クベシ

(丁)一杯ニ開カサル二艘ノ船風ヲ受クル舷方同シキ時ハ風上ノ船ヨリ風下ノ航路ヲ避クベシ

第十五條　二艘ノ蒸氣船正シク眞向又ハ殆ト眞向ニ行逢フテ衝突ノ懼アルトキハ兩船共鐵路ヲ右舷ニ轉シ互ニ他船ノ左舷ノ方ヲ行過スベシ

本條ハ兩船正シク眞向ニ行逢フテ衝突ノ懼アル時ニ限リ應用スベク各其鐵路ヲ保チテ必ス替リ行ク時ニ應用スベカラス

本條ヲ應用スヘキ至當ノ塲合ハ兩船共ニ正シク眞向又ハ殆ト眞向ニ行逢ヒタル時即チ晝間ハ我船ノ檣ト他船ノ檣ト一直線又ハ殆ト一直線ニ見ユル時夜間ハ互ニ他船ノ兩舷燈ヲ一時ニ見ル時ニ限ルベシ

本條ハ晝間他船ノ我鐵路ヲ横切リテ我船ノ前面ニ見ユル時又ハ夜間我船ノ紅燈他船ノ紅燈ニ對シ或ハ我船ノ綠燈他船ノ綠燈ニ對スル時又ハ我船ノ前面ニ綠燈ナクシテ紅燈ヲ見或ハ紅燈ナクシテ綠燈ヲ見ル時又ハ絲紅ノ兩燈ヲ我船ノ前面ヨリ他ノ位置ニ見ル時ハ應用スヘカラス

第十六條　二艘ノ蒸氣船互ニ航路ヲ横切リ衝突ノ懼アル時ハ我右舷ニ他船ヲ見ル船ヨリ他船ノ航路ヲ避クベシ

第十七條　帆前船ト蒸氣船ト互ニ近寄リ衝突ノ懼アル時ハ蒸氣船ヨリ帆前船ノ航路ヲ避クベシ

第十八條　總テ蒸氣船他船ニ近寄リ衝突ノ懼アル時ハ速力ヲ緩ニシ又ハ時宜ニ依リ停止シ且後退スベシ

第十九條　蒸氣船此規則ニ遵テ鐵路ヲ取ル時ハ左ノ滾笛信號ヲ以テ他船ニ其鐵路ヲ通知スルヲ得ベシ

短聲一發　我船ノ鐵路ヲ右舷ニ取ル

短聲二發　我船ノ鐵路ヲ左舷ニ取ル

短聲三發　我船一杯ノ速力ニテ退却ス

此信號ヲ用フルト否ラザルトハ隨意タルベシ但此信號ヲ用ヒタル時之ヲ用ヒタル船ハ必ス其信號通リニ其鐵路ヲ取ラサルヘカラス

第二十條　帆前船ト蒸氣船トノ差別ナク他船ヲ追越サントスル時ハ以上ノ規則ニ拘ラス總テ他船ノ航路ヲ避クベシ

第二十一條　總テ蒸氣船狹隘ノ水路ヲ通航スルニ當リ無難ニ通行シ得ル時ハ其航路ノ中流ヨリ其船ノ右舷ニ當ル方ヲ航行スヘシ

第二十二條　以上ノ規則ニ依リテ兩船ノ內一船ヨリ他船ノ航路ヲ避クル時ハ他船ニ於テ其鐵路ヲ保守スベシ

第二十三條　此規則ヲ遵守スルニ就テハ航海上百般ノ危險ニ心ヲ配リ且

危險切迫シテ此規則ヲ遵守スル暇ナキ特別ノ場合ニ於テハ臨機ノ處置ヲ以テ之ヲ避クルニ注意スヘシ

懈怠ノ責

第二十四條　此規則ニ於テ點燈又ハ信號又ハ見張ノ怠リ又ハ海員ノ常務又ハ臨機處置ニ於テ必要ナル用心ノ怠リヨリ生シタル事件ニ於テハ船、船主、船長、乘組人員、各其責ヲ免ル可カラザルモノトス

別則

第二十五條　此規則ハ各地官府ニ於テ特ニ制定シタル港、川其他內海ノ航行規則ノ施行ニ干渉セサルモノトス

第二十六條　此規則ハ二艘以上ノ軍艦又ハ軍艦ニ護送セラルヽ船ニ增揭スル列位燈火及信號燈火ニ付各國政府ニ於テ特ニ制定シタル規則ニ干渉セサルモノトス

罰則

第二十七條　凡船舶合格ノ燈籠及信號器ヲ所持セス若クハ點燈及信號ヲ怠リ又ハ燈籠ノ裝置ヲ過リタル者ハ貳圓以上貳拾圓以下ノ罰金ニ處ス

但甲板ナキ漁船及甲板ナキ小船ハ此限ニアラス

商船學校官制

第一條　商船學校ハ遞信大臣ノ管理ニ屬シ航海運用機關ノ學術ヲ敎授スル所トス

第二條　商船學校ニ職員ヲ置クコト左ノ如シ

校長　幹事

助敎　書記　敎授

第三條　校長ハ一人奏任二等以下トス遞信大臣ノ指揮監督ヲ承ケ校務ヲ掌理シ及幹事以下ノ職員ヲ監督ス

第四條　幹事ハ一人奏任三等以下トス校長ノ指揮ヲ承ケ庶務ヲ掌理シ校長事故アルトキハ其職務ヲ代理ス

第五條　敎授ハ三人奏任三等以下トス生徒ノ敎授ヲ掌ル

第六條　助敎ハ判任トス敎授ノ職掌ヲ佐ク

第七條　書記ハ判任トス校長ノ指揮ヲ承ケ庶務ニ從事ス

東京商船學校規則

第一章　總則

第一條　東京商船學校ハ遞信省ノ所管ニシテ航海科及機關科ノ生徒ヲ教育スル所ナリ

第二條　本校生徒トナルヘキ者ハ海軍豫備員志願ノ者ニ限ル

第三條　生徒卒業ノ後ハ航海科ニ在テハ商船ノ船長運轉手機關科ニ在テハ機關手ノ業務ニ從事スヘキモノトス

第四條　本校生徒ハ海軍士官豫備員トシテ海軍兵籍ニ編入シ海軍一定ノ規則ニ據リ服役スヘキモノトス

第二章　教科

第五條　航海科ニ在テハ航海術運用術砲術機關科ニ在テハ機關學製圖砲術ヲ本科トシ其他ノ科程ヲ豫科トナス

第六條　航海科生徒ノ學フヘキ課程ヲ分テ五級トナス其第五級ヨリ第二級ニ至ル迄ハ本校ニ在テ毎級六箇月以内ニ左ニ揭クル學科ヲ學ハシム

但シ砲術ノ一科ハ別ニ海軍砲術練習艦ニ於テ五箇月以内之レヲ學ハシム

第五級
　和漢學　英學　數學　運用術　砲術
第四級
　和漢學　英學　數學　運用術　砲術
第三級
　英學　機關學大意　航海術　運用術　砲術
第二級
　英學　機關學　數學　製圖

第七條　機關科生徒ノ學フヘキ課程ヲ分テ四級トナス其第四級ヨリ第三級ニ至ル迄ハ本校ニ在テ毎級六箇月以内ニ左ニ揭クル學科ヲ學ハシム

第四級
　和漢學　英學　數學　機關學　製圖
第三級
　其第二級ハ機關場ニ在テ滿三箇年間機械製作ノ實科ヲ修業セシム其第一級ハ航海船ニ乘組ミ滿一箇年間機關運轉ノ業ヲ修メシム

第三章　學年休業

第八條　學年ハ九月一日ニ始マリ翌年七月二十日ニ終ル

第九條　學年ヲ分テ二學期トス第一學期ハ九月一日ヨリ二月二十日ニ至リ第二學期ハ二月二十一日ヨリ七月二十日ニ至ル

第十條　冬期休業ハ十二月二十五日ヨリ一月十日迄トシ夏期休業ハ七月二十一日ヨリ八月三十一日迄トス

第十一條　日曜日並左ニ揭クル祭日祝日ハ休業トス

神嘗祭
秋季皇靈祭
天長節
新嘗祭
孝明天皇祭
紀元節
春季皇靈祭
神武天皇祭

第四章　試驗

第十二條　試驗ハ小試驗中試驗大試驗ノ三種トス

第十三條　小試驗ハ現修ノ學科ニ就キ敎官ノ見込ヲ以テ隨時之レヲ施行シ其得點ノ多寡ニ應シ中試驗ノ得點ニ增減ヲ與フルモノトス

但シ砲術ハ一敎科ノ終リニ於テ試驗スルモノトス

第十四條　中試驗ハ每學期ノ終リニ於テ之ヲ施行シ其合格者ニハ及第證書ヲ授與スルモノトス

第十五條　大試驗ハ全科修了ノ後チ本科ニ就キ之レヲ施行シ其合格者ニハ卒業證書ヲ授與スルモノトス

第十六條　大試驗及中試驗ハ其得點ノ數本科ニ於テ全點ノ五分三豫科ニ於テ三分一以上ヲ得而シテ其得點ヲ合算シ（懲戒ニヨリ罰點ヲ附科シタルトキハ合算點ヨリ罰點ヲ減却ス）全點ノ五分三以上ニ至ルヲ及第トス

第十七條　大試驗ニ落第セシ者ハ若干月復習ヲ命シ再試驗ヲ施行ス

第十八條　中試驗ニ落第セシ者ハ原級ニ止メテ復習セシム

但シ貸費生落第スルコト二回ニ及フトキハ及第スル迄經費金ハ自辨セシム

第十九條　中試驗又ハ大試驗ノ得點數最モ多ク且平素格別ニ品行端正ノ者ニハ褒賞ヲ附與ス

第五章　入學

第二十條　入學ノ期ハ毎年七月ト定ム

第二十一條　入學ヲ許スヘキ者ハ左ノ三項ニ適合シ且體格檢查及學科試驗ニ合格セル者ニ限ル

第一　航海科ハ年齡十四年以上十九年以下機關科ハ十五年以上二十年以下ノ者

第二　品行端正且貳人以上ノ保證人アル者

第三　在學中家事ニ係累ナキ者

第二十二條　學科試驗ノ科目ハ左ノ如シ

第一　英學　會話　書取　和英復文　歷史及物理講義

第二　數學　算數學　代數學　幾何學

第三　和漢學　史類及文集類講義

第四　作文　記事及尺牘

第二十三條　體格檢查ハ海軍尉官及本校幹事臨席シ海軍醫官之レヲ行フ而シテ合格ノ者ニアラサレハ學科試驗ヲ行フコトナシ

第二十四條　學科試驗ハ校長及海軍尉官臨席シ本校教官之レヲ行フ

第二十五條　入學志願者ハ甲號書式ノ入學願書及乙號書式ノ學業履歷書ヲ出スヘシ

第二十六條　入學ノ許可ヲ得タル者ハ丙號書式ノ誓書ヲ出シ又自費生ハ丁號書式ノ證書ヲ出スヘシ

第二十七條　保證人ハ丁年以上ニシテ東京府下ニ居住シ且其府下ニ於テ地所若クハ家屋ヲ所有スル者ニ限ル

第二十八條　保證人府外ヘ轉住シ又ハ地所家屋ノ所有權ヲ失シ或ハ死亡スルトキハ保證人ヲ更定スヘシ

第二十九條　保證人旅行等ヲ爲スヨキハ代理者ヲ立ツヘシ

第六章　退校

第三十條　生徒ハ自費貸費ヲ問ハス中途退校ヲ出願スルヲ許サス但シ一家ノ安危ニ係ル事故アルモノハ願書ニ其事由ヲ詳記シ親族保證人連署ノ上在籍區戶長ノ奥書證印ヲ受ケ出願スルコトヲ得

第三十一條　生徒ニシテ左項ノ一ニ該ル者ハ直チニ退校ヲ命ス

第一　禁錮以上ノ刑ニ處セラレタル者

第二　品行不良或ハ怠惰ニシテ屢校則ヲ犯ス者

第三　小試驗ノ成績屢不良ニシテ卒業ノ目途ナキ者
第四　中試驗又ハ大試驗ニ於テ落第三回ニ及フ者
第五　傷痍疾病ニ罹リ前途ノ目的ナキ者

第三十二條　貸費生徒ニシテ第三十條第三十一條ニ據リ退校スル者ハ其貸與金ハ本人若クハ保證人ヨリ本校指定ノ期限内ニ還納スヘシ

第七章　自費貸費

第三十三條　自費生ハ在學中ノ經費都テ之レヲ自辨シ貸費生ハ之レヲ本校ヨリ貸與スルモノトス

第三十四條　生徒ノ經費ハ自費貸費ヲ問ハス一箇月凡金八圓ト定ム
但シ實地派遣中食費或ハ報酬金ヲ其船舶若クハ機關場等ヨリ支給セシムヘキ定約ヲナシタル生徒ハ本條經費金ノ内若干ヲ減縮スルコトアルヘシ

第三十五條　貸費生在學中又ハ卒業ノ後死亡シ或ハ業務上ノ爲メ癈疾不具トナル者ハ貸與金ヲ還納スルニ及ハス

第三十六條　貸費生卒業ノ後貸與金ノ還納ヲ了ル迄本校ノ指命ニ遵ヒ船舶ニ乘組ミ若クハ之レニ關スル業務ニ從事シ毎月俸給高五分一以上ノ金額ヲ以テ本人若クハ保證人ヨリ其貸與金ヲ還納スヘシ
但シ事故アリテ船舶ニ關セサル業務ニ從事スルトキハ其貸與金ハ一時ニ還納スヘシ

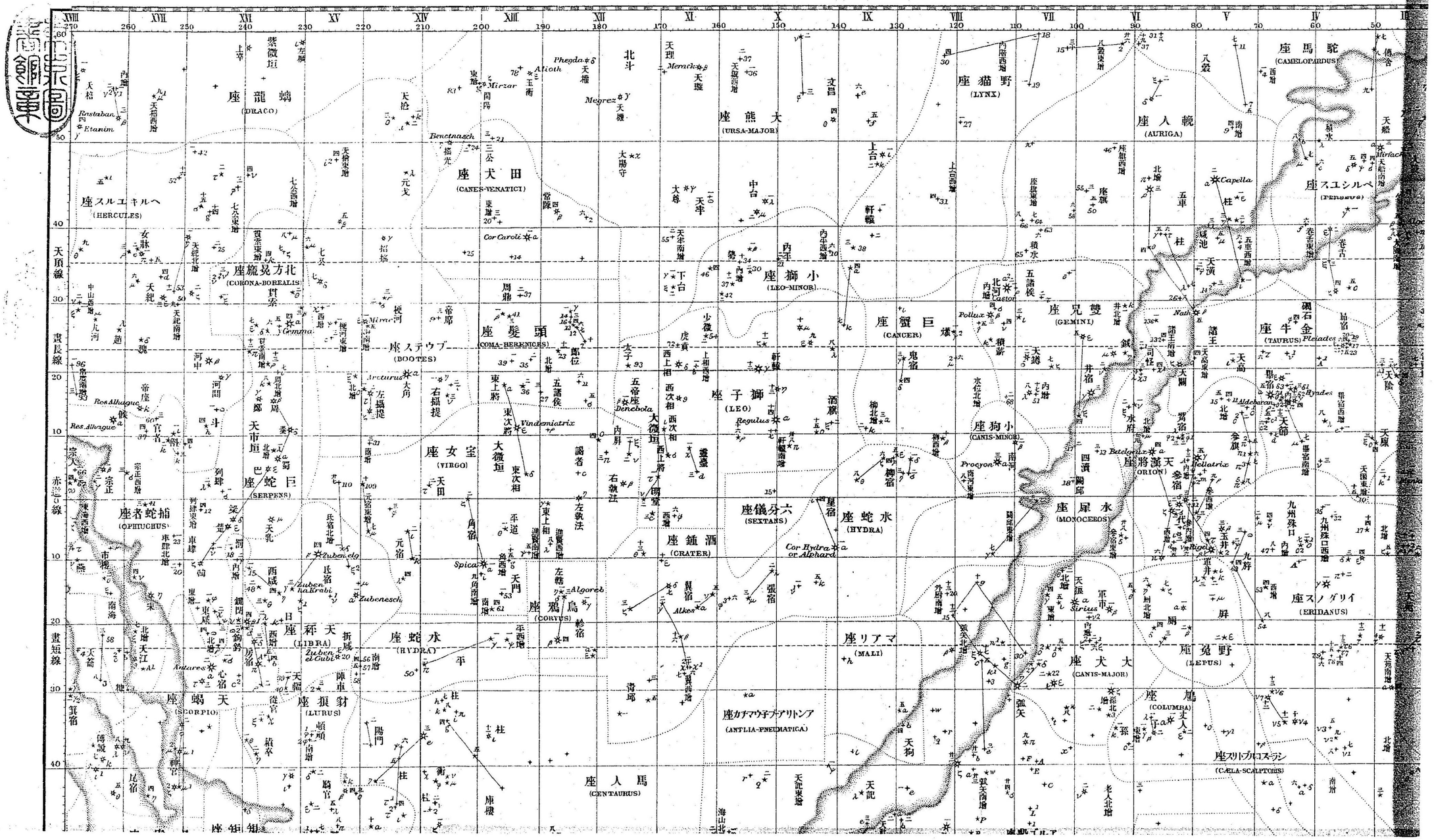
海員必携附錄終

自赤道線至南北六十度之距等線諸恒星之圖

✳ 變星 ✳ 一等 ✳ 二等 ☆ 三等 ★ 四等 + 五等

南北六十度之距等線諸恒星之圖

※ 變星 ※ 一等 ※ 二等 ※ 三等 ★ 四等 + 五等



天頂線
晝長線
赤道線
晝短線
座龍螭 (DRACO)
座大田 (CANES-VENATICI)
座熊大 (URSA-MAJOR)
座猫野 (LYNX)
座人輓 (AURIGA)
座馬駝 (CAMELOPARDUS)
座スユシルペ (PERSEUS)
座スルユキルヘ (HERCULES)
座方冕旒北 (CORONA-BOREALIS)
座髪頭 (COMA-BERENICES)
座獅小 (LEO-MINOR)
座蟹巨 (CANCER)
座兄雙 (GEMINI)
座牛金 (TAURUS)
座ステウブ (BOOTES)
座子獅 (LEO)
座狗小 (CANIS-MINOR)
座漢天將 (ORION)
座蛇巨 (SERPENS)
座女室 (VIRGO)
座儀分六 (SEXTANS)
座蛇水 (HYDRA)
座犀水 (MONOCEROS)
座者蛇捕 (OPHIUCHUS)
座鍾酒 (CRATER)
座鴉烏 (CORVUS)
座スノダリイ (ERIDANUS)
座秤天 (LIBRA)
座蛇水 (HYDRA)
座リアマ (MALI)
座犬大 (CANIS-MAJOR)
座兎野 (LEPUS)
座蝎天 (SCORPIO)
座狼豺 (LURUS)
座カチマウ子ブアリトンア (ANTLIA-PNEUMATICA)
座鳩 (COLUMBA)
座スリトプルコスラシ (CÆLA-SCALPTORIS)
座人馬 (CENTAURUS)

天頂線
晝長線
赤道線
晝短線
地平線

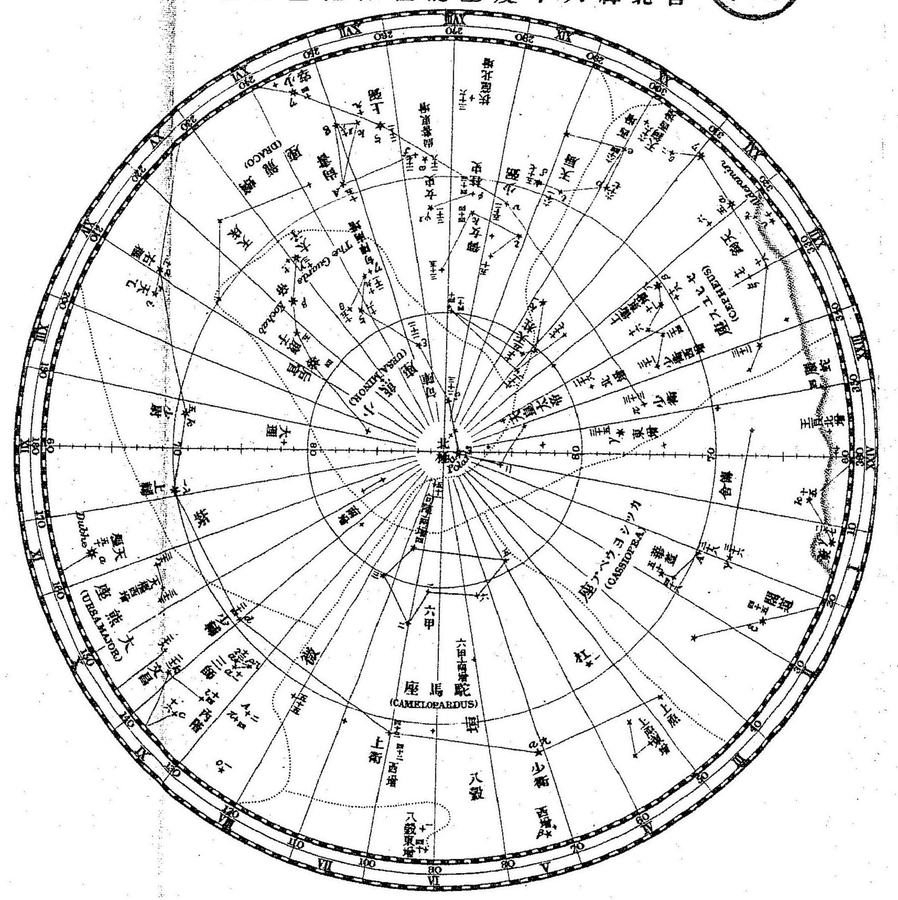
天圖

CHART OF THE HEAVENS

例言

圖中ノ恒星ハ英國公會星表ヨリ撰出シ其數一千五百顆其等級一等ヨリ五等ニ至ル而シテ其一等半ナル者ハ之ヲ一等トシ二等半ナル者ハ之ヲ二等トシ已下皆之ニ準ス蓋シ星座ハ點綴ヲ以テ區分シ銀河或ハ星雲ノ如キハ各星ノ位置ニ從フテ之ヲ界定スルヲ以テ又各星ノ度位ハ西曆一千八百八十年十月一日ノ平位ニ改算シタル者ナリ

自北緯六十度至北極諸恒星之圖



自南緯六十度至南極諸恒星之圖

石炭及電信圖

英國諸社會ニ屬スル海底線 ——————

白他ノ諸社會ニ屬スル海底線 - - - - - - - -

陸線 ——————

● 所場ルス藏貯ヲ炭石ノ上以噸百五

+ 所場ルス藏貯ヲ炭石ノ量少

50° 40° 30° 20° 10° 0° 10° 20°

60°

50°

40°

EUROPE

Tilt Cove
Bonavista
St Johns
Placentia
Fayal
Terceira
S. Miguel
Funchal
Edinburgh
Peterhead
Dublin
Valentia
London
P. Lizard
Brest
St Nazaire
Sables d'Olon
Rochelle
Rochefort
Bordeaux
Arcachon
Bayonne
Biarritz
Pasages
Santander
Gijon
Ribadeo
Coruña
Vigo
Oporto
Lisboa
Madrid
Tarragona
Valencia
Alicante
Carthagena
Malaga
Cadiz
Gibraltar
Algeciras
Tangier
Almeria
Oran
Beni Saf
Algiers
Bona
Bengazi
Tunis
Susa
Sfax
El Aghouat
Kabes
Djerba
Ghardaia
Tripoli
Malta
Palma
P. Mahon
Bastia
Ajaccio
Cagliari
Palermo
Messina
Catania
Syracuse
Castellamare
Naples
Gaeta
Civita Vecchia
Ancona
Leghorn
Genoa
Nice
Marseilles
Toulon
Lyon
Paris
Metz
Calais
Boulogne
Dieppe
Havre
Cherbourg
Caen
St Malo
Dunkerque
Ostend
Antwerp
Flushing
Rotterdam
Amsterdam
Harlingen
Delfzijl
Emden
Bremerhaven
Brake
Wilhelmshaven
Cuxhaven
Hamburg
Lübeck
Berlin
Munich
Vienna
Prague
Warsaw
Kiel
Copenhagen
Elsinore
Carlskrona
Ystad
Malmo
Romne
Landskrona
Oxelsund
Oscarshamn
Malmar
Westervik
Gothenburg
Marstrand
Lysekil
Strömstad
Frederikshald
Moss
Christiania
Arendal
Farsund
Flekkefiord
Stavanger
Egersund
Tonsberg
Skien
Drammen
Bergen
Trondheim
Hernösand
Sundsvall
Söderhamn
Gefle
Umea
Stockholm
Norrkoping
Gotland
Wisby
Libau
Windau
Riga
Pernau
Reval
Mariehamn
Aland Is.
Abo
Hangoe
Helsingfors
Kotka
Mystad
Uleaborg
Tornea
Kaina
Soumski Possad
Onega
Viborg
St. Petersburg
Kronstadt
Vitegra
Totma
Vologda
Iaroslav
Nijni Novgorod
Moscow
Tambov
Kharkov
Kiev
Odessa
Nicolaiew
Azov
Kertch
Sebastopol
Sulina
Galatz
Ismail
Belgrade
Constantinople
Gallipoli
Dardanelles
Salonica
Volo
Athens
Zante
Cephalonia
Khios
Smyrna
Syra
Scala Nuova
Rhodes
Sudek
Batoum
Tiflis
Erzeroum
Beirut
Damascus
Trieste
Fiume
Spalato
Lesina
Gravosa
Ragusa
Cattaro
Durazzo
Brindisi
Otranto
Bari
Manfredonia
Ancona
Civita Vecchia
Leghorn
Genoa
Nice
Toulon
Marseilles
Cette
Agde
Narbonne
Port Vendres
Barcelona
Bilbao
Pasages
Santander
Gijon
Ribadeo
Coruña
Vigo
Oporto
Lisboa
Madrid
Tarragona
Valencia
Alicante
Carthagena
Malaga
Cadiz
Gibraltar
Algeciras
Tangier
Almeria
Oran
Beni Saf
Algiers
Bona
Bengazi
Tunis
Susa
Sfax
El Aghouat
Kabes
Djerba
Ghardaia
Tripoli
Malta
Palma
P. Mahon
Bastia
Ajaccio
Cagliari
Palermo
Messina
Catania
Syracuse
Castellamare
Naples
Gaeta
Civita Vecchia
Ancona
Leghorn
Genoa
Nice
Marseilles
Toulon
Lyon
Paris
Metz
Calais
Boulogne
Dieppe
Havre
Cherbourg
Caen
St Malo
Dunkerque
Ostend
Antwerp
Flushing
Rotterdam
Amsterdam
Harlingen
Delfzijl
Emden
Bremerhaven
Brake
Wilhelmshaven
Cuxhaven
Hamburg
Lübeck
Berlin
Munich
Vienna
Prague
Warsaw
Kiel
Copenhagen
Elsinore
Carlskrona
Ystad
Malmo
Romne
Landskrona
Oxelsund
Oscarshamn
Malmar
Westervik
Gothenburg
Marstrand
Lysekil
Strömstad
Frederikshald
Moss
Christiania
Arendal
Farsund
Flekkefiord
Stavanger
Egersund
Tonsberg
Skien
Drammen
Bergen
Trondheim
Hernösand
Sundsvall
Söderhamn
Gefle
Umea
Stockholm
Norrkoping
Gotland
Wisby
Libau
Windau
Riga
Pernau
Reval
Mariehamn
Aland Is.
Abo
Hangoe
Helsingfors
Kotka
Mystad
Uleaborg
Tornea
Kaina
Soumski Possad
Onega
Viborg
St. Petersburg
Kronstadt
Vitegra
Totma
Vologda
Iaroslav
Nijni Novgorod
Moscow
Tambov
Kharkov
Kiev
Odessa
Nicolaiew
Azov
Kertch
Sebastopol
Sulina
Galatz
Ismail
Belgrade
Constantinople
Gallipoli
Dardanelles
Salonica
Volo
Athens
Zante
Cephalonia
Khios
Smyrna
Syra
Scala Nuova
Rhodes
Sudek
Batoum
Tiflis
Erzeroum
Beirut
Damascus

第二圖

石炭及電信圖

100°
90°
80°
70°
60°
50°
40°
30°
20°
10°
60°
50°
40°
英國諸會社ニ屬スル海底線
自他ノ諸會社ニ屬スル海底線
陸線
五百噸以上ノ石炭ヲ貯藏スル場所
少量ノ石炭ヲ貯藏スル場所
NORTH
AMERICA
Winnipeg
P. Arthur
Quebec
Montreal
Toronto
Detroit
Chicago
Omaha
Kansas
St. Louis
Anticosti I.
Gaspe B.
Miramichi
Richibucto
Summerside
Charlotte Tn.
Georgetown
Tilt Cove
Hearts Content
St. Johns
St. Pierre
Placentia
Sydney
Cow Bay
Louisburg
Pictou
Halifax
Parsboro
St. John
Digby
Yarmouth
Portland
Portsmouth
Boston
Newport
New London
New York
Philadelphia
Baltimore
Washington
Norfolk
Wilmington
Charleston
Port Royal
Savannah
Bermuda
Fayal
Terceira
S. Miguel
Funchal
Dublin
Valentia
Brest
Oporto
Madrid
Lisbon
Malaga
Gibraltar
Tangier
Almeria

St. Johns
Paris
Metz
Munich
Vienna
Odessa
Nicolaev
Azov
Brest
Rochelle
Rochefort
Bordeaux
Arcachon
Bayonne
Lyon
Marseilles
Toulon
Nice
Venice
Trieste
Belgrade
Galatz
Sulina
Sebastopol
Kertch
Bilbao
Barcelona
Tarragona
Madrid
Oporto
Valencia
Alicante
Carthagena
Malaga
Cadiz
Gibraltar
Almeria
Lisbon
Fayal
Terceira
S. Miguel
P. Mahon
Palma
Bastia
Ajaccio
Cagliari
Ancona
Civita Vecchia
Manfredonia
Naples
Castellamare
Palermo
Messina
Catania
Syracuse
Malta
Bari
Brindisi
Otranto
Corfu
Cephalonia
Zante
Salonika
Volo
Constantinople
Smyrna
Khios
Syra
Rhodes
Suda
Tiflis
Batoum
Erzeroum
Tangier
Oran
Beni Saf
Algiers
Bona
Tunis
Susa
Sfax
Gabes
Djerba
Tripoli
El Aghouat
Ghardaia
Damascus
Beirut
Jerusalem
Alexandria
P. Said
Suez
Medina
Jidda
Mecca
Sawakin
Musawwa
Asab
Perim I.
Aden
Obokh
Funchal
Teneriffe
Las Palmas
Cruces
Palma
S. Vincent
P. Praya
S. Louis
Dakar
Bathurst
Bissao
Bulama
Bamaku
Konakri
St. Leone
Gd. Bassum
Elmina
Accra
Kotonu
Lagos
Akassa
Brass
Bonny
Fernando Po
Cameroons R.
AFRICA
40°
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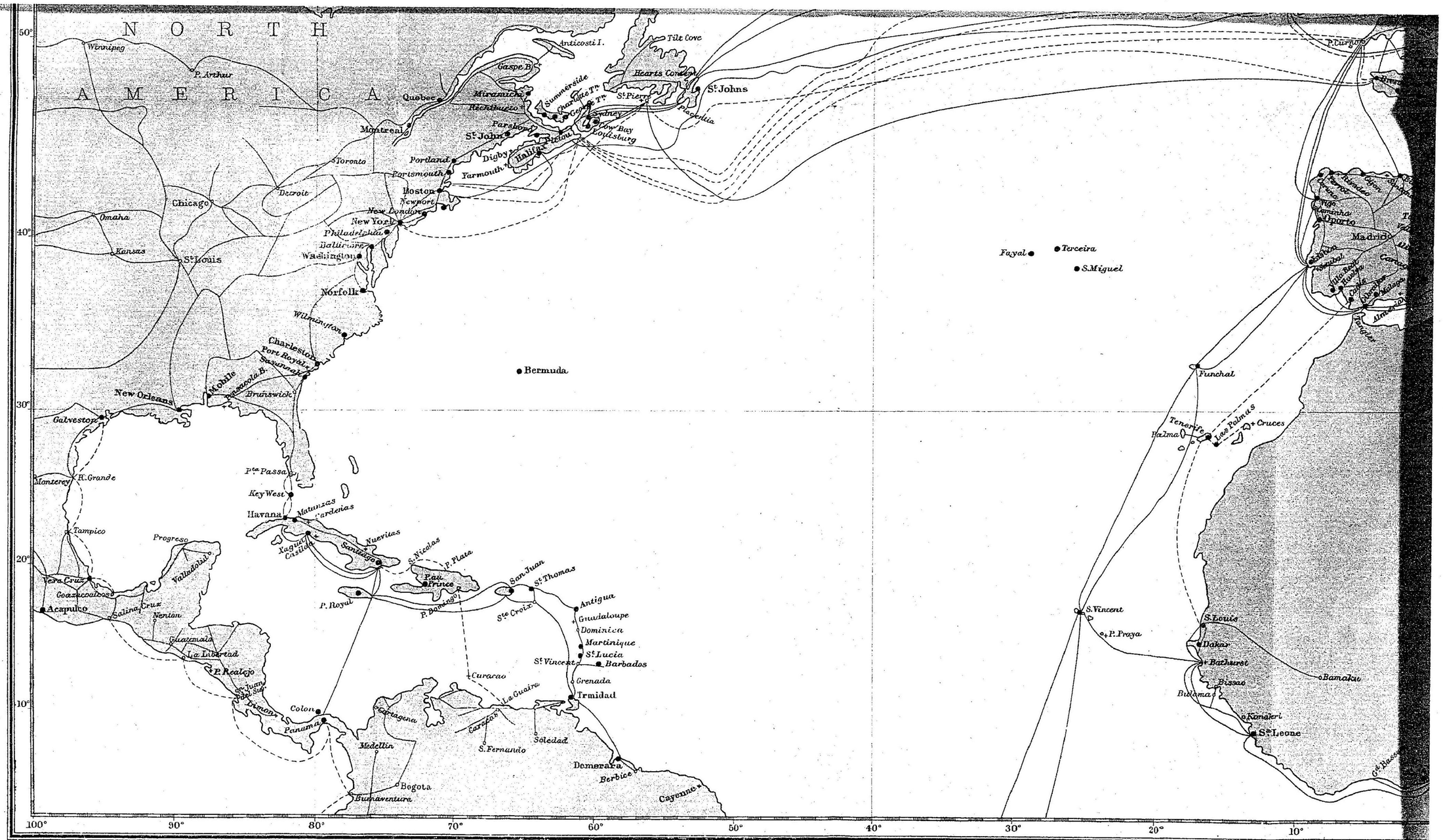
NORTH AMERICA
Winnipeg
P. Arthur
Quebec
Montreal
Toronto
Detroit
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Omaha
Kansas
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Portland
Portsmouth
Boston
Newport
New London
New York
Philadelphia
Baltimore
Washington
Norfolk
Wilmington
Charleston
Port Royal
Savannah
Mobile
Pensacola B.
Brunswick
New Orleans
Galveston
Monterey
R. Grande
Tampico
Progreso
Valladolid
Vera Cruz
Goazacoalcos
Acapulco
Salina Cruz
Nenton
Guatemala
La Libertad
P. Realejo
Colon
Panama
Medellin
Bogota
Buenaventura
Pta. Passa
Key West
Havana
Matanzas
Cardenas
Xagua
Casilda
Santiago
Nuevitas
S. Nicolas
P. Plata
P. au Prince
P. Royal
P. Domingo
San Juan
St. Thomas
Ste. Croix
Antigua
Guadaloupe
Dominica
Martinique
St. Lucia
St. Vincent
Barbados
Grenada
Trmidad
Curacao
La Guaira
Caracas
S. Fernando
Soledad
Demerara
Berbice
Cayenne
Bermuda
Anticosti I.
Gaspe B.
Miramichi
Richibucto
Summerside
Charlotte Tn.
George Tn.
Parsboro
St. John
Digby
Halifax
Pictou
Yarmouth
Sydney
Cow Bay
Louisburg
St. Pierre
Tilt Cove
Hearts Content
St. Johns
Placentia
Fayal
Terceira
S. Miguel
Funchal
Tenerife
Palma
Las Palmas
Cruces
S. Vincent
P. Praya
S. Louis
Dakar
Bathurst
Bissao
Bulama
Konakri
Sa. Leone
Bamaku
Madrid
Oporto
Lisbon
Tangier
Almeria
Gd. Bassa
P. Curno
50°
40°
30°
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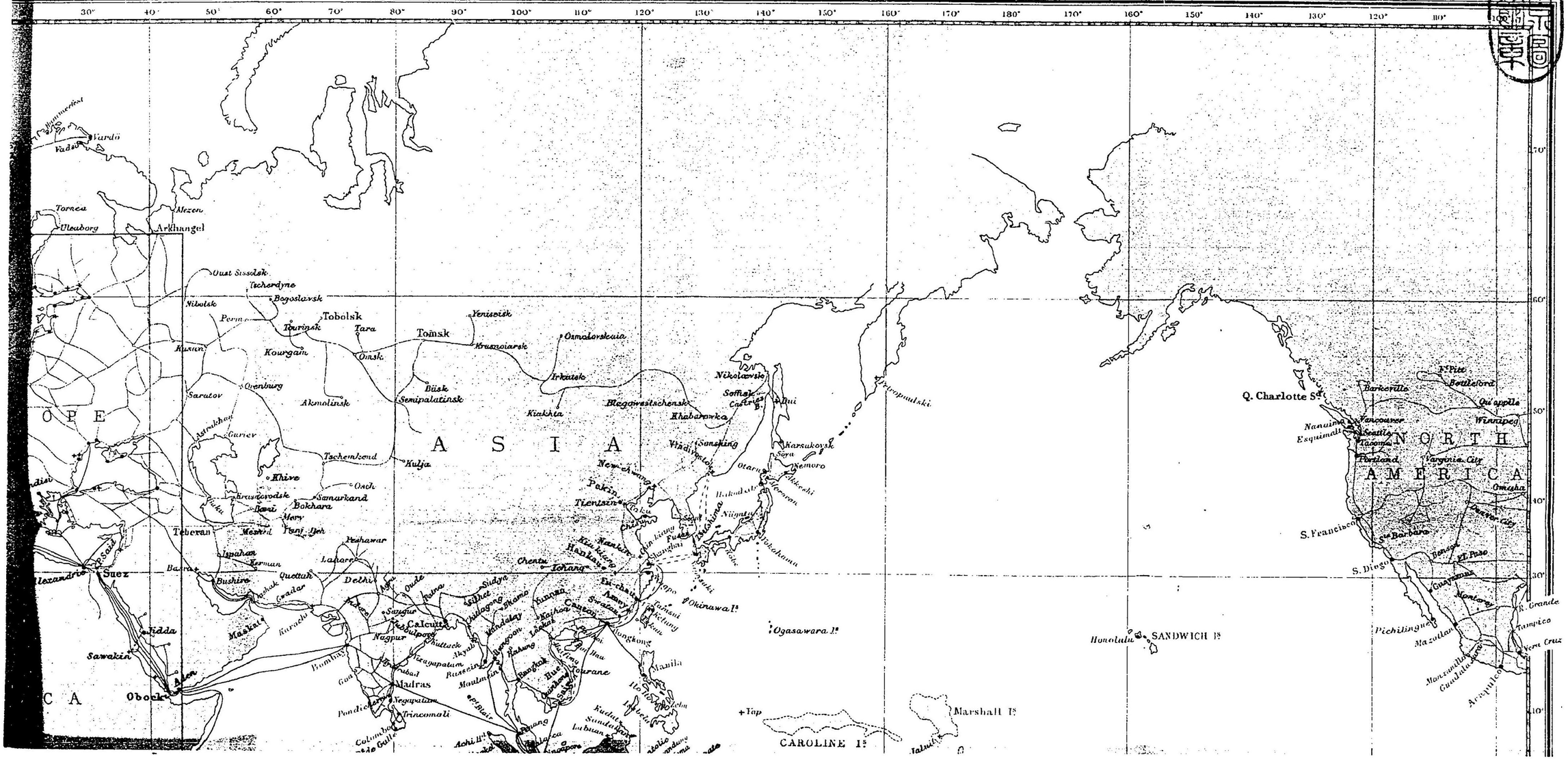
10°
100°
90°
80°
70°
60°
50°
40°
30°
20°
10°

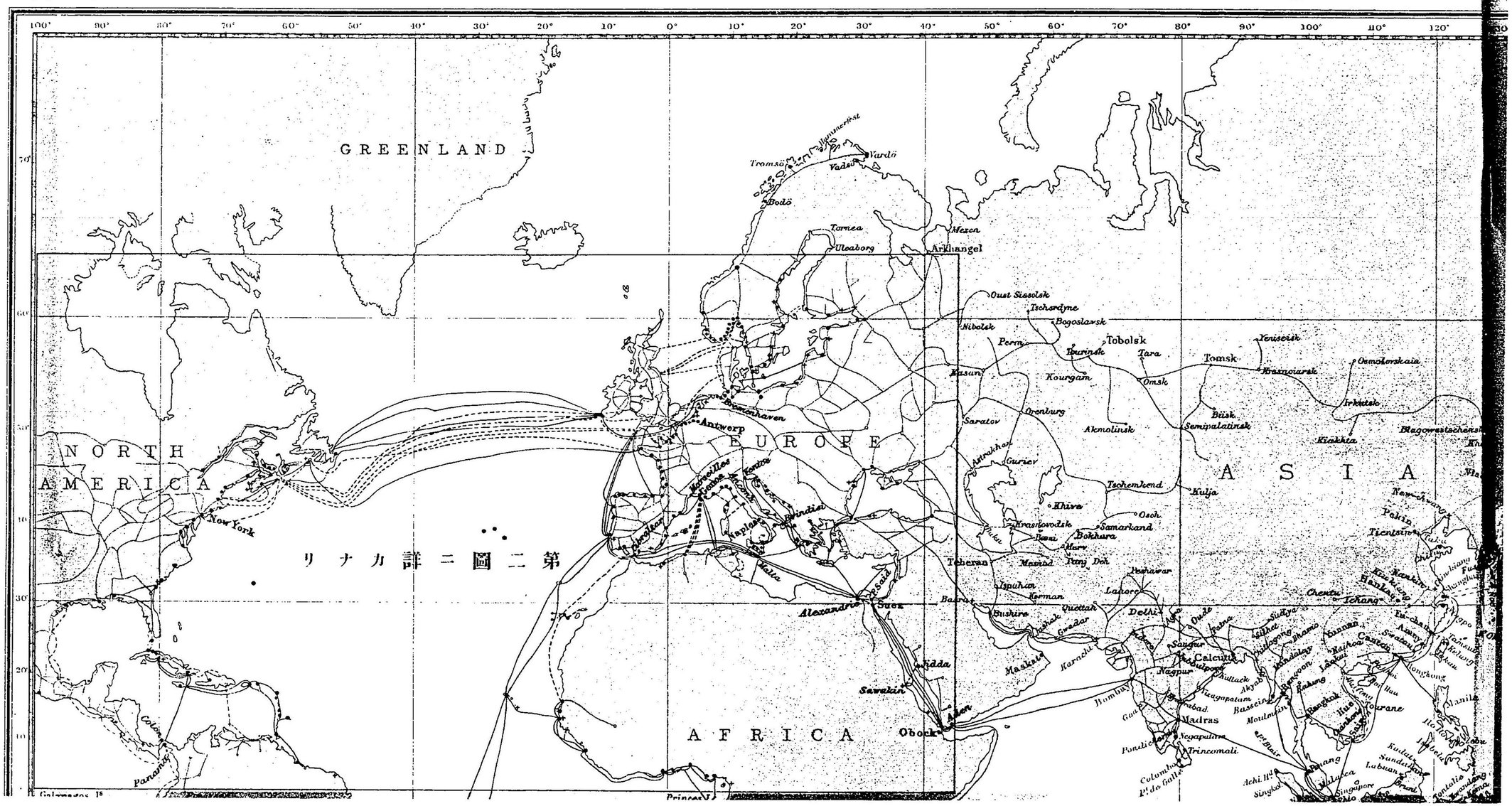
石炭及電信圖

東京帝國大學圖書館藏書



第一圖

石炭及電信圖


GREENLAND
NORTH AMERICA
EUROPE
ASIA
AFRICA
第二圖ニ詳カナリ
Tromsö
Hammerfest
Vardö
Vadsö
Bodö
Tornea
Uleaborg
Archangel
Mezen
Oust Sissolsk
Tschrdyne
Nikolsk
Bogoslavsk
Perm
Tobolsk
Yeniseisk
Ekaterinb
Tara
Tomsk
Krasnoiarsk
Omskorskaia
Kasan
Kourgan
Omsk
Irkutsk
Saratov
Orenburg
Akmolinsk
Biisk
Semipalatinsk
Kiakhta
Astrakhan
Gurief
Tschemkend
Kulja
Khiva
Osch
Krasnovodsk
Samarkand
Bokhara
Teheran
Meshed
Yezd
Peshawar
Ispahan
Lahore
Kerman
Quetta
Delhi
Bushire
Basra
Aleppo
Suez
Alexandria
Malta
Gibraltar
Marseilles
Genoa
Venice
Trieste
Corfu
Copenhagen
Antwerp
Dunkirk
Calcutta
Bombay
Madras
Maskat
Aden
Obock
Zanzibar
Mozambique
Durban
Cape Town
Port Elizabeth
East London
Natal
Delagoa Bay
Beira
Mauritius
Réunion
Colombo
Pt de Galle
Trincomali
Pondicherry
Negapatam
Moulmein
Bangkok
Singapore
Malacca
Batavia
Sandakan
Labuan
Brunei
Hongkong
Amoy
Foochow
Swatow
Shanghai
Chefoo
Tientsin
Peking
Newchwang
Hankow
Ichang
Chentu
Manila
Yokohama
Nagasaki
Fusan
Gensan
Vladivostock
Petropaulovsk
Sitka
Victoria
Port Simpson
Esquimalt
Port Townsend
San Francisco
Santa Barbara
Mazatlan
Manzanillo
Acapulco
Panama
Galapagos
Callao
Valparaiso
Coronel
Montevideo
Buenos Ayres
Rio de Janeiro
Pernambuco
Bahia
Para
Barbados
Jamaica
Haiti
Porto Rico
Trinidad
Curaçao
Bermudas
Halifax
St. John's
Cape Race
Cape Breton
Sydney
Louisburg
Canso
Rimouski
Quebec
Montreal
Ottawa
Toronto
Kingston
Port Stanley
Detroit
Chicago
Milwaukee
Duluth
Winnipeg
Port Arthur
Moose Jaw
Regina
Calgary
Edmonton
Prince Albert
Battleford
Prince Rupert
Victoria
Vancouver
New York
Boston
Portland
Buffalo
Cleveland
Pittsburg
Philadelphia
Baltimore
Washington
Norfolk
Charleston
Savannah
Jacksonville
Key West
Pensacola
Mobile
New Orleans
Galveston
Port Arthur
Brownsville
Tampico
Vera Cruz
Progreso
Havana
Nassau
Turks Island
Kingston
Port Antonio
Port Limon
Colon
Panama

ASIA

NORTH AMERICA

AUSTRARIA

CAROLINE Is

SANDWICH Is

Marshall Is

Gilbert Is

New Hebrides

New Caledonia

Fiji Is

Samoa Is

Tonga Is

Paumotu Archipelago

Caroline Is

Marquesas Is

Tahiti

Chatham Is

Ogasawara Is

Okinawa Is

Seychelle Is

Mauritius

Reunion

Natal

Alexandria

Suez

Aden

Obock

Bombay

Madras

Calcutta

Colombo

Singapore

Batavia

Manila

Hongkong

Shanghai

Yokohama

Hakodate

Vladivostock

Sansking

Karsakovsk

Pekin

Tientsin

Honolulu

S. Francisco

S. Diego

Portland

Seattle

Esquimalt

Nanaimo

Acapulco

Vera Cruz

Tampico

R. Grande

Manzanillo

Guadalajara

Mazatlan

Pichilinguey

Perth

Adelaide

Melbourne

Launceston

Hobart

Brisbane

Sydney

Newcastle

Wellington

Auckland

Nelson

Lyttelton

Dunedin

Otago Hr.

Bay of Islands

Wanganui

Plenty B.

Cooktown

Townsville

Mackay

Rockhampton

Roebuck Bay

Derby

Fremantle

Bunbury

K. George Sd.

Torres Str.

Banda

Amboina

Ternate

Timor

Celebes

Java

Sumatra

Borneo

Penang

Singapore

Malacca

Rangoon

Bangkok

Saigon

Hué

Amoy

Foochow

Ningpo

Chefoo

Newchwang

Hankow

Nankin

Chinkiang

Kiukiang

Hiogo

Nagasaki

Niigata

Aomori

Hakodate

Otaru

Hakodate

Nemoro

Soya

Hakodate

Omaha

Denver City

Monterey

Chihuahua

El Paso

Santa Barbara

Carson

Virginia City

Portland

Esquimalt

Nanaimo

Seattle

Wrangel

Sitka

Kadiak

Unalaska

Behring Str.

Behring Sea

Aleutian Is

Kamtschatka

Okhotsk Sea

Japan Sea

Yellow Sea

China Sea

Java Sea

Timor Sea

Arafura Sea

Coral Sea

Tasman Sea

Great Australian Bight

Indian Ocean

Pacific Ocean

Mozambique

Zanzibar

Lovanda

Natal

Pretoria

Port Elizabeth

Capetown

Walfish B.

Agulhas C.

Nossi Ve

Mayotte

Nosi Be

Diego Suarez

Mauritius

St. Mary

Madagascar

Seychelle Is

Aden

Obock

Suez

Alexandria

Bushire

Bussorah

Muscat

Karachi

Quetta

Peshawar

Lahore

Delhi

Agra

Oude

Jeypore

Nagpur

Calcutta

Bombay

Madras

Pondicherry

Negapatam

Trincomali

Colombo

Pt de Galle

Goa

Mangalore

Seringapatam

Bangalore

Hyderabad

Bussein

Moulmein

Rangoon

Bangkok

Saigon

Hué

Tourane

Malacca

Penang

Singapore

Rhio

Sambas

Pontianak

Sarawak

Labuan

Sandakan

Kudat

Palawan

Manila

Hongkong

Amoy

Foochow

Ningpo

Chefoo

Newchwang

Pekin

Tientsin

Chefoo

Nankin

Hankow

Kiukiang

Chinkiang

Shanghai

Fusan

Nagasaki

Hiogo

Yokohama

Niigata

Hakodate

Otaru

Nemoro

Soya

Karsakovsk

Vladivostock

Sansking

Kulja

Tschemkend

Khiva

Osch

Samarkand

Bokhara

Merv

Meshed

Teheran

Ispahan

Kerman

Yezd

Kashan

Tabreez

Erivan

Tiflis

Baku

Astrakhan

Caviar

Orenburg

Orsk

Troitsk

Tobolsk

Tomsk

Barnaul

Irkutsk

Yakutsk

Okhotsk

Petropawlowsk

Kamtschatka

Behring Str.

Behring Sea

Aleutian Is

Unalaska

Kadiak

Sitka

Wrangel

Nanaimo

Esquimalt

Seattle

Portland

Virginia City

Omaha

Denver City

Monterey

Santa Barbara

S. Francisco

S. Diego

Chihuahua

El Paso

Pichilinguey

Perth

Mazatlan

Manzanillo

Guadalajara

Acapulco

Vera Cruz

Tampico

R. Grande

Monterey

Carson

Virginia City

Portland

Seattle

Esquimalt

Nanaimo

Wrangel

Sitka

Kadiak

Unalaska

Behring Str.

Behring Sea

Aleutian Is

Kamtschatka

Okhotsk Sea

Japan Sea

Yellow Sea

China Sea

Java Sea

Timor Sea

Arafura Sea

Coral Sea

Tasman Sea

Great Australian Bight

Indian Ocean

Pacific Ocean

英國諸屬ニ社會諸國ヘ

白他ノ諸社會諸屬ニ海底線

陸線

所場ルス藏貯ノ炭石ノ上良噸百五

所場ルス藏貯ノ炭石ノ量少

10° 30° 40° 50° 60° 70° 80° 90° 100° 110° 120° 130° 140° 150° 160° 170° 180° 170° 160° 150° 140° 130° 120° 110° 100°

40° 30° 20° 10° 0° 10° 20° 30° 40° 50° 60°

第二圖ニ詳カナリ

NORTH AMERICA

SOUTH AMERICA

EUROPE

AFRICA

ASIA

AUSTRA

New York
Colon
Panama
Galapagos Is.
Papayan
Quito
St. Elena
Guayaquil
Paita
Chimbote
Callao
Para
Maranham
Ceara
Natal
Pernambuco
Bahia
Diamantina
Rio Janeiro
Santos
St. Catharina
Rio Grande do Sul
Montevideo
Maldonado
Mar del Plata
Bahia Blanca
Carmen
Patagonia
Rosario
Asuncion
Corrientes
Buenos Aires
Mendoza
Chuy
Coronel
Lota
Valparaiso
Coquimbo
Pena Blanca
P. Caldera
Pande Azucar
Antofagasta
P. Iquique
Mollendo
Arica
La Paz
Oruro
Chiquisaca (Sucre)
Guarapuaca
Cruz del Eje
Catamarca
Tucuman
Jujuy
Salta
Oran
Cape Horn
Stanley H.r
Ascension I.
St. Helena
Tristan da Cunha
Princes I.
St. Thomé
Gaboon
Banana Creek
St. Paul de Loanda
Benguela
Mossamedes
Zanzibar
Mozambique
Seychelle Is.
Maké
Mayotta
Nosi Be
Diego Suarez
Nossi Ve
Mauritius
P. Louis
Reunion
St. Mary
Mozanga
Tamatave
Majunga
Maroantsetra
P. St. Vincent
Delagoa B.
Pretoria
Kimberley
P. Nolloth
Calvinia
Cape Town
Simons B.
Bloemfontein
P. Natal
Richmond
P. Elizabeth
Algoa B.
Port Louis
Gibraltar
Marseilles
Genoa
Venice
Trieste
Naples
Malta
Brindisi
Alexandria
Suez
Jidda
Sawakin
Aden
Obock
Astrakhan
Gurief
Tschemkend
Kulja
Khiva
Orsk
Krasnovodsk
Samarkand
Bokhara
Merv
Teheran
Meshed
Pang Deh
Ispahan
Kerman
Bushire
Basra
Peshawar
Lahore
Delhi
Agra
Oude
Jeypore
Sangur
Calcutta
Nagpur
Cuttack
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Karachi
Maskat
Bombay
Goa
Pondicherry
Madras
Negapatam
Trincomali
Colombo
Pt. de Galle
Moulmein
Bassein
Rangoon
Prome
Bangkok
Hue
Saigon
Tourane
Singapore
Malacca
Achi H.d
Singkel
Tapanuli
Padang
Benkulen
Palembang
Telok Betung
Batavia
Tyliatjap
Samarang
Soerabaya
Bandjermassin
Macassar
Celebes
Timor
Sandalwood I.
Labuan
Kudat
Sandakan
Brunei
Sarawak
Pontianak
Banka
Billiton
Borneo
Java
Sumatra
Celebes
Batjan I.
Ternate
Gilolo
Amboyna
Banda
Timor
Roebuck Bay
Derby
Broome
Dampier
Cossack
Onslow
Exmouth
Bunbury
Fremantle
Dongara
K. George Sd.
Vladivostock
Newchwang
Pekin
Tientsin
Chefoo
Kiaochau
Chinkiang
Hankow
Kiukiang
Nanking
Wuhu
Chentu
Ichang
Fu-chau
Amoy
Swatow
Hoihow
Hongkong
Macao
Canton
Foochow
Wenchow
Ningpo
Shanghai
Tsingtau
Tsushi
Gensan
Fusan
Nagasaki
Hakodate
Manila
Iloilo
Cebu
Mindoro
Tawitawi
Sandakan
Labuan
Kudat
Brunei
Sarawak
Pontianak
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Java
Sumatra
Celebes
Batjan I.
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Banda
Timor
Roebuck Bay
Derby
Broome
Dampier
Cossack
Onslow
Exmouth
Bunbury
Fremantle
Dongara
K. George Sd.

英國諸社會ニ屬スル海底線
自他ノ諸社會ニ屬スル海底線
陸線
所場ルス藏貯ノ炭石ノ上貝噸百五
所場ルス藏貯ノ炭石ノ量少

10° 30° 20° 10° 0° 10° 20° 30° 40° 50° 60° 70° 80° 90° 100° 110° 120°

郵船線路圖

加奈佗太平洋瀛船會社線

太平洋郵船會社線

東西瀛船會社線

日本ヨリ東走シテ米國ニ至ル重ナル汽船

一 太平洋郵船線 Pacific Mail S.S.Com

二 東西汽船會社線 Occidental and Orient

三 加奈佗太平洋汽船會社線 Canadian Pacific S.S.

日本ヨリ西走シテ歐洲ニ至ル重ナル汽船

一 北亘憂ロイド線 North Gorman Lloyd

二 佛蘭西郵船線 Messageries Maritime

三 彼阿汽船會社線 Peninsular and Orient

東京圖書館藏書

郵船線路圖

加奈佗太平洋瀛船會社線

太平洋郵船會社線

東西瀛船會社線

日本ヨリ東走シテ米國ニ至ル重ナル汽船線

一　太平洋郵船線　Pacific Mail S.S.Company

二　東西汽船會社線　Occidental and Oriental S.S.Company

三　加奈佗太平洋汽船會社線　Canadian Pacific S.S.Company

日本ヨリ西走シテ歐洲ニ至ル重ナル汽船線

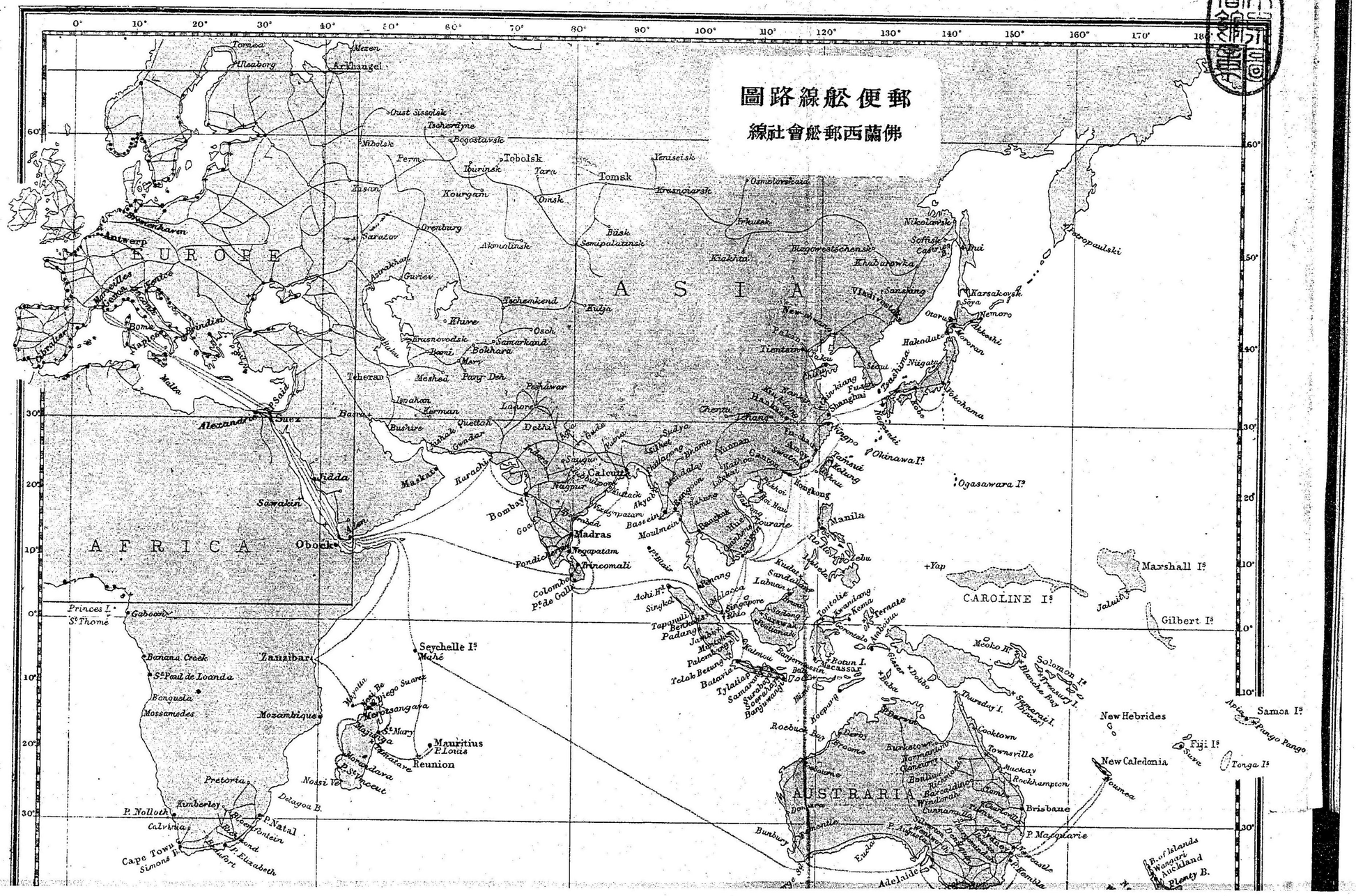
一　北耳曼ロイド線　North German Lloyd's

二　佛蘭西郵船線　Messageries Maritimes

三　彼阿汽船會社線　Peninsular and Oriental S.S.Company

郵便船線路圖

佛蘭西郵船會社線



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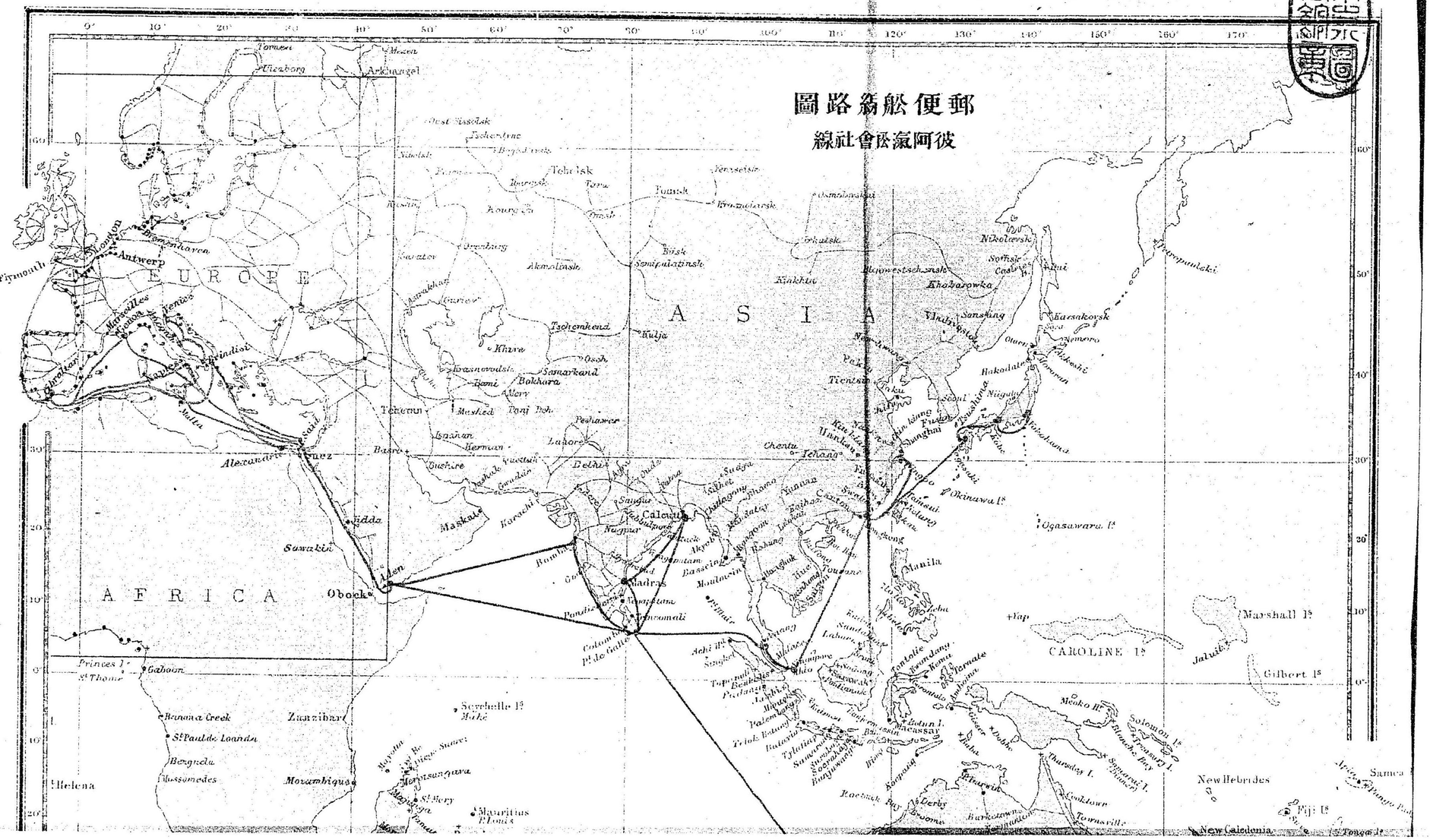
ASIA
AFRICA
AUSTRARIA
Marseilles
Genoa
Rome
Naples
Brindisi
Malta
Gibraltar
Alexandria
P. Said
Suez
Jidda
Sawakin
Aden
Obock
Maskat
Teheran
Ispahan
Kerman
Bushire
Basra
Meshed
Bokhara
Samarkand
Krasnovodsk
Khiva
Osch
Kulja
Peshawar
Lahore
Delhi
Quettah
Karachi
Bombay
Goa
Nagpur
Calcutta
Madras
Negapatam
Pondicherry
Trincomali
Colombo
Pt. de Galle
Akyab
Bassein
Rangoon
Moulmein
Bangkok
Hué
Saigon
Canton
Hongkong
Amoy
Ningpo
Shanghai
Hankau
Tientsin
Pekin
Kiakhta
Khabarowka
Vladivostok
Nagasaki
Kobe
Yokohama
Hakodate
Niigata
Nemoro
Okinawa Is.
Ogasawara Is.
Manila
Zebu
Yap
Marshall Is.
CAROLINE Is.
Jaluit
Gilbert Is.
Penang
Malacca
Singapore
Achi Hd.
Padang
Palembang
Batavia
Samarang
Surabaya
Banjermassin
Macassar
Labuan
Sandakan
Ternate
Amboina
Mioko Hr.
Solomon Is.
Thursday I.
New Hebrides
New Caledonia
Noumea
Samoa Is.
Apia
Pango Pango
Fiji Is.
Suva
Tonga Is.
Princes I.
St. Thomé
Gaboon
Banana Creek
St. Paul de Loanda
Benguela
Mossamedes
Zanzibar
Mozambique
Seychelle Is.
Mahé
Mayotta
Nosi Be
Diego Suarez
St. Mary
Tamatave
Mauritius
P. Louis
Reunion
Nossi Vé
Pretoria
Kimberley
P. Nolloth
P. Natal
Delagoa B.
Cape Town
Simons B.
P. Elizabeth
Roebuck Bay
Derby
Broome
Cooktown
Townsville
Burketown
Normanton
Rockhampton
Brisbane
P. Macquarie
Bunbury
Fremantle
K. George Sd.
Eucla
Adelaide
P. Augusta
Sydney
Newcastle
Melbourne
Ballarat
Launceston
Hobart
Auckland
Plenty B.
Wellington
Nelson
Westport
P. Lyttelton
Oamaru
Otago Hr.
Bluff
Chatham Is.
0° 10° 20° 30° 40° 50° 60° 70° 80° 90° 100° 110° 120° 130° 140° 150° 160° 180°

圖路爲船便郵

線社會氏瀛阿彼



郵便船線路圖
彼阿滊船會社線
EUROPE
ASIA
AFRICA
Plymouth
Southampton
Antwerp
Bremerhaven
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郵便船線路圖

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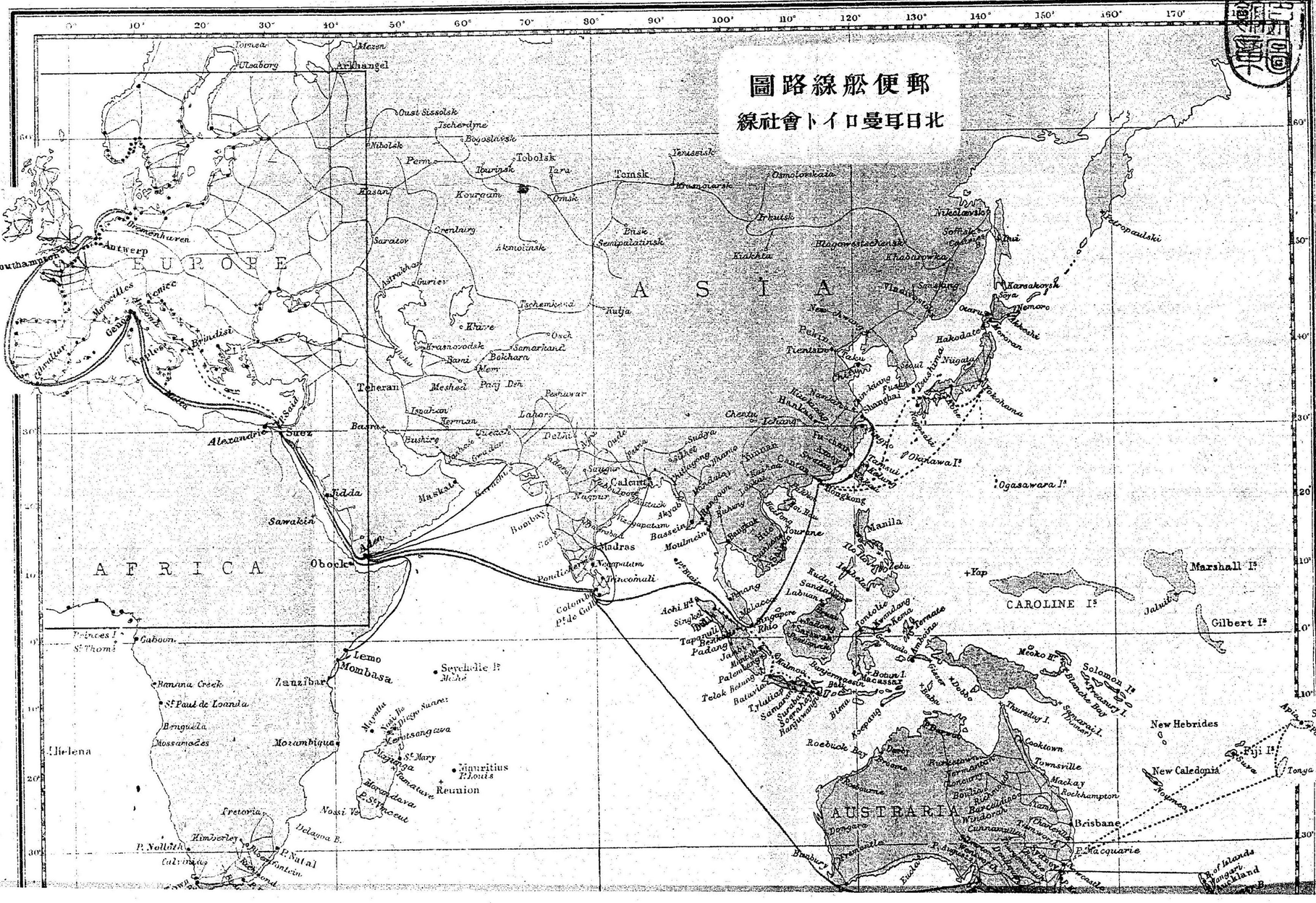

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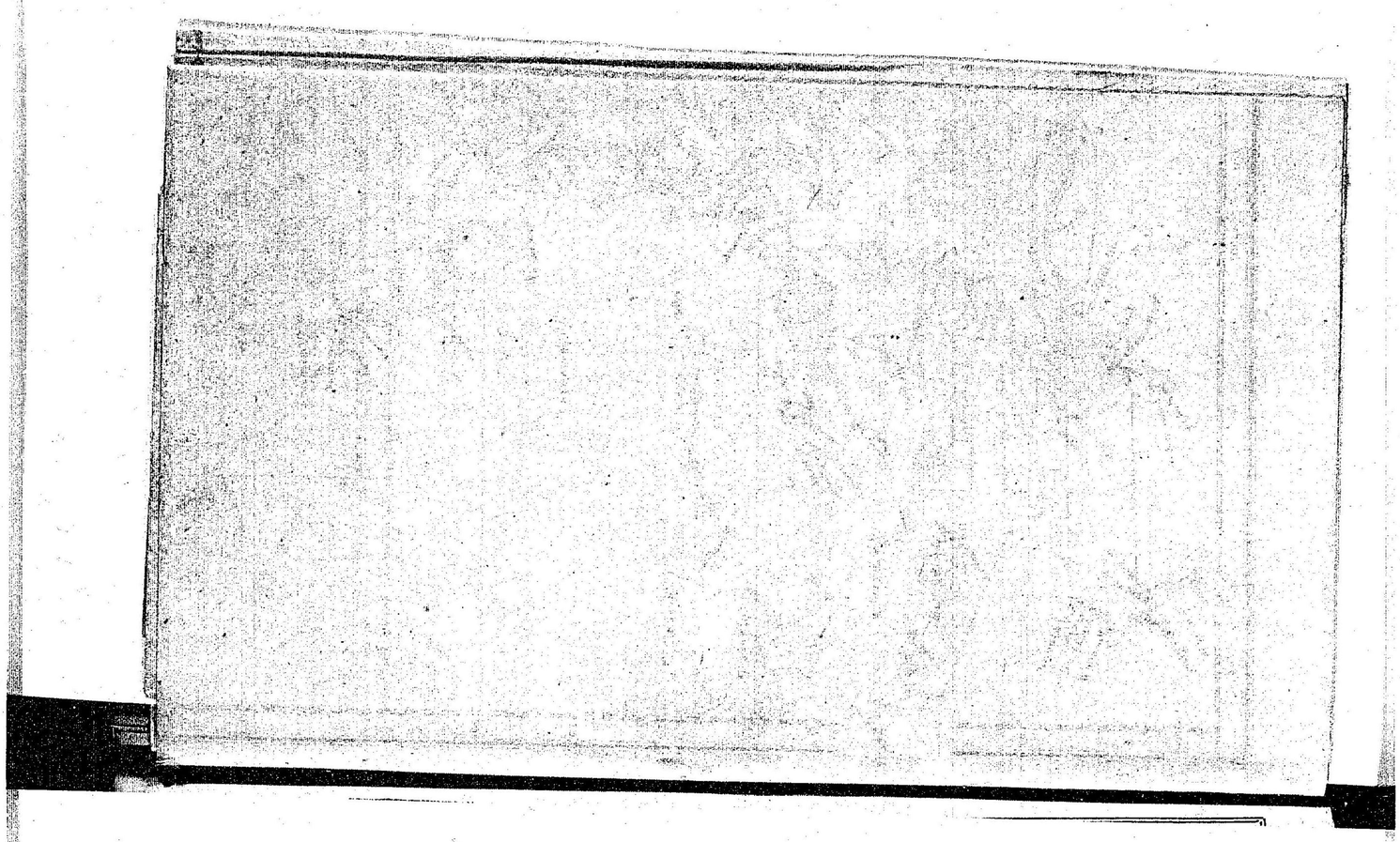

FORMULÆ

OF

Navigation, Nautical Astronomy, &c.

海員必携附錄　實測算式

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TRIGONOMETRY.

Useful Formulæ.

$\sin^2 A + \cos^2 A = 1$ (1) $\quad \tan A = \frac{\sin A}{\cos A}$ (2)

$\sin (A \pm B) = \sin A \cos B \pm \cos A \sin B$ (3)

$\cos (A \mp B) = \cos A \cos B \mp \sin A \sin B$ (4)

$\sin (A + B) + \sin (A - B) = 2 \sin A \cos B$ (5)

$\sin (A + B) - \sin (A - B) = 2 \cos A \sin B$ (6)

$\cos (A + B) + \cos (A - B) = 2 \cos A \cos B$ (7)

$\cos (A + B) - \cos (A - B) = -2 \sin A \sin B$ (8)

$\sin (A + B) \sin (A - B) = \sin^2 A - \sin^2 B = \cos^2 B - \cos^2 A$ (9)

$\cos (A + B) \cos (A - B) = \cos^2 A - \sin^2 B = \cos^2 B - \sin^2 A$ (10)

$\sin A \pm \sin B = 2 \sin \frac{1}{2} (A \pm B) \cos \frac{1}{2} (A \mp B)$ (11)

$\cos A + \cos B = 2 \cos \frac{1}{2} (A + B) \cos \frac{1}{2} (A - B)$ (12)

$\cos A - \cos B = -2 \sin \frac{1}{2} (A + B) \sin \frac{1}{2} (A - B)$ (13)

$\sin 2A = 2 \sin A \cos A$ (14); $\cos 2A = 1 - 2 \sin^2 A = 2 \cos^2 A - 1$ (15)

$\frac{1 - \cos A}{2}$, or $\frac{\text{vers } A}{2}$, or haversine $A = \sin^2 \frac{A}{2}$ (16); chord $A = 2 \sin \frac{A}{2}$ (17)

$\tan (A \pm B) = \frac{\tan A \pm \tan B}{1 \mp \tan A \tan B}$ (18); $\quad \tan A \pm \tan B = \frac{\sin (A \pm B)}{\cos A \cos B}$ (19)

$\tan \frac{A}{2} = \sqrt{\frac{1 - \cos A}{1 + \cos A}} = \frac{1 - \cos A}{\sin A}$ (20); $\quad \cot A \pm \cot B = \frac{\sin (A \pm B)}{\sin A \sin B}$ (21)

$\frac{\sin A + \sin B}{\sin A - \sin B} = \frac{\tan \frac{1}{2} (A + B)}{\tan \frac{1}{2} (A - B)}$ (22)

$\sin a = a - \frac{a^3}{1.2.3.} + \frac{a^5}{1.2.3.4.5.} - \&c.$ (23)

$\cos a = 1 - \frac{a^2}{1.2.} + \frac{a^4}{1.2.3.4.} - \&c.$ (24)

$\text{Arc } a = \sin a + \frac{\sin^3 a}{2.3.} + \frac{3 \sin^5 a}{2.4.5.} + \frac{3.5 \sin^7 a}{2.4.6.7.} + \&c.$ (25)

$= \tan a - \frac{1}{3} \tan^3 a + \frac{1}{5} \tan^5 a - \frac{1}{7} \tan^7 a + \&c.$ (26)

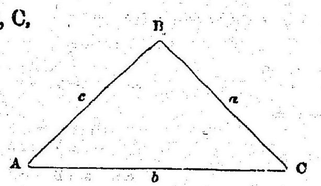
Signs of the Trigonometrical Functions.

Quadrants.	sin.	cos.	tan.	cot.	sec.	cosec.
1st	+	+	+	+	+	+
2nd	+	−	−	−	−	+
3rd	−	−	+	+	−	−
4th	−	+	−	−	+	−

Plane Trigonometry.

Solution of Triangles.

If A B C be a plane triangle, A, B, C, the angles, a, b, c the sides,



$\cos A = \frac{b^2 + c^2 - a^2}{2bc}$ (1)

$\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}$ (2)

$\sin^2 \frac{A}{2} = \frac{(S-b)(S-c)}{bc}$ } where $S = \frac{a+b+c}{2}$ (3)

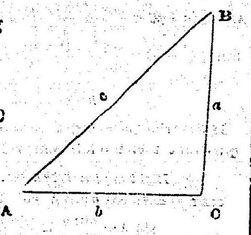
$\cos^2 \frac{A}{2} = \frac{S.(S-a)}{bc}$ } (4)

$a = \frac{\sqrt{4bc \sin^2 \frac{A}{2}}}{\sin \phi}$, where $\tan \phi = \frac{\sqrt{4bc \sin^2 \frac{A}{2}}}{b-c}$ (5)

$\frac{a+b}{a-b} = \frac{\tan \frac{1}{2} (A + B)}{\tan \frac{1}{2} (A - B)}$ (6)

$\text{Area} = \frac{a^2 \sin B \sin C}{2 \sin (B+C)} = \frac{bc}{2} \sin A = \sqrt{S.(S-a)(S-b)(S-c)}$ (7)

When the triangle is right-angled, C being the right angle.



$c^2 = a^2 + b^2$ (8)

$\sin A = \frac{a}{c}$ (9) $\quad \cos A = \frac{b}{c}$ (10) $\quad \tan A = \frac{a}{b}$ (11)

$= \frac{\text{perp}^{\text{r}}}{\text{hyp}^{\text{se}}}$ $\quad = \frac{\text{base}}{\text{hyp}^{\text{se}}}$ $\quad = \frac{\text{perp}^{\text{r}}}{\text{base}}$

* Tables of Log. $\sin^2 \frac{A}{2}$ to arguments A, are given in Inman's collection of Nautical Tables, under the title of "Log. Haversines," (Table 4); and in Raper's Tables as "Log. Sine Square," (Table 69). Partial tables of Log. $\sin^2 \frac{A}{2}$, for the special purpose of facilitating the determination of the time, are also given under various titles in other collections of Nautical and Mathematical Tables. If this Table is not employed, or not at hand for use, the value of $\frac{A}{2}$, and thence that of A, must be found from the ordinary Table of Log sines, since $\frac{1}{2}$ log $\sin^2 \frac{A}{2}$ = log sin $\frac{A}{2}$, which gives us $\frac{A}{2}$, and hence A, the required arc or angle. Conversely when log $\sin^2 \frac{A}{2}$ is required, log sin $\frac{A}{2}$ must be doubled or twice written down.

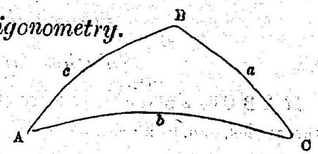
No. II. 2

Spherical Trigonometry.

If A B C be a spherical triangle.

A, B, C the angles; a, b, c the sides,

$b' = 90° - b$ and $c' = 90° - c$



$$\cos A = \frac{\cos a - \cos b \cos c}{\sin b \sin c} = \frac{\cos a - \sin b' \sin c'}{\cos b' \cos c'} \quad (1)$$

$$\frac{\sin A}{\sin a} = \frac{\sin B}{\sin b} = \frac{\sin C}{\sin c} \quad (2)$$

$$\cot A \sin B = \cot a \sin c - \cos B \cos c \quad (3)$$

$$\sin^2 \frac{A}{2} = \frac{\sin (S-b) \sin (S-c)}{\sin b \sin c} \quad (4)$$

$$\cos^2 \frac{A}{2} = \frac{\sin S. \sin (S-a)}{\sin b \sin c} \quad (5)$$

where $S = \frac{a+b+c}{2}$

$$\sin^2 \frac{A}{2} = \frac{\sin (S-b') \sin (S-c')}{\cos b' \cos c'} \quad (6)$$

$$\cos^2 \frac{A}{2} = \frac{\cos S. \cos (S-a)}{\cos b' \cos c'} \quad (7)$$

where $S = \frac{a+b'+c'}{2}$

Vers. a = vers. $(b-c) + N$

where $N = 2 \sin b \sin c \sin^2 \frac{A}{2}$ (8)

$$\sin^2 \frac{a}{2} = \sin (\tfrac{1}{2}(b+c)+\phi) \sin (\tfrac{1}{2}(b+c)-\phi)$$

where $\sin \phi = \sqrt{\sin b \sin c \cos^2 \frac{A}{2}}$ (9)

Vers. a = vers. $(b'-c') + N$

where $N = 2 \cos b' \cos c' \sin^2 \frac{A}{2}$ (10)

$$\sin^2 \frac{a}{2} = \cos (\tfrac{1}{2}(b'+c')+\phi) \cos (\tfrac{1}{2}(b'+c')-\phi)$$

where $\sin \phi = \sqrt{\cos b' \cos c' \cos^2 \frac{A}{2}}$ (11)

$$\tan \tfrac{1}{2}(a+b) = \frac{\cos \tfrac{1}{2}(A-B)}{\cos \tfrac{1}{2}(A+B)} \tan \frac{c}{2}$$

$$\tan \tfrac{1}{2}(a-b) = \frac{\sin \tfrac{1}{2}(A-B)}{\sin \tfrac{1}{2}(A+B)} \tan \frac{c}{2} \quad (12)$$

$$\tan \tfrac{1}{2}(A+B) = \frac{\cos \tfrac{1}{2}(a-b)}{\cos \tfrac{1}{2}(a+b)} \cot \frac{C}{2}$$

$$\tan \tfrac{1}{2}(A-B) = \frac{\sin \tfrac{1}{2}(a-b)}{\sin \tfrac{1}{2}(a+b)} \cot \frac{C}{2} \quad (13)$$

Right-angled and Quadrantal Spherical Triangles.

If the triangle be right-angled, C being the right angle; or quadrantal, c being the quadrant, then the following relations hold good:—

Right angled Triangles.

$$\cos c = \cos a \cos b \cot A \cot B \quad (14)$$

$$\sin A = \frac{\sin a}{\sin c} = \frac{\cos B}{\cos b} \quad (15)$$

$$\sin B = \frac{\sin b}{\sin c} = \frac{\cos A}{\cos a} \quad (16)$$

$$\cos A = \frac{\tan b}{\tan c}; \ \cos B = \frac{\tan a}{\tan c} \quad (17)$$

$$\tan A = \frac{\tan a}{\sin b}; \ \tan B = \frac{\tan b}{\sin a} \quad (18)$$

Quadrantal Triangles.

$$\cos C = -\cos A \cot B = -\cot a \cot b \quad (19)$$

$$\sin a = \frac{\sin A}{\sin C} = \frac{\cos b}{\cos B} \quad (20)$$

$$\sin b = \frac{\sin B}{\sin C} = \frac{\cos a}{\cos A} \quad (21)$$

$$\cos a = -\frac{\tan B}{\tan C}; \ \cos b = -\frac{\tan A}{\tan C} \quad (22)$$

$$\tan a = \frac{\tan A}{\sin B}; \ \tan b = \frac{\tan B}{\sin A} \quad (23)$$

NOTE.—The quadrantal formulæ can be derived from the right-angled ones, by changing sides for angles (small letters into large) and angles for sides (large letters into small), and by marking them as negative when the function in which the left-hand member of the equation is expressed is a cosine.

No. III. 1

NAVIGATION.

1. In correcting "compass courses," *easterly* variation and *easterly* deviation are to be allowed to the *right*; *westerly* variation and *westerly* deviation to the *left*.

In converting true courses into compass courses, the corrections for variation and deviation are to be applied conversely.

In correcting courses for leeway, the correction is to be allowed to the *right* when the ship is on the *port tack*; and to the *left* when on the *starboard tack*.

Formulæ for the Sailings.

2. Sin Course = $\frac{\text{Dep.}}{\text{Dist.}}$ (*a*) Cos Course = $\frac{\text{True Diff. Lat.}}{\text{Dist.}}$ (*b*)

Cos Mid. Lat. = $\frac{\text{Dep.}}{\text{Diff. Long.}}$ (*c*)

Tan Course = $\frac{\text{Dep.}}{\text{True diff. Lat.}}$ (*d*) Tan Course = $\frac{\text{Diff. Long.}}{\text{Mer. Diff. Lat.}}$ (*e*)

Formulæ (*a*), (*b*), (*c*), and (*d*) are used in "mid. lat. sailing;" and formulæ (*b*) and (*e*) when the computations are made by the method of "meridional parts." Cases of parallel sailing are solved by the formula,

Cos Lat. = $\frac{\text{Dist.}}{\text{Diff. Long.}}$ (*f*)

Note.—In the practical solution of these formulæ, the "Dist.," "Diff. Lat.," "Diff. Long." &c., should be expressed in minutes of arc, or nautical miles. The reductions may be made by the use of logarithms, or more readily by the aid of the "Traverse Table."

The Traverse Table contains the "Dist.," "Diff. Lat.," and "Dep." corresponding to the hypothenuse base and perpendicular of a right-angled triangle, for all values of the course or base angle: and since all the relations between any two quantities may be expressed as functions of some angle, in terms of the sine, cosine, or tangent, it may be used, in fact, as a general proportion table.

NAUTICAL ASTRONOMY.

Miscellaneous Memoranda.

3. Greenwich Date (G. D.) = Local Time (L. T.) at any moment ± Longitude in time if $\begin{Bmatrix} \text{West} \\ \text{East} \end{Bmatrix}$. The date being expressed as well as the time.

The Greenwich date is usually given in mean time, but it may be expressed in apparent, or sidereal, time when required.

4. In reducing quantities from the *Nautical Almanac*, find G. D. for required time. Take from *Nautical Almanac* the quantities corresponding to the epoch in the Tables, which next precedes the date, and find the proportional part of the change due to the interval between the epoch and the date; adding when the quantities are increasing, and subtracting when decreasing. When extreme precision is required the correction for second differences* should be taken into account.

* Inman Table 22; Raper, No. 25; Bowditch, No. XI A.

No. III.

NOTE.—The corrections are best determined by the "Rules of Practice," which are preferable to the use of "Proportional Logarithms," since the latter, involving three entries in two special Tables, are more troublesome and not so accurate.

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5. Local Sidereal Time (L. S. T.) = Sidereal Time at preceding Greenwich Mean Noon + Local Mean Time (L. M. T.) + acceleration for G. D.
NOTE.—The acceleration can be taken from the "Table of Time Equivalents" in *Nautical Almanac* "for converting intervals of Mean Solar Time into equivalent intervals of Sidereal Time," by taking the excess of the equivalent above the argument Or it may be computed by allowing a correction at the rate of $9^{s}\cdot8565$ for every hour of the G. D., of $0^{s}\cdot1643$ for every minute, and of $0^{s}\cdot0027$ for every second.

---

6. Star's hour-angle (h) = L.S.T. — Star's R.A.

7. Passage of Stars over the Meridian between two given times.
To the two times add in succession the Right Ascension of the mean sun at preceding Greenwich Mean Noon *; those stars whose R.A.'s fall between the two times thus obtained will be the stars sought for. As this knowledge is only required approximately, further precision is needless.

---

8. Passage of a given Star over the Meridian.
"Approximately."—
Mean Time of Transit } = Star R. A. − { Sidereal Time at preceding Greenwich Mean Noon.* }
"Accurately."— Find the Greenwich Sidereal Date at the moment of the star's transit;
(G.S.D.) = Star's R.A. ± long. in time if { West / East }.
Then,
Mean Time of Transit } = { Greenwich Mean Time of preceding Transit of the first point of *Aries*, † } − { Retardation ‡ for G.S.D. } + Star's R.A.

---

9. Apparent Altitude, a' = Observed Altitude ± Ind. Corr. − Dip ± Semid.
Apparent Zen. Dist. $z' = 90^{\circ} - a'$.
NOTE.—The tabular semid. should be increased by the augmentation, § and diminished by the vertical contraction, when necessary. The vertical contraction is the difference of the refraction in altitude of the limb observed and that of the body's centre. It is very sensible at low altitudes.

---

10. True Altitude, a = Obs. Alt. ± Ind. Corr. − Dip − Refraction in Alt. (of limb observed) ± Aug. Semid. + Par. in Alt.
True Zen. Dist. $z = 90^{\circ} - a$.
Parallax in Alt. = P sin z', or P cos a' (P being the hor. par.)
NOTE.—The corrections for parallax and refraction are frequently combined together in one Table. Instrictness, the corrections to the observed altitude should be applied in the order just given, and the tabular value of the refraction should be corrected (when necessary) for the height of the barometer and thermometer.—(Inman's Table, 2, 4; Raper, Nos. 32, 33; Riddle, No. V.; Norie, No. III.; Bowditch, No. XXXVI.)

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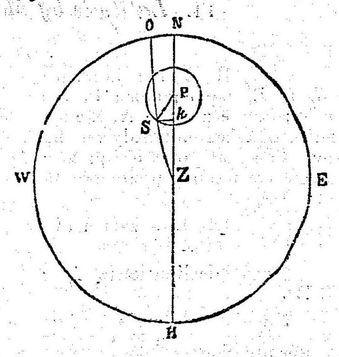
* *Nautical Almanac*, page II.　　† *Nautical Almanac*, page III.
‡ The retardation is the defect of the equivalent from the argument in the table of time equivalents in *N. A.* for converting "sid" into "mean time;" or it may be computed by allowing $9^{s}\cdot8296$, $0^{s}\cdot1638$, and $0^{s}\cdot0027$ for every hour, minute, or second respectively of the G.D.
§ Inman's Tables (9); Raper, No. 42; Riddle (7th Ed.), No. VIII.; Norie, No. VII.; Bowditch, No. XV.

No. IV.

12. *Latitude by Pole Star.*



a = star's true alt. (Os, or N k nearly).
h = star's hour-angle, sPk (No. III. 5 and 6).
p = its polar distance (Ps) in minutes of arc.
Then, latitude (nearly)
$= a - p \cos h$.

The reduction of $p \cos h$ may be made by means of the "Traverse Table"* entering with the hour-angle as a course, and p in the dist. column; the corresponding "diff. lat" will be $p \cos h$.

$p \cos h$ will be positive, and should therefore be subtracted from a, when the hour-angle lies between 0^{hr} and 6 hrs, or between 18^{hrs} and 0^{hrs}. When the hour-angle lies between 6^{hrs} and 18^{hrs}, $p \cos h$ is negative, and is therefore to be added to a.

The above formula, except in high latitudes (say above 60°), will give the latitude sufficiently near for the ordinary purposes of navigation at sea, the error rarely exceeding 2′

If the reduction of the latitude is required accurately, it may be computed from the formula

$$l = a - p \cos h + \tfrac{1}{2} \sin 1'' \, (p \sin h)^2 \tan a \,\dagger$$

from which the Tables given in the *Nautical Almanac* are derived, and which can be used if necessary.

Or otherwise by *direct* calculation of spherical trigonometry from the formulæ

$$\sin (l + \varphi) = \frac{\sin a \cos \varphi}{\sin \delta}\,; \text{ where } \tan \varphi = \frac{\cos h}{\tan \delta}$$

Hence　　$l = (l + \varphi) - \varphi$.　　δ = star's declination.

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* In Raper's *Navigation* the courses in the "Traverse Table" are given in "time" as well as in degrees. If other tables are used, the hour-angle must be reduced to degrees, at the rate of 15, for every hour.

† Log ½ sin 1″ = 4·384545.

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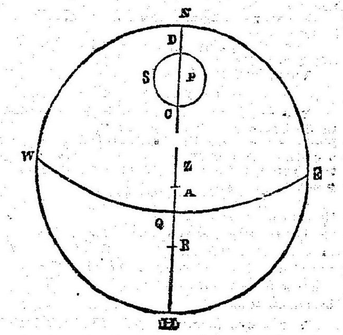
No. IV.

11. *Latitude by Meridian Altitudes*



N W H E, the horizon; W Q E, the equator; P, the pole; Z, the zenith; A, the position of a heavenly body on the meridian north of the equator; B, a corresponding position south of the equator.

z = body's true zenith distance (Z A or Z B).

δ = its declination (Q A or Q B).

Then latitude $= z \pm \delta$ when the declination is $\left\{\begin{matrix}\text{N.}\\\text{S.}\end{matrix}\right\}$

The annexed figure is drawn for a place in north latitude.

If the place is in South latitude, then, as will appear by drawing an appropriate figure, latitude $= z \pm \delta$ when the declination is $\left\{\begin{matrix}\text{S.}\\\text{N.}\end{matrix}\right\}$

When a body's declination is of the same name and greater than the latitude, the body will pass the meridian between the zenith and the pole as at C; and in this case,

$$\text{Latitude} = \delta - z$$

or we may use the formula,

$$\text{Latitude} = a - p$$

[a being the body's true altitude (C N), and p its polar distance (P C)].

If C s D represents the diurnal path of a circumpolar star, D is its position on the meridian below the pole.

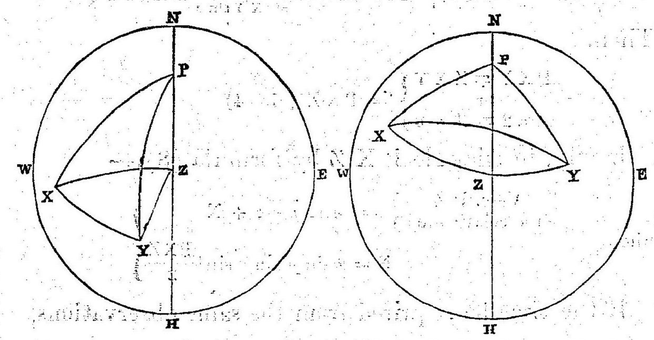
Let a = star's true altitude (D N), p = star's polar distance (P D); then latitude $= a + p$.

NOTE.—When the moon's meridian altitude is observed, care must be taken in correcting the moon's declination, thus: find the L.M.T. of the moon's meridian passage by applying the correction for longitude to the G.M.T. of passage from the *Nautical Almanac*; from this time and the estimated longitude find a G.D., and then from the *Nautical Almanac* find the moon's declination, &c. The correction to be applied to the moon's Greenwich meridian passage, for the longitude, is the proportional part of the daily change due to the difference of longitude, in direct proportion to 360°, and can be at once determined by the computer, or taken by inspection from the Tables:*

* See Inman Tables (*k*); Raper's, No. 23; Norie's, No. XVI.; Bowditch, No. XXVIII.

No. V.

14. *Latitude by Double Altitude; Inman's Method.*



Let X and Y be the positions of the bodies at the moments of observation.

Given the polar distances p and p'; the zenith distances z and z'; the polar angle X P Y $= a$.

NOTE.—In the case of two observations of the same body at different times, X P Y represents the "Elapsed Time;" and in the case of observations of two different bodies at the same time, it is their difference of right ascension.

1st. In triangle X P Y by formula (8),—

$$\left.\begin{matrix}\text{Vers. X Y}\\(Arc\ 1)\end{matrix}\right\} = \text{vers. } \overline{p - p'} + \text{N}$$

where

$$\left.\text{N} = 2 \sin p \sin p' \sin^2 \frac{a}{2}.\right\}$$

2ndly. In triangle X P Y by formula (4),—

$$\left.\sin^2 \frac{\text{P X Y}}{2}\ (Arc\ 2)\right\} = \frac{\sin \tfrac{1}{2}\,(p' + \overline{\text{XY} - p})\ \sin \tfrac{1}{2}\,(p' - \overline{\text{XY} - p})}{\sin \text{X Y} \sin p}$$

No. V.

3dly. In triangle X Z Y by formula (4),—

$$\sin^2 \frac{Z X Y}{2} (Arc\ 3) \Big\} = \frac{\sin \frac{1}{2}(z' + X\overline{Y-z}) \sin \frac{1}{2}(z' - X\overline{Y-z})}{\sin X Y \sin z}$$

Then,

$$\left.\begin{array}{c} P X Y \mp Z X Y \\ \text{or} \\ Arc\ 2 \mp Arc\ 3 \end{array}\right\} = P X Z\ (Arc\ 4)$$

Lastly, in triangle P X Z by formula (8),—

$$\left.\begin{array}{l} \text{Vers. P Z} \\ \text{(the colatitude)} \end{array}\right\} = \text{vers.}\ \overline{p-z} + N$$

where

$$N = 2 \sin p \sin z \sin^2 \frac{P X Z}{2}$$

If the time be required from the same observations,

$$\sin Z P X = \frac{\sin z}{\cos \text{lat.}} \cdot \sin P X Z$$

whence ZPX, the hour-angle of the body X, becomes known, and hence the time; and therefore the longitude, if the corresponding G.M.T. (from a chronometer) is also known.

NOTE 1.—The preceding method of solution is perfectly general; equally applicable to two observations of the same body at different times, or of two different bodies at the same time: and the computations, though long, give results theoretically exact.

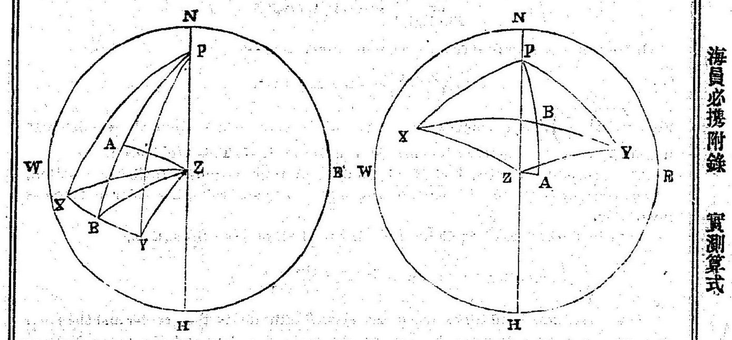
NOTE 2.—In taking double-altitude observations, the nearer the difference of azimuth of the two bodies, or of the two positions of the same body, approaches to 90°, or a right angle, the better; and the less will be the effects on the resulting latitude of any errors in the observed altitudes.

NOTE 3.—In reducing observation by this method, the computations of the angles PXY and ZXY should be made for the body furthest from the meridian.

NOTE 4.—When the ship has moved between the two observations the first altitude must be corrected for the run of the ship in the interval, thus. Enter the Traverse Table with the angle between the bearing of the body at the first observation and the ship's course made good in the interval as a *course*, and the distance run as a *dist.*, the corresponding *diff. lat.* will be the correction to the first altitude, to be added when the *course* is less than eight points, and subtracted when greater.

No. VI.

15. *Latitude by Double Altitude: Ivory's Method.**



Let P B be a perpendicular from the pole bisecting X Y in B.

Z A a perpendicular from the zenith cutting P B (or P B produced) in A.

Given the sun's polar distance at the middle of the interval = p (the polar distance being supposed to remain invariable during the period of observation), the two true altitudes a and a'; † the half-elapsed time = $\frac{d}{2}$

Then, 1st,—

$$\left.\begin{array}{c} \sin B X \\ (Arc\ 1) \end{array}\right\} = \sin \frac{d}{2} \cdot \sin p$$

2dly,—

$$\left.\begin{array}{c} \cos P B \\ (Arc\ 2) \end{array}\right\} = \frac{\cos p}{\cos B X}$$

NOTE.—Arc 2 is to be taken out from the Tables greater or less than 90° according as, p, the polar distance, measured from the elevated pole, is greater or less than 90°.

3dly,—

$$\left.\begin{array}{c} \sin Z A \\ (Arc\ 3) \end{array}\right\} = \frac{\cos \frac{1}{2}(a + a') \sin \frac{1}{2}(a - a')}{\sin B X.}$$

4thly,—

$$\left.\begin{array}{c} \cos B A \\ (Arc\ 4) \end{array}\right\} = \frac{\sin \frac{1}{2}(a + a') \cos \frac{1}{2}(a - a')}{\cos B X. \cos Z A}$$

Then,

$$\left.\begin{array}{c} P B \mp B A \\ \text{or} \\ Arc\ 2 \mp Arc\ 4 \end{array}\right\} = P A\ (Arc\ 5)$$

---

* This method is only intended to be applied to two observations of the sun. It might also be used for two observations of the same star, or of a planet, if the change of declination in the interval were very small.

† See No. V. Note 4.

No. VI.

Lastly,—

$$\left.\begin{matrix}\text{Cos P Z}\\ \text{or}\\ \text{Sin Lat.}\end{matrix}\right\} = \cos \text{P A} \cdot \cos \text{Z A}$$

If the time be required from the same observation,—

$$\left.\begin{matrix}\text{Sin Z P A}\\ \text{(H)}\end{matrix}\right\} = \sin \text{Z A} \cdot \sec \text{lat.}$$

Then $\left(\text{H} \pm \frac{a}{2}\right) \pm$ equation of time = time at the place when either observation was taken: whence the longitude becomes known, if the G. M. T. is also known.

The preceding results, both for latitude and time, require a further correction, when accuracy is aimed at, for the error involved by assuming the polar distance as invariable.

Let c be the change of declination during the half-elapsed time, then,—

$$\text{Correction for Latitude, C} = c \frac{\sin \text{H}}{\sin \frac{1}{2} a}$$

The correction is additive when the second altitude is the greater and the polar distance decreasing, or when the second altitude is the less and the polar distance increasing; otherwise it is subtractive.

$$\text{Correction for Middle Time} = a \mp b$$

$$\text{where } a = \text{C} \frac{\tan l}{\tan \text{H}} \qquad \text{and } b = c \frac{\tan \delta}{\tan \frac{1}{2} a}$$

$a - b$, or $a + b$, is to be taken according as the latitude and declination have like or unlike names, and the result is to be added to, or subtracted from, H, the middle time, according as the polar distance (from the elevated pole) is decreasing or increasing *

---

16. *Latitude by the "Simultaneous Altitudes" of two Stars.*

The latitude may frequently be found at sea with great facility by observing the altitudes of two stars, lying in suitable positions, at the same moment.

The method of "Simultaneous Altitudes" may be practised with great advantage at the periods of morning and evening twilight, when, the stars being then clearly visible, the distinct definition of the horizon permits the altitudes to be taken with great precision.

The observations may be reduced, either by the direct rules of spherical trigonometry according to Inman's method, or by the application of the principles of Ivory's solution.

In the former case, the arc X Y (Arc 1) and the angles P X Y or P Y X (Arc 2) may be taken by inspection for certain pairs of stars from "Shadwell's Star Tables."

If the computation be made by Ivory's method, the arc P B and certain auxiliary quantities, A, B, C, and D, together with the horary angles X P B and Y P B for the same couplets of stars, will also be found in that work.

On account of the shortness and simplicity of the calculations this method will be found to possess great advantages, and may with confidence be recommended to the attention of seamen.

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* See Riddle's Navigation, Seventh Edition, pp. 173 and 273.

No. VII.

17. *Longitude by Chronometer.*

NOTE.—The most advantageous time for taking the altitude of a heavenly body to determine the time, is when the body is on (or near) the prime vertical (See No. X., 27). The altitude, however, should not be less than about 15°, on account of the uncertain errors of refraction at low altitudes. In the case of the sun, it is not desirable that the time from noon should exceed three or four hours, on account of the magnitude of the correction, for the run of the ship, to the latitude, between the time of observation and noon.

By Single or Independent Altitude of the Sun.

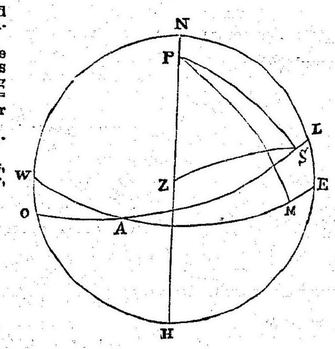
Take several altitudes (three or five) and note the corresponding times by a "assistant watch."

Correct the mean altitude and find the corresponding true zenith distance z.

Apply the "comparison" with the chronometer to the mean of the times by watch, and find the corresponding chronometer time. Then G. M. T. = time by chronometer ± original error ± accumulated rate.

Find the sun's declination and equation of time for the Greenwich date.

Let S be the true sun in the ecliptic, O L; M the mean sun in the equator, W E; S P M the "Equation of time."



Given the Latitude = l

Sun's Decl. = δ

Zen. Dist = z

Then in triangle Z P S by formula (6),—

$$\sin^2 \frac{\text{Z P S}}{2} = \frac{\sin \frac{1}{2} (z + \overline{l \pm} \,) \sin \frac{1}{2} (z - \overline{l \pm \delta})}{\cos l \cos \delta}$$

The difference between l and δ being used when their names are alike, and their sum when unlike.

Then Z P S or h (the sun's western hour-angle) ± equation of time = L. M. T.

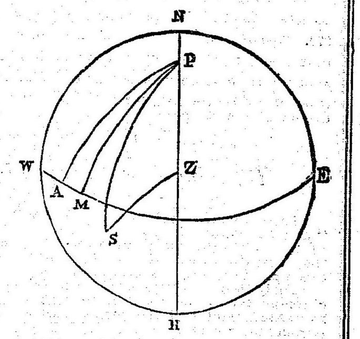
And Longitude = G. M. T. ~ L. M. T.

West, if the Greenwich time is greater than the local time; east, if less.

NOTE.—In order to avoid any distinction of cases, the hour-angle should always be measured towards the west. In the case of the sun the hour-angle is then the apparent time. The time corresponding to $\sin^2 \frac{\text{Z P S}}{2}$ should therefore be taken when the table of "Log. Haversines" is used, from the top of the page when the observation is made P M, and from the bottom when A M.

Longitude by Chronometer.

18. *By Single Altitudes of Moon,* Star, or Planet.*



A, the first point *Aries*.

M, the mean sun.

Given the Latitude $= l$

Decl. $= \delta$

Zen. Dist. $= z$

Then, as before, in triangle Z P S by formula (6),—

$$\sin^2 \frac{ZPS}{2} = \frac{\sin \tfrac{1}{2}(z + \overline{l \mp \delta}) \sin \tfrac{1}{2}(z - \overline{l \mp \delta})}{\cos l \cos \delta}$$

$ZPS = h$, the star's hour-angle;

also, $APS = a$, the star's R.A.;

and $APM = m$, the R.A. of the mean sun.

$$m = \left\{\begin{matrix}\text{Sidereal Time at preceding} \\ \text{Greenwich Mean Noon}\end{matrix}\right\} + \left\{\begin{matrix}\text{Acceleration for the} \\ \text{Greenwich Date.}\end{matrix}\right\}$$

Then, M P Z the L.M.T. $= h + a - m$.†

And, as before,

Longitude = G.M.T. ~ L.M.T.

NOTE.—The hour-angle should always be measured towards the west, and therefore, if the body is east of the meridian, the hour-angle should be taken out greater than 12 hours.

---

* It is not advisable to use the moon for determining the time by, if other bodies are also available for the purpose, because any uncertainty as to the estimated time or longitude affecting the Greenwich date may produce large errors in the results by its effects on the computed right ascension and declination of the moon, and hence on the hour-angle.

† This is the usual method given by the writers on Navigation, but it is not suited to accurate practice, because in order to find "m" we require previously to know the mean time. The following is better:—

L.S.T. $= h + a$. Find the Greenwich Sidereal Date (G.S.D.) = L.S.T. ± Long. in time if $\left\{\begin{matrix}\text{West} \\ \text{East}\end{matrix}\right\}$.

Then, L. M. T. $= \left\{\begin{matrix}\text{Greenwich Mean Time of preceding transit of the first point of } \textit{Aries}\end{matrix}\right\} - \left\{\begin{matrix}\text{Retardation} \\ \text{for G.S.D.}\end{matrix}\right\} + \text{L.S.T.}$

23. *By the observed Amplitude.*

If S′ be the body in the horizon, its zenith distance = 90°.

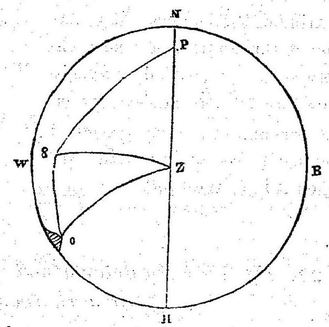
Given the Latitude $= l$

Declination $= \delta$

Then, $\left.\begin{matrix}\text{Cos P Z S}' \\ \text{or} \\ \text{Sin W Z S}'\end{matrix}\right\} = \frac{\sin \delta}{\cos l}$

W Z S′, the amplitude of the body, or its bearing from the west (or east) point being thus known, the variation is obtained as before by comparison with the compass-bearing.

24. *To determine the true Azimuth of a Terrestrial Object by "Astronomical Bearings."*



S, the sun.

O, the object.

a and a', their apparent altitudes.

d, their apparent distance = observed distance ± ind corr. + semid.

Then in triangle O Z S by formula (6),—

$$\text{Sin}^2 \frac{OZS}{2} = \frac{\sin \tfrac{1}{2}(d + \overline{a - a'}) \sin \tfrac{1}{2}(d - \overline{a - a'})}{\cos a \cos a'}$$

whence O Z S, the difference of azimuth of the sun and the object, becomes known. If the object is on the horizon, or has no sensible altitude,

$$\text{Sin}^2 \frac{OZS}{2} = \frac{\sin \tfrac{1}{2}(d + a) \cdot \sin \tfrac{1}{2}(d - a)}{\cos a}$$

P Z S, the sun's azimuth, being found by (21 or 22) P Z O, the true azimuth of the object = P Z S ± O Z S becomes known; and hence, also, the variation, if the compass-bearing of O is likewise known.

NOTE.—In all observations to determine the variation of the compass on board ship, the results are in the first instance affected by the "deviation" due to the particular position of the ship's head in which the compass-bearings were observed

No. VIII　　2

Variation of the Compass.

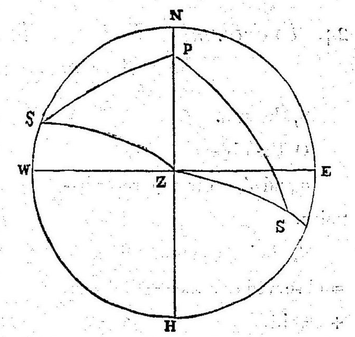
21. *By Azimuth determined by the observed Altitude of a Heavenly Body.*

Given the Latitude $= l$
Polar distance $= p$
True altitude $= a$

Then in triangle P Z S by formula (6),

$$\mathrm{Sin}^2 \frac{\mathrm{PZS}}{2} = \frac{\sin \tfrac{1}{2}(p + l - a) \sin \tfrac{1}{2}(p - l - a)}{\cos l \,.\, \cos a}$$

P Z S is the (north) azimuth of the body S; and, comparing this with the observed compass-bearing of the body S, the variation of the compass, or the angle between the true and magnetic meridians, is obtained—*west* when the true azimuth is to the *left* of the compass-bearing, and *east* when it is to the *right*.



22. *By Azimuth determined by the observed Hour-angle of a Heavenly Body.*

The times when the compass-bearings are taken being noted by a chronometer, whose error on L.M.T. is known, the corresponding hour-angles can be found.

Given the Hour-angle $= h$
Latitude $= l$
Declination $= \delta$

Then in triangle P Z S,

$$\text{If } \tan \varphi = \frac{\tan \delta}{\cos h}$$

$$\text{Tan PZS} = \frac{\tan h \cos \varphi}{\sin (p - l)}$$

P Z S, the (north) azimuth of S, being thus known, the variation is determined as before.

No. IX.　　1

25. *Latitude by Altitudes near the Meridian.*

When the Sun is near the meridian, observe a number of altitudes, noting the corresponding times by a chronometer whose error on apparent time is known (taking, when practicable, an equal number on each side of the meridian).

From the times and the known error of the chronometer find the hour-angles corresponding to each observation; take out the *nat. versines** of these hour-angles, and, dividing their sum by their number, find the mean versine (*Vers. h*).

Take the mean of the altitudes, correct it, and find the mean true zenith distance $= z'$. Let z be the meridian zenith distance. n'' the correction in seconds by which it differs from the observed zenith distance z'; let l be the true and l' the approximate latitude, and δ the declination at apparent noon.

Then,
$$n'' = [9{\cdot}314425\dagger] = \frac{\cos l' \cos \delta}{\sin z'} \text{ Vers. } h$$
$$z = z' - n''$$
$$l = z \pm \delta \quad \text{(see No. IV. II.)}$$

At sea, where, perhaps, only a single altitude can be obtained, proceed thus:—Let.
$$\mathrm{N} = 2 \cos l' \cos \delta \sin^2 \frac{h}{2};$$
then
$$\text{Vers. } z = \text{vers. } z' - \mathrm{N}$$
and
$$l = z \pm \delta \quad \text{(See No. IV. II.)}$$
as before.

If the latitude found differs much from the assumed latitude, repeat the calculation with the new value of l instead of l', and thus approximate towards the true latitude.

25*. *Latitude by Altitudes near the Meridian.*

The latitude may also be conveniently found by the following formulæ, given by Robertson ‡ and revived by Jeans§; this method being independent of the use of any special tables, and also of any previous knowledge of the latitude by account.

The altitude near the meridian (a) and the corresponding hour-angle being found in the manner already described,

Let
$$\tan \mathrm{M} = \frac{\cos h}{\tan \delta}; \quad \cos \mathrm{N} = \frac{\sin a \cos \mathrm{M}}{\sin \delta}$$

then
$$\text{Colatitude} = \mathrm{M} \mp \mathrm{N}$$

the upper sign being taken if the Sun passes the meridian outside the pole and zenith, and the lower if it passes between them.

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* Inman's Tables (v).
† A number enclosed thus, in square brackets, indicates the logarithm of a factor in the expression.
‡ Robertson's Navigation, vol. i. p. 266. § Jeans's Navigation, Ed. 1868, p. 54.

26†. *Latitude by Three Altitudes taken near the Meridian, at equal intervals of time.*

The following ingenious method of finding the latitude is given by Chauvenet. (*Chauvenet's Astronomy*, vol. I. p. 309.)

Observe three altitudes of a heavenly body near the meridian, a_1. a_2, and a_3; the interval between the first and second observations, and second and third, being *equal*. Let the required meridian altitude denoted by a; then if

$$q = \frac{[\frac{1}{4}(a_1 - a_3)]^2}{a_2 - \frac{1}{2}(a_1 + a_3)} \text{ ; } q \text{ being expressed in seconds of arc,}$$

$$a = a_2 + q.$$

The meridian altitude being known, the latitude can be found in the usual manner. (*See* No. IV. 11.)

This method is independent of any previous knowledge of the latitude or time; it only requires a watch whose steadiness can be depended on for a short interval. No special tables are requisite, and the reduction can even be made without the aid of logarithms. The limits of observations are the same as in all other methods near the meridian, say practically not exceeding half an hour on each side. It is to be noted also that the observations are not necessarily restricted to the same side of the meridian. In strictness the first and second altitudes should be reduced to the place of the third, when necessary, by the correction for the run of the ship. (*See* No. V. Note 4.) The meridian altitude thus obtained will be that corresponding to the place of the ship at the last observation.

NOTE.—All the preceding methods, although usually applied to the case of the Sun, are equally suited to observations of the stars or planets near the meridian.

26. *To find the Time of Rising or Setting of the Heavenly Bodies.*

Let h be the hour-angle at rising, or setting, l the latitude, δ the declination. Then, $\cos h = -\tan l \tan \delta$

If the latitude and declination have like names, h will be greater than 6 hrs; if unlike, it will be less.

Find the time (T) of the body's meridian passage (No. III. 8).

Then, $T - h$ will be the time of rising, and
$T + h$ . . . . setting.

27. *To find when a Body is on the Prime Vertical.*

$$\cos h = \frac{\tan \delta}{\tan l}$$

h being thus known, the time can be determined:

$$= T \mp h$$

If the latitude and declination have different names, the body will not cross the prime vertical above the horizon; and if the declination is of the same name and greater than the latitude, the body will not cross the prime vertical at all.

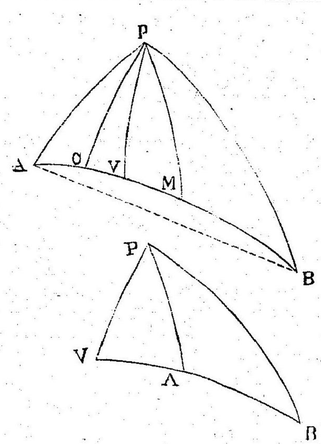
28. *To find its Altitude at this Time.*

$$\sin a = \frac{\sin \delta}{\sin l}$$

28*. *Great Circle Sailing.*

The shortest line that can connect any two points on the surface of the earth being the arc of a great circle, there is sometimes an advantage in making a voyage by "great circle sailing:" a knowledge of the principles of great circle sailing and of the necessary formulæ of computation, is therefore indispensable to the scientific navigator.

In the annexed figures, let P be the pole of the earth; A and B, two points, or places, on its surface; P A and P B, their colatitudes, λ and λ'; A P B, their difference of longitude, D. Let the plain line, A B, be the distance arc (δ) between them, and let the dotted line A B be their distance measured on the rhumb-line. Also, let V, the vertex, be the point where the meridian cuts the distance arc at right angles. This point will be between the points A and B, when the angles P A B and P B A are both acute, and outside them, as at V', on the distance arc produced, when either of them is obtuse.



The vertex is the highest point of latitude attained.

When the places A and B are on opposite sides of the equator, there will be two vertices, one on each side, and they will be diametrically opposite to one another, both in latitude and longitude.

Let M be the point of "maximum separation in latitude," which is where the great circle course is for the moment the same as the rhumb course. This point necessarily falls between the two places. When the ship crosses the equator there are two such points, one lying on each side.

Also (the ship sailing from A to B), the angle P A B (or A) is called the *initial* course, and the supplement of P B A (or B) to 180° the *terminal* course.

Then 1st, by formula (8),

$$\text{Vers } \delta = \text{vers}(\lambda \sim \lambda') + N$$
$$\text{where } N = 2 \sin \lambda \sin \lambda' \sin^2 \frac{D}{2}$$

Or by formula (9),

$$\sin \frac{\delta}{2} = \sqrt{\left(\sin\left(\frac{\lambda + \lambda'}{2} + \sigma\right) \sin\left(\frac{\lambda + \lambda'}{2} - \sigma\right)\right)}$$
$$\text{where } \sin = \sigma \sqrt{\left(\sin \lambda \sin \lambda' \cos^2 \frac{D}{2}\right)}$$

which last formulæ can be solved with a table of log sines, &c. only.

Either of these formulæ determine δ, the distance arc, and δ, reduced to minutes of arc, is the distance between the two places, in nautical miles, on the great circle track.

2ndly. To find the position of the vertex.

$$\cos l = \frac{\sin \lambda \sin \lambda' \sin D}{\sin \delta}$$

which gives l, the latitude of the vertex.

Also in the triangle A P V (calling the angle A P V, P) by formulæ (17) and (14),

$$\cos P = \cot l \cot \lambda \quad ; \quad \cos A V = \frac{\cos \lambda}{\sin l}$$

which give the difference of longitude reckoned from A, and its distance from A measured along the distance arc.

Or, similarly, reckoning from B (and calling B P V, P')

$$\cos P' = \cot l \cot \lambda' \quad ; \quad \cos B V = \frac{\cos \lambda'}{\sin l}$$

Check $P \pm P' = D$; and $A V \simeq B V = \delta$; the agreement of these values affords tests of the accuracy of the computations.

3rdly. For the *initial* course by formula (15) we have $\sin A = \frac{\cos l}{\sin \lambda}$

and similarly for the supplement of the *terminal* course $\sin B = \frac{\cos l}{\sin \lambda'}$

Or, again, the angles P A B (or A) and P B A (or B) may both be found at the same time by employing the well-known formula (13),

$$\tan \tfrac{1}{2}(A+B) = \frac{\cos \frac{1}{2}(\lambda \sim \lambda')}{\cos \frac{1}{2}(\lambda + \lambda')} \cot \frac{D}{2}\ ;\quad \tan \tfrac{1}{2}(A \sim B) = \frac{\sin \frac{1}{2}(\lambda \sim \lambda')}{\sin \frac{1}{2}(\lambda + \lambda')} \cot \frac{D}{2}$$

The sum of the ½ sum and ½ difference gives the greater of the two required angles, and their difference the less; observing also that the greater angle will correspond with the place of highest latitude and the lesser with the lowest.

4thly. To find the position of the point of "Max. Sep." Find the rhumb course between the points A and B by the rules for the sailings (No. III. 2); then by formulæ (15), (16), and (18), from the triangle P M V,

$$\sin PM = \frac{\sin PV}{\sin \text{rhumb course}};\ \sin VPM = \frac{\cos \text{rhumb course}}{\cos PV}$$

$$\sin VM = \frac{\tan PV}{\tan \text{rhumb course}},$$

which determine the latitude of the point M; its difference of longitude reckoned from the vertex; and its distance from it measured along the distance arc.

Lastly, to find the position of any point on the distance arc, as C: assume A C any convenient length, say 10° or 20°, &c., then in the oblique-angled triangle P A C, knowing the sides P A and A C and the included angle P A C, we might find P C and the angle A P C by formulæ (8) and (2), which would determine its latitude and also its position in longitude referred to the place A, but it will generally be more convenient to refer the point C to the vertex; then assuming a value for C V, as before, we have by formulæ (14) and (18) from the right-angled triangle P C V,

$$\cos PC = \cos CV \cos PV;\ \tan CPV = \frac{\tan CV}{\sin PV},\ \tan PCV = \frac{\tan PV}{\sin CV}$$

which determine the latitude of the point C, its longitude referred to the vertex and also the great circle course (or its supplement) at the point C.

The position of the vertex, point of "Max. Sep." and also those of any other points that may have been determined (and the more numerous they are the better) may then be marked down on the chart. A curve drawn freely through them will represent the projection of the great circle track, which may then be immediately compared with the corresponding route by the rhumb line.

If the great circle track passes through too high latitudes, or is otherwise inconvenient, the track must be modified accordingly, and the highest point in latitude which it is proposed to attain being noted on the chart, a new curve drawn through it will indicate the modified route to be followed. It will generally be convenient that the new selected point of maximum latitude should be on the meridian passing through the original vertex or original point of "Max. Sep.;" the new curve may generally be drawn by eye and estimation, but specific points in it may be found by calculation as above, if thought necessary. This mode of proceeding has received the name of "Approximate Great Circle Sailing."

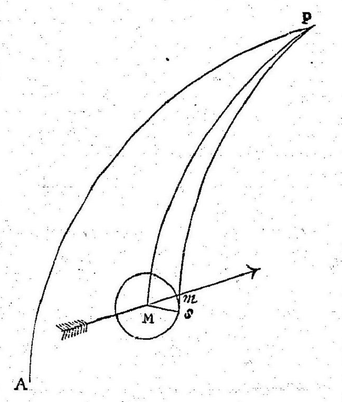
In any case, the track to be followed having been projected on the chart, and the position of the several points lying in it determined, the ship may then be conducted from point to point by the ordinary rules of the "sailings" in Navigation. The great circle arc and the rhumb line between any two points nearly coincide for short distances, the approximation being the closer the more near the points are to one another. This proceeding, involving the combination of the rules of "great circle" and "plane sailings," has been termed "Composite Sailing."

Finally, since the great circle course is the only one on which the ship makes good every mile of distance sailed over towards the point to which she is proceeding; in case of meeting with adverse winds the ship should be put on that tack which most nearly coincides with the great circle course, unless other considerations should render it manifestly inexpedient.

29. *Computation of the Longitude from an observed Occultation.**

The determination of the longitude from an observed occultation depends on the following principles:—

At the moment of immersion or emersion of the star, the point of the Moon's limb in contact with the star has the same apparent position as the star; consequently, if the effect of the Moon's parallax in right ascension and declination be computed for the star's position, and applied in reverse order to the star's place, we obtain the true right ascension (α_0) and declination (δ_0) of that point of the Moon's limb which was in contact with the star.



Let P be the North Pole; P A the circle of declination passing through the first point of *Aries*; *s* the point of the Moon's limb which was in contact with the star, and whose true R. A., A P *s*, and corresponding declination have been determined as above.

Let M *m* be a portion of the Moon's true orbit; M the position of her centre when apparently in contact with the star; *m* her place when she has the same right ascension as the point *s*; and M *s* her semidiameter.

Then the R A. (α_0) of the point *s* being known, we can find by interpolation in the ephemeris of the Moon's R A in the *Naut. Almanac* the corresponding G. M. T. (t_0) when the Moon's R. A. was equal to α_0, and also the corresponding declination D_0 at that time. Hence the difference of declination $m\,s = k = (D_0 - \delta_0)$ can be found; also the Moon's true hourly motions in R. A. and declination at this time. A_1 and D_1 being known from the ephemeris, the angle M *m s* can be determined, and hence in the triangle M *m s* (considered as rectilinear) the angles *m* M *s* and M *s m*.

Hence, therefore, in the spherical triangle P M *s*; P M, M *s*, and P *s*, M being known, M P *s*, the difference of R A. of M and *m*, can be determined, and hence the time of the Moon's describing it, by dividing it by A_1.

Applying this time as a correction to t, the G. M. T. when the Moon was at *m*, we obtain the time when she was at M, or the G. M. T. at the moment of contact.

From these considerations we derive the followings method of reduction:—

1. From the L. M. T. of contact and the estimated longitude find a G. D., and take from the *Nautical Almanac* D, the Moon's declination, and P, her hor. parallax. Reduce the latitude and parallax by the corrections for the Earth's spheroidity; † let l and P′ be their reduced values.

Find the star's hour-angle h (No. III., 5 and 6).

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* From Mr. Woolhouse's Paper, Appendix, *Nautical Almanac*, 1837.

† See Inman's Tables (h); Raper's, Nos. 52 and 41; Riddle, VII. and VI.; Bowditch, No. XXXVIII.

No. XI. 2

2. Then, $p = P' \cos l \sin h$

$\frac{1}{2} \Delta h$ (in seconds of time) $= [8{\cdot}522879] \frac{p}{\cos D}$

$(h) = h - \frac{1}{2} \Delta h$

$\varkappa = P' \sin l \cos \delta \qquad \varkappa' = P' \cos l \sin \delta \cos (h)$

$\delta_0 = \delta + (\varkappa - \varkappa')$

Δd (in seconds of time) $= [8{\cdot}823909] \frac{p}{\cos \delta_0}$

$d_0 = d + \Delta d$

NOTE.—d and δ for the star observed will be found in the Table of Elements of Occultations in the *Nautical Almanac*.

3. Find by interpolation in the ephemeris of the Moon on the given day in the *Nautical Almanac* the the time (t_0) when the Moon's R. A. $= d_0$ and also her corresponding declination D_0 at that time. Thus:—

Let (A) be the Moon's R. A. in the ephemeris next less to d_0 and (D) the corresponding declination; also let A_1 and D_1 be the interpolated values of the hourly variations in R. A. and Decl., corresponding to the middle of the interval, between the times when the Moon's R.A. was (A) and d_0 respectively, the latter time being in the first instance estimated approximately.

$t^s = \frac{d_0 - (A)}{A_1}$ [3·556302]

t_0 = Hour of Gr. Time corresponding to (A) $+ t^s$

$D_0 = (D) + \frac{d_0 - (A)}{A_1} \cdot D_1$

4 $k = D_0 - \delta \qquad n = [1{\cdot}176091] A_1 \cos D_0$

$\text{Tan } \eta = -\frac{D_1}{n} \qquad \cos \psi = [0{\cdot}563907] \frac{k \cos \eta}{P}$

G. M. T. at moment of contact $= t_0 + [2{\cdot}992395] \frac{P}{n} \sin (\eta \mp \psi)$

Upper / Under sign when an immersion / emersion is observed.

Longitude = G.M.T ~ L.M.T.

NOTE.—In the reduction of these formulæ the details of the computations must be accurately performed, and attention paid to the algebraic signs of the several quantities.

North latitudes and declinations, northerly motions in declination, west hour-angles and direct motions in R.A., are reckoned positive, or +; *vice versâ*, these several quantities are to be considered negative, or —.

In consequence of the minute errors in the Lunar Tables, and also from possible inaccuracies in the assumed place of the star, the longitudes obtained from occultations reduced by the ephemeris in the *Nautical Almanac* can only be regarded in the first instance as close approximations; and no results can be considered as finally satisfactory till the errors of the Tables have been corrected by the results of the *Greenwich Observations*.

No. XII. 1

30. *Finding the Time by Equal Altitudes.*

The times of observation are usually taken by an "assistant watch," whose connexion with the chronometer is obtained by means of a "comparison." Take the mean of the times by watch A. M., and the mean of the corresponding times P.M. Apply the comparisons to each mean, and thus obtain the corresponding chronometer times. Half the sum of these times (adding 12hrs. to the P.M. times when necessary) will be the approximate time by chronometer at the moment of apparent noon, and their difference the "elapsed time" = E. Find a G. D. for apparent noon at the place, and take from the *Nautical Almanac* the sun's declination (δ) and the equation of time. Take out also the change of the sun's declination between the noon of the day preceding and the noon of the day following the given date: express it in seconds $= \Delta''$. Also, let l be the latitude.

Then the equation of equal altitudes $= \alpha + \beta$, where

$\alpha = \quad \Delta'' \tan l \left\{ [5{\cdot}063486] \, E^m \text{ cosec } \frac{1}{2} E \right\}$

$\beta = -\Delta'' \tan \delta \left\{ [5{\cdot}063486] \, E^m \text{ cotan } \frac{1}{2} E \right\}$

NOTE.—[5·063486] is a constant logarithm entering into the expression: E^m is the number of minutes in the elapsed time.

The first part will be positive or + from the summer to the winter solstice, and negative or — from the winter to the summer solstice (according to the hemisphere* in which the observer is). The second + between the equinoxes and the solstices, and — from the solstices to the equinoxes (but if the elapsed time is greater than 12hrs. the sign of the second part must be reversed). If the signs of the two parts are alike, take their sum, which mark with their common name; if unlike, their difference, which mark with the name of the greater. Apply the equation with its proper sign to the approximate time by chronometer at noon; the result will be the time shown by chronometer at the moment of apparent noon.

To 0h or 24h apply the "Equation of Time," the result will be mean time at apparent noon; and comparing the time by chronometer with this, its error on local mean time becomes known.†

Tables of the Logarithms of A and B, where

$A = [5{\cdot}063486] \, E^m \text{ cosec } \frac{1}{2} E, \quad \text{and } B = [5{\cdot}063486] \, E^m \text{ cotan } \frac{1}{2} E,$

will be found in Riddle's *Navigation* (early editions), Table XVIII.; and Norie's, Table LII. If these tables are not at hand, the equation of equal altitudes must be computed from the formula.

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* That is, considering the summer solstice to be in December, and the winter solstice to be in June, when the observer is in south latitude.

† If the observations are taken P.M. and A.M. the half sum of the times will be the approximate time of apparent midnight. In this case, find the equation of EA by the above formula, marking, however, the sign of the first part with a *contrary* sign, and the second with the *same* sign as above directed, and then apply it as before. Then compare the corrected chronometer time with the mean time at apparent mionight.

31. *Useful Miscellaneous Memoranda.*

	Logarithms.
Circumference of a circle to diameter 1 or $\pi = 3{\cdot}1415926$	0·4971499
$\frac{\pi}{4} = 0{\cdot}7853982$	9·8950899
$\frac{\pi}{6} = 0{\cdot}5235988$	9·7189986
Area of any circle $= d^2 \frac{\pi}{4}$	
Volume of sphere $= d^3 \frac{\pi}{6}$	
Surface of sphere $= d^2 \pi$	
Earth's polar axis 7899·11 miles	
Earth's equatoreal diameter 7925·60 miles	
Earth's compression, $c = \frac{1}{299\,1528}$	7·5241069
Earth's excentricity. $e = 0{\cdot}0816968$	8·9122051
Force of gravity in London, $g = 32{\cdot}19084$ feet	1·5077323
Number of feet in one statude mile 5280	3·7226339
Number of feet in one nautical mile 6082	3·7840464
French metre in English feet 3·2808992	0·5159929
French foot in English feet 1·065777	0·0276663
Length of arc equal to radius $\begin{cases} 57^{\circ}\cdot2957795 \\ 206264''\cdot8 \end{cases}$	1·7581226 5·3144251
Sine of 1″ 0·00000485	4·6855749
Sine of 1′ 0·00029089	6·4637261
The Napierian base, $e = 2{\cdot}7182818$	0·4342945
The modulus of common logarithms, M = 0·4342945	9·6377843

Light travels 200 000 miles per second.
Sound travels 1142 ft. per second.
Velocity of electric fluid about 16.000 miles per second.
1 lb. avoirdupoise = 7000 grains troy.
1 cubic foot of water = 1000 ounces avoirdupoise.

法定測圈轉廻
TO MEASURE A SHIP'S CIRCLE.

A Practical Method of Measuring the Circle Described by a Ship. (*F. Martin, M.I.N.A.*)

Fig. A shows the small portable fittings to be used on the occasion. A is a quadrant with the degrees carefully marked on a piece of wood which is temporarily secured on the ship's rail, with its inner edge AB kept parallel to the middle line of the ship; C is a batten about 4 feet long and 3 inches broad, with two upright wire sights S, S, one in each end, about 8 inches long. The batten is placed on the quadrant, with the centre of one end coinciding with the centre of the quadrant, and fixed with a pin through the centre, so that it can revolve. A base (AB, fig. A) is set off in a fore and aft direction, of any convenient length, and at its foremost extremity a straight batten D is fixed vertically to the ship's side, extending a few feet above the rail. The same arrangement is carried out on each side of the ship, and a line joining the edges of the battens D, D must be at right angles to the middle line of the ship. These are all the fittings necessary. When the helm is hard over, and the ship has fairly commenced her circular course, throw overboard a rough wood box about a foot square and painted black: as the ship moves onwards the box remains nearly stationary on the water, till presently the ship has described a semicircle, which is known by the two battens D, D and the box coming into the same straight line. At that instant the batten C is made to revolve till the two wire sights S, S and the box are in the same straight line; the angle A (fig. A) is then known, being denoted by the batten C on the quadrant. The angle B is a right angle, and the base AB being known, then DO = tangent A × BA, to which must be added twice the breadth of the ship for the greatest space occupied by her in describing the circle.—*Ex.*: If the angle A = 80° 15′, and the base BA = 90 feet, and the breadth of the vessel = 40 feet, then the greatest space occupied by her in describing the circle is = (90 × 5·81965) + (2 × 40) = 603·768 feet.

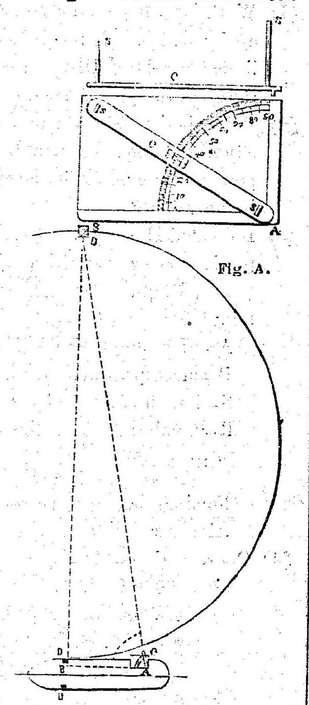


Fig. A.

機關及造船要式

MARINE ENGINEERS.

(1) Work is a compound of force and motion and is generally represented by foot-pounds: fore instance, if the pressure of steam in a cylinder equals 50 lbs. and the stroke 3 feet, the work done at each stroke of the piston equals 150 foot-pounds.

(2) Power is the ability a motor has of performing work in a certain Time, and requires a unite for comparison which we call. Horse power. Horse power is the ability to raise 33,000 lbs, one foot high in one minute.

(3) Indicated Horse power,—To find the I. H. P. of a steam-engine four particulars are requisite, viz;—area of cylinder, mean pressure of steam, length of stroke, and number of revolutions of crank per minute.

A=area of cylinder in inches.
P=mean pressure of steam in cylinder in lbs.
S=length of stroke in feet.
R=number of revolutions of crank per minute.

$\frac{A \times P \times 2S \times R}{33,000}$ = I. H. P. exerted by one engine.

Nominal horse power = about $\frac{1}{3}$ I. H. P. (these figures may be taken for designing).

(4) Consumption of Coal per I. H. P. per Hour. for compound Engines.

above 2000 I. H. P.	2lbs.
Between 1000 and 2000 I. H. P.	2¼lbs.
Under 1000 I. H. P.	2½ „

for Expantion Engines.

Above 2000 I. H. P.	3.25lbs.
Between 1000 and 2000 I. H. P.	4.0 „
Under 1000 I. H. P.	5.0 „

(5) *Computation of a Ship's Displacement.*

This consists in computing the volume of the body of the vessel below the water-plane, up to which it is required to know her displacement, by one of the rules used for finding the volume of solids bounded on one side by a curved surface.

Two processes are generally made use of in computing a vessel's displacement, as the calculations in each process are required to determine the position of the centre of displacement, or centre of buoyancy, and also because the two results are a check on the correctness of the calculations.

But the approximate volume of the displacement may be obtained by the parallel-lopipedon circumscribing the immersed body.

V=Volume of displacement in cubic feet.
I=length of vessel at load water-line in feet.
B=extreme immersed breadth in feet.
D=draught of water in feet.

$V=(L \times B \times D) \times K$. tons.

K=Coefficient of fineness.

There K is called the percentage of volume divided by 35 which cubic feet of sea water beers to the ton

Early types of Ironclads	$\frac{K}{\frac{55}{3500}}$
Modern types of rigged ironclads	$\frac{60}{3500}$ to $\frac{62}{3500}$

(6) *Formula for the inflow of water.*

A=area of the hole (in square feet).
d=the depth below water in feet (taken about the centre of the hole will be near enough for practical purposes).
V=velocity of inflow of the water in feet per second.

$V=8\sqrt{d} \times A$.

(7) *The statical stabitity of ships.*

If D=total weight of the ship (in tons)
GZ =perpendicular distance between the parallel lines of action of the weight and buoyancy (in feet).
moment of couple = D × GZ (foot-tons).

(8) *Metacentre and the centre of buoyancy.*

If M=the metacentre.
B_1 = the centre of buoyancy.

$B_1 M = \frac{\text{Moment of inertia of water line area}}{\text{Volume of displacement}}$.

and D=draught of water in feet.

B = extreme immersed breadth in feet.
a = the coefficient.

Then $B_1 M = a.\frac{B^2}{D}$.

	Value of a
Ship of ordinary forms.	.09 to 0.1
Ship of full forms	.08 to .09

(9) *To find the tons per inch of immertion.*

A = area of longitudinal water plane in sqnare feet.

T = tons per inch of immersion at water-plane.

$T = \frac{A}{12 \times 35}$ for salt water.

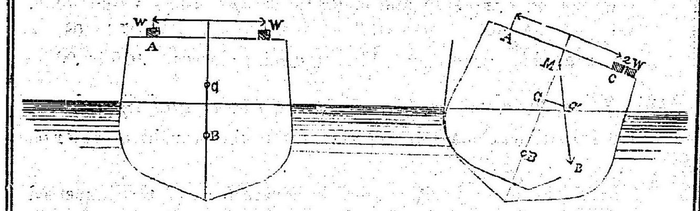
$T = \frac{A}{12 \times 36}$ for fresh water.

(10) *To find the centre of gravity and the metacentres height above the centre of gravity.*

The Ship being practically complete—with spars on end, the bilges dry, the boilers either empty or quite full, no water in interior free to shift, and all weights on board well secured so that they may not fetch away when she is inclined—is allowed to come to rest in still water. A calm day is desirable, but if there be any wind, the ship should be placed head or stem to it and allowed to swing free, the warps being so led that they may practically have no effect in resisting the inclination of the ship. For the purpose of producing inclination, piles of ballast are usually placed on the deck, being at first equally distributed on either side, but in some cases the guns, of a ship have been traversed from side to side instead of using ballast. Two or three long plumb-lines are hung in the hatch ways, and by means of these lines the inclination from.

Upright are noted. All being ready, and the ship at rest, the water is taken, the positions of the metacentre corresponding to this drought can then be ascertained by calculation from the Drawings.

Next a known weight of ballast is moved across the deck through a known distance.



a = the angle of inclination noted on the plumb-lines when the ballast W has been moved through the transverse distance d.

Then $GG_1 = GM \tan a$; or $GM = GG_1 \cot a$. (since GG_1 is perpendicular to GM).

if D = displacement of the ship
d = transverse distance of the ballast W
W = weight of the ballast

$D \times GG_1 = W \times d.$; $GG_1 = \frac{W.d}{D}$

$\therefore \quad GM = \frac{W}{D}.\ d \cot a.$

(11) *To find the Change of trim.*

L = length of the ship
a = the angle measured when the weight W is shifted longitudinally along the deck.
d = transverse distance of the ballast W

change in trim = $L \times \tan a$.

Shift of centre of gravity $(GG_1) = \frac{W.d}{D}$.

$GG_1 = GM \tan a$ = „

$\tan a = \frac{W.d}{D \times GM}$:

Change in trim $= \frac{W.d}{D} \times \frac{1}{GM}$

there GM being the height of the longitudinal metacentre above the centre of gravity,

Height of longitudinal metacentre $= 6.\frac{L^2}{D}$.

Unarmoured war-ship and merchant ship of ordinary proportions	Values of 6. .07 to .08
armoured ships; merchant ships of special classes.	.075 to .09

(12) *The relation of Indicated Horse Power and Speed.*

Let D = displacement of ship (in tons) at the draught of water on the trail.

A = the corresponding area (in square feet) of the immersed midship section

V = Speed (in Knots) per hour,

C_1 = midship-Section Coefficient

C_2 = displacement Coefficient

$$\text{I. H. P.} = \frac{A \times V^3}{C_1}$$

$$\text{I. H. P.} = \frac{D^{\frac{2}{3}} \times V^3}{C_2}$$

DEVIATION OF COMPASS.

Heeling Error.

It is the error on the North or South points by Compass, caused by one degree of heel, and is found by dividing the difference between the deviation, ship upright and ship heeling, by the number of degree of heel.

Sign.
East = +
West = —

Examples.

1. For Example, given the deviation on North, ship upright, equal to + 21°; when heeling 12° to starboard, equal to + 3°; this is equivalent to a minus change of 18°, which divided by 12° of heel, gives —1.°5 as the heeling co-efficient for each degree of heel to Starboard.

Or

Deviation	
North point + 21°.	Upright
„ „ + 3.	heeling 12° to starboard

12) 18 (—1.5 For each degree of heel to starboard

From this it will be seen that the heeling error is directly proportional to the amount of heel.

Now, when the heeling Error is given for any other than the North or South points, it is easily reduced to these by simply dividing it by the natural cosine of the number of points from north or south then divide the result by the inclination to starboard or port, as the case may be and you have the heeling co-efficient as before.

(Co-efficient C)

---

2. For example, the heeling Error on W. N. W., with 16° of heel to port is -9.° 19; divide this by ·383 (the natural Cosine of 6 point) and you get 24°; divide this by the heel (16°), and once again we shake hands with our friend the heeling Co-efficient.

Now it is evident that if we require the heeling error for any other given point, we have merely to multiply the heeling co-efficient by the Natural Cosine of the number of points contained between North or South (taking the nearest) and the stated point, multiply the result by the fresh heel, and we have the error required.

Or

W. N. W. point.—9.°19 heeling 16° to port.

Nat. cos. 0.383)——

North point —24° ,, ,, ,, ,,

16°) —24° / —1.5 for each degree of heel to port.

3. For example, the heeling co-efficient on North is—1.°5 for each degree of heel to Starboard; required the heeling Error on N.E. by N. ½ N., heeling 10° to starboard.

Multiply-1.°5 by 0.882 (the natural cosine of 2½ points): the result is-1.°323; Multiply this again by 10° inclination to starboard, and we get—13.°23 as the answer.

Or

N. E. by N.½ N. or 2½ points

Nat. cos. $2\frac{1}{2}$ pt. = 0.882 × (—1.°5) = 1.°323 for 1°

∴ 1.°323 × heel 10° = —13.°23 = For 2½ points.

If the heeling error has a plus sign when heeling to starboard, it will have a minus one with a heel in the opposite direction; also, that the sign are reversed when the northern semicircle of the Compass is substituted for the southern one, or the contrary.

4. For example, if the heeling co-efficient on North is + 1.°5 when heeling to starboard, it will be —1.°5 on south when heeling the same way.

In conclusion, the heeling Error on any given point must not be confounded with the deviation on the same point.

5. For example, the Deviation, ship upright on S. W. is + 13,° but when heeling 17° to port it is only + 2,° the heeling error is consequently—11.°

Or

S. W. point +13° upright

S. W. point + 2 heeling 17° to port

17°) — 11 / 0.65 for each degree of heel—to port

4pt. Nat. cos 0.707)—0.65

—0.92 for south point of each degree of heel to port

∴

—0.92 × 17° = —15.°64 For South point, heel 17° to port

6. Complete example—with ship's head S. E. by E., and upright, the Deviation is + 23°; when heeling 8° to port it is + 3.°

Required the deviation on N. N. W., when heeling 15° to Starboard; the deviation on that point, when upright, being—14°; magnetic latitude the same in each case

Answer—76.°25

Or

S.E. by E point + 23° upright

+ 3° heeling 8° to port

8°) — 20 / — 2.5 for each degree of heel—to port

5 pt. Nat. cos. 0.556) — 2.°5 / — 4.496 Coefficient for each degree of heel to both sides at N.S. 2 pt. Nat. cos. 0.924 × (—4.496) = 4.154301 Coefficient for each degree of heel to Starboard (for 2 pt.)

∴—4.154304 × 15° = — 62.31 } heeling Error 15° to Starboard
upright = — 14.00 }
Deviation = —76.31

兩高度時辰儀經緯度測定法
DOUBLE CHRONOMETER RULE.

By the Graphic Method.

Where the heavenly body observed is supposed to be the sun.

Fig. 1.

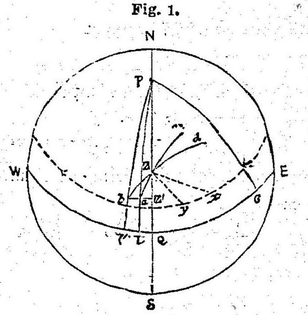
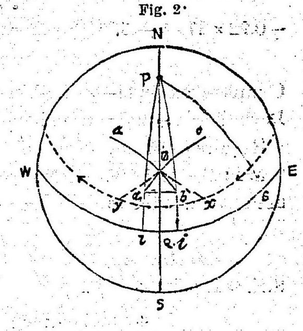


Fig. 2.



Let PG represent the meridian of Greenwich.

z the true Zenith of the observer at time of second observation.

x the Sun's place at the first observation.

y the Sun's place at the second observation.

ZQ the true Lat. at the time of second observation, and Z′Q the Lat. by dead reskoning at the same instant.

In the triangles ZbZ′, ZaZ′, which being very small may be considered as plane triangles, ab is known (=departure corresponding to ll′) and ZaZ′ (=to the first true bearing Z′ZX, since they are both Complements to Z′Za) and ZbZ′ (=the second true bearing Z′Zy, since both are Complements of Z′Zb); hence we can find ZZ′ the correction for the latitude Z′Q; and thence Z′a, Z′b, and Ql, Ql′ the corrections for the two longitudes.

Let the true bearings of the Sun at the times of first and second observations be represented by A_1 and A_{11}.

Then if the first chronometer is worked with the Lat. D. R. at that time and corrected for run, the first observation places the ship at a when the second observation is taken, the second places her at b, both a and b being of course, on the same parallel of lat. as Z′.

The longitudes corresponding to these positions are Gl and Gl′.

Then Gl′—Gl=ll′, the diff. long.

$$\therefore \text{ zz′ or Corr. in lat.} = \frac{\text{diff. Long} \times \text{Sin. } A_1 \times \text{Sin } A_{11} \times \text{Cor lat.}}{\sin (A_1 \pm A_{11})} \quad . \quad (1)$$

The upper sign applying to fig. 2, and the lower to fig. 1.

$$\text{Also bz′ or Corr. in long.} = \text{zz′} . \cot A_{11} . \sec . \text{lat}_{11} \quad . \quad . \quad . \quad (2)$$

The second observation is worked with this corrected latitude are marked (1) and (2).

The second observation is worked with this corrected latitude, and the longitudes are marked.

Table (A).

To Name the correction for the D.R. Latitude.

The observation's Latitude with reference to the Sun's Declination.	Observation the Same side of Mer.		Observation on the Opposite Side of Mer.	
	Longitudes	Corr. for D.R. Lat.	Longitudes	Corr. for D.R. Lat.
Northward	(1) East of (2) (1) West of (2)	N. S.	(1) East of (2) (1) West of (2)	S. N.
Southward	(1) East of (2) (1) West of (2)	S. N.	(1) East of (2) (1) West of (2)	N. S.

Table (B).

To name the Correction for the Approximate Longitude.

A.M., or Sun East of Meridian			P.M, or Sun west of Meridian		
True bearing reckoned from	When Corr. in Lat. is	Corr. in Long. is	True bearing reckoned from	When Corr. in Lat. is	Corr. in Long. is
N.	N.	W.	N.	N.	E.
N.	S.	E.	N.	S.	W.
S.	N.	E.	S.	N.	W.
S.	S.	W.	S.	S.	E.

Example.

On January 17, in Lat. 9° 22′ 10″ N., and Long. 158° 50′ 0″ E.,(by D.R.), at 8h 0m A.M., when the G.M.T. was 9h 27m 50s ,the alt. of the Sun was 22° 11′ 0″, and Decl. and Eq. of time 20° 48′ 50″ S., and 10m 12s add. to app. time.

The ship Then ran N. 50° W. (True) 13.5 miles and at 10h 10m A. M., when the G.M.T. was 11h 34m 57s , the alt. of the Sun was 47° 37′ 50″ and Decl. and Eq. of time 20° 47′ 49″ S., and 10m 14s .

Find the Lat. and Long. of second position of observation.

The altitudes given are true altitudes of the Sun's Centre ; the Declination and equation of time, &c, are corrected for Greenwich date.

1st bearing S 62° 52′ E.

2nd „ S 27 52 E.

$A_1 - A_{11} = 35\ 0$

Ran N. 50° W. 13.5 miles

∴

Diff. Lat.= 8′ 41″ N.

Dep.= 10.34′.

Diff. Long.=10′30″ W.

D.R. 1st Lat = 9° 22′10″N.

Diff. Lat.= 8 41 N.

D.R. 2nd Lat.= 9 30 51 N.

N. 9°30′51″ . . 0.006015

S. 20 47 49. . . 0.029260

30 18 40

Z.D. 42 22 10

N. 9° 22′ 10″ 0.005832

S. 20 48 50.....0.029409

30 11 00

Z.D. 67 49 00

S. 98 00 00.....4.877780

D.37 38 00.....4.508585

9.421606

S. 72 40 50. . . 4.772747

D. 12 3 30. . . 4.021333

8.829355

S. A. T. = 21h 59′ 32″

Eq. of„ = + 10 14

S. M. „ = 22 9 46

S. A. T. = 19h 52m 40s

Eq. of „ = + 10 12

S. M. „ = 20 2 52

G.M. „ = 9 27 50

Long. in „ = 10 35 2

∴ Long. = 158°45′ 30 ′E.

Corr. for ran = 10 30 W.

Long. (1)=158 35 0 E.

G. M. T = 11 34 57

Long. in T = 10 34 49

∴ Long. (2) = 158° 42′ 15″E.

(1) =158 35 0 E.

Diff. Long.= 0 7 15

or 7.25′

Then

$ZZ' = \text{Diff. Long.} \times \sin A_1 \times \sin A_{11} \times \cos L_{11} \times \text{Cosec}\,(A_1 \pm A_{11})$

$bz' = ZZ' \times \cot A_{11} \times \text{Sec}\, L_{11}$

Log. Diff. Long. = 0.860338

„ sin A_1 = 9.949364

„ sin A_{11} = 9.669703

„ cos L_{11} = 9.993985

„ Cosec $(A_1 - A_{11})$ = 0.241409

„ ZZ_1 = 0.714799. ∴ ZZ′ or corr. in Lat.=5′,185 or5′11S.

„ cot A_{11} = 0.276768 D.R. 2nd Lat.= 9 30 51N.

„ Sec L_{11} = 0.005906 True Lat.= 9 25 40N.

„ bz' = 0.997473

∴ bz' = 9.942 or Corr. in Long. = 9′57″ W.

Long.(2) = 158°42′15″ E..

True long. = 158 32 18 E.

シ綜錯ヲ且シ費ヲ間時ハ時ルム定リヨ上論理ヲ頁正ノ正改差誤ノ此ンメ定ニヲ直ヲ頁正其テ於ニ地實ニ故ズラカナ少フルズ生ヲ惑疑テニカ速層一亦モリヨ表該ヒレ然リセ製ヲ表號符ノ(B)及(A)メ爲カス明說ナレ之ニ下テ以リア法捷簡ルム定ト然判ツ且

(2)ト(1)ノ度經ニレ之キ引ヲ線度緯ルナ W.E.ク如ノ圖下ッ先ナル在ニレ何西東ノ(2)ハ(1)ノ度經) シベス記テ隔クシ少ヲ點ノト

其各リヨ點此メ而　リナ西ノ(2)ハ(1)ハテ於ニ題例此シ但シバム定
レ何ハ線切此ハハキク引ヲ (tangent) 線切ニレ之レニ引チ線ノ度角位方
リナ地在所ノ眞ハPチ即點會交此シベス會交テ於ニカ
ルナ W. ハ差誤ノ度經リナト負テ以チルナS.ナルテ以テ負ト差誤ノ度緯ニ故
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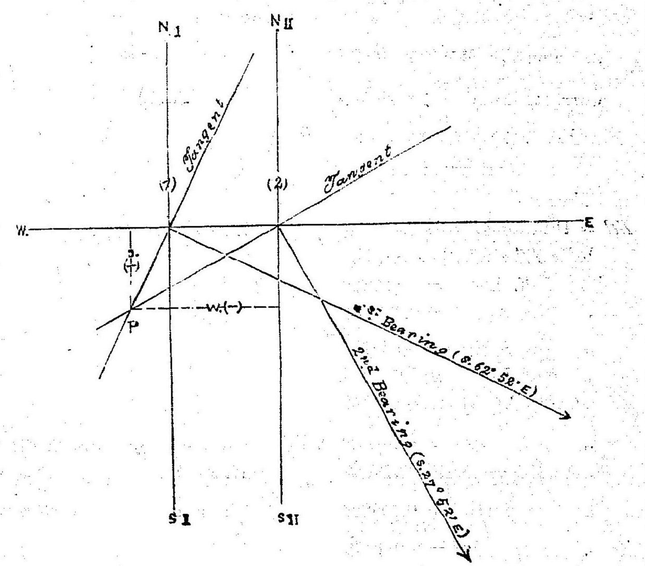

時辰儀日差推算法

On the Method of Correcting the rate of a Marine Chronometer.

When the mean rates which a Chronometer has made in the three emperatures, 55°, 70°, and 85°, are known from the observatory rate sheets, it is necessary to calculate the quantities, C, T, and R, for that watch.

T is the temperature in which the watch attains its maximum gaining rate.

R is the rate at T.

C is a Constant factor, which, multiplied by the square of any number of degrees from T, shows the amount of loss for that number of degrees.

It may be here mentioned that C and T have been found by expriment to remain constant for long periods, seldom changing, unless the watch is either cleaned or repaired.

R, on the contrary, is liable to change occationary, and should be verified at every opportunity of obtaining a rate by observation.

Formula for finding C, T, and R.

Sign + indicates fast error, or gaining rt.

„ − „ slow „ ,or losing. „

Rate in T° = r　　r − r′ = d.

Rate in T, = r′

Rate in T„ = r″　　r′ − r″ = d′.

$$C = \frac{2\,(d - d')}{(T_{,,} - T_o)^2}$$

$$(T - T_o) = \frac{d + d'}{c \times 60},$$

$$T = T^\circ \pm \frac{d + d'}{c \times 60},$$

R = r° ± difference to T.

Difference to T = $(T - T_O)^2 \times C$

(1) Rate in 55° Say -0.72^s ... r

... $r - r' = -0.45^s$ ... d

„ „ 70 „ -0.27 ... r′

... $r' - r'' = +1.08$ ... d′

„ „ 85 „ -1.35 ... r″

$d - d' = \overline{-1.53^s}$

$d + d' = +0.63$

To find C

$$C = \frac{2(d-d')}{(T_{,,}-T_{,})^2} = \frac{2 \times -1.53^s}{(85^\circ-55^\circ)^2} = \frac{-3.^s06}{900} = -0.0034$$

To find T

$$(T-70^\circ) = \frac{d+d'}{C \times 60} = \frac{+0^s.63}{-0.0034 \times 60} = \frac{+0.^s63}{-0\,204} = -3^\circ.1 \quad T = 70^\circ - 3^\circ.1 = 66^\circ.9$$

To find R

$$(T - 70^\circ)^2 \times C = (-3^\circ.1)^2 \times 0.0034 = 0.03^s$$

∴

Rate at 70° $= -0.27^s$ losing.

Difference to T $= +0.03$ faster.

R $= \overline{-0.24}$ losing.

(2) Rate in 63° $= +4^s.0$ ... r

... $r - r' = +1.^s5$ ... d

„ „ 69 $= +2.5$ ... r′

... $r' - r'' = +1.2$ ... d′

„ „ 75 $= +1.3$ ... r″

$d - d' = \overline{+0\cdot3}$

$d + d' = +2\cdot7$

$$C = \frac{2 \times 0.^s3}{12^2} = \frac{0.^s6}{144} = +0.004\blacktriangle$$

$$(T = 63^\circ) = \frac{2.^s7}{0.004 \times 60} = \frac{2.^s7}{0\,24} = 11^\circ.2$$

$T = 63^\circ - 11^\circ.2 = 51^\circ.8$

$C \times (T - T_o) = (51.^\circ8 - 63^\circ) \times 0.004 = -11^\circ.2^2 \times 0.004 = 0.^s502$

Rate at 63° $= +4^s.0$ gaining.

„ „ $\underline{11.2} = +0.502$ „

„ „ $51.8 = +4.502$ „ or R.

Let.....N = any number of degrees from T.

Then $C \times N^2$ = Amount of loss for N.

The quantities C, T, and R, for any watch, having been found, the rule for finding the rate of the same watch in any given temperature is as follows :—

Take the difference between the given temperature and T (calling this difference N).

Multiply N^2 by C, and the result will be the amount by which the watch will go slower or faster at the given temperatures than it does at T; and, therefore, by applying the amount thus obtained to R (the rate of the watch at T), the rate in the given temperature will be obtained.

When C, T, and R have been found, the rate which the watch will Keep in Various temperatures Can be found the Table.

The Table gives the amount by which a watch will go slower or faster at T, at any given Number of degrees from T.

The rule for using the Table is :—

Take the difference between the given temperature and T (that is, N).

Take C to the nearest third decimal place.

Enter the Table with C at the head

Enter the Column marked N, with N as given to nearest degree, and in the Column marked Cor'n. will be found the amount by which the watch will go slower or faster for N degrees.

Example.

T 72° C0.003 R -0.54^s

Required the rate in 60°

Difference between T and given temperature = 12° = N.

Enter Table headed C0.003, and Column N, and take 12°

The Column Cor'n gives -0.43^s losing

R $\underline{-0.54_s}$ „

Rate in 60° $= -0.97^s$.

時辰儀日差推算表
Table of Corrections due to Change of Chronometer.

C 0.001.

N.	Cor'n.	N.	Cor'n.	N.	Cor'n.	N.	Cor'n.	N.	Cor'n.
°	s.	°	s.	°	s.	°	s.	°	s.
1	0.00	21	0.44	41	1.68	61	3.72	81	6.56
2	0.00	22	0.48	42	1.76	62	3.84	82	6.72
3	0.01	23	0.53	43	1.85	63	3.97	83	6.89
4	0.02	24	0.58	44	1.94	64	4.10	84	7.06
5	0.02	25	0.62	45	2.02	65	4.22	85	7.22
6	0.04	26	0.68	46	2.12	66	4.36	86	7.40
7	0.05	27	0.73	47	2.21	67	4.49	87	7.57
8	0.06	28	0.78	48	2.30	68	4.62	88	7.74
9	0.08	29	0.84	49	2.40	69	4.76	89	7.92
10	0.10	30	0.90	50	2.50	70	4.90	90	8.10
11	0.12	31	0.96	51	2.60	71	5.04	91	8.28
12	0.14	32	1.02	52	2.70	72	5.18	92	8.46
13	0.17	33	1.09	53	2.81	73	5.33	93	8.65
14	0.20	34	1.16	54	2.92	74	5.48	94	8.84
15	0.22	35	1.22	55	3.02	75	5.62	95	9.02
16	0.26	36	1.30	56	3.14	76	5.78	96	9.22
17	0.29	37	1.37	57	3.25	77	5.93	97	9.41
18	0.32	38	1.44	58	3.36	78	6.08	98	9.60
19	0.36	39	1.52	59	3.48	79	6.24	99	9.80
20	0.40	40	1.60	60	3.60	80	6.40	100	10.00

時辰儀日差推算表
Table of Corrections due to Change of Chronometer.

C 0.002.

N.	Cor'n.	N.	Cor'n.	N.	Cor'n.	N.	Cor'n.	N.	Cor'n.
°	s.	°	s.	°	s.	°	s.	°	s.
1	0.00	21	0.88	41	3.36	61	7.44	81	13.12
2	0.01	22	0.97	42	3.53	62	7.69	82	13.45
3	0.02	23	1.06	43	3.70	63	7.94	83	13.79
4	0.03	24	1.15	44	3.87	64	8.19	84	14.11
5	0.05	25	1.25	45	4.05	65	8.45	85	14.45
6	0.07	26	1.35	46	4.23	66	8.71	86	14.79
7	0.10	27	1.46	47	4.42	67	8.98	87	15.14
8	0.13	28	1.57	48	4.61	68	9.25	88	15.49
9	0.16	29	1.68	49	4.80	69	9.52	89	15.84
10	0 20	30	1.80	50	5.00	70	9.80	90	16.20
11	0.24	31	1.92	51	5.20	71	10.08	91	16.56
12	0.29	32	2.05	52	5.41	72	10.37	92	16.93
13	0.34	33	2.18	53	5.62	73	10.66	93	17.30
14	0.39	34	2.31	54	5.83	74	10.95	94	17.67
15	0.45	35	2.45	55	6.05	75	11.25	95	18.05
16	0.51	36	2.59	56	6.27	76	11.55	96	18.43
17	0.58	37	2.74	57	6.50	77	11.86	97	18.82
18	0.65	38	2.89	58	6.73	78	12.17	98	19.21
19	0.72	39	3.04	59	6.96	79	12.48	99	19 60
20	0.80	40	3.20	60	7.20	80	12.80	100	20.00

海員必携附録　時辰儀日差推算表