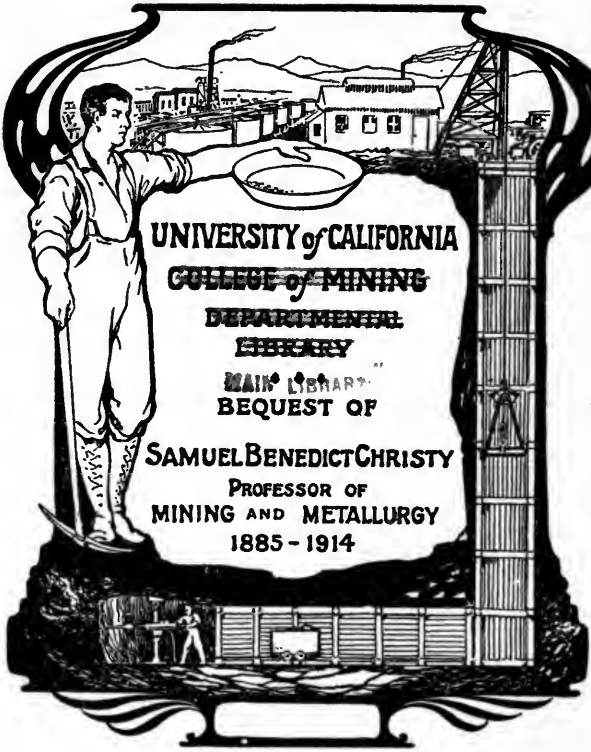
HENDY'S HANDY ATLAS OF THE WORLD

MINING MACHINERY



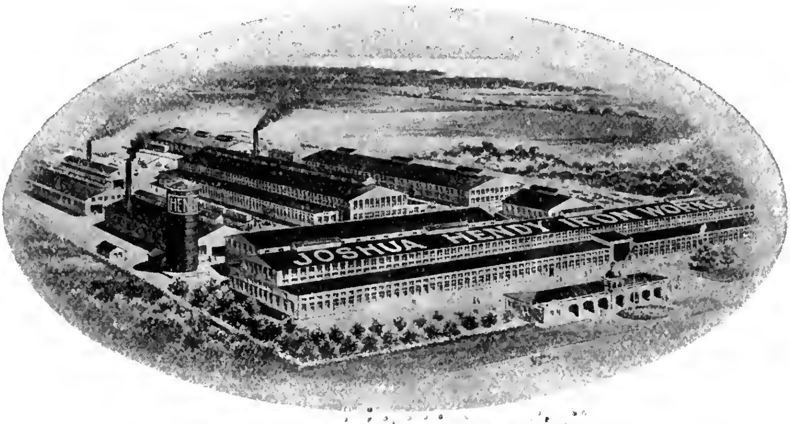
4

HENDY'S

Handy Atlas of the World

Containing New Maps of Each State and Territory in the United States and Each Country in the World

Also Practical Pointers and Condensed Data for the Machinist, Mechanic, Millman and Miner.



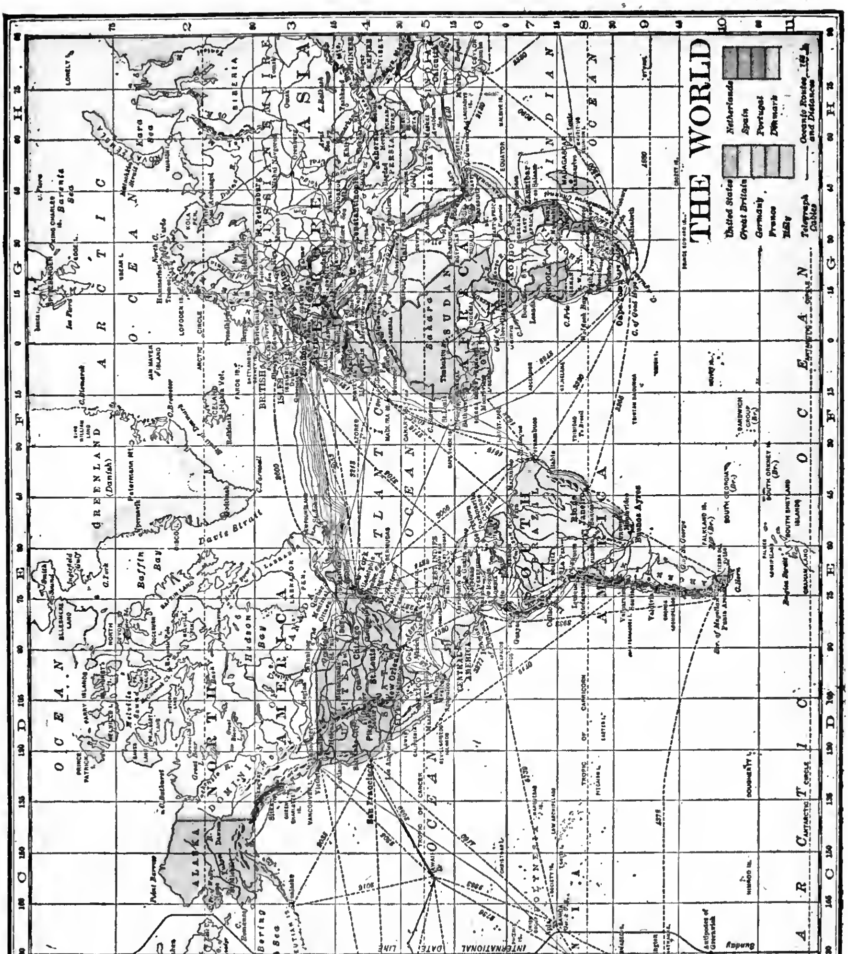
Works at Sunnyvale, California

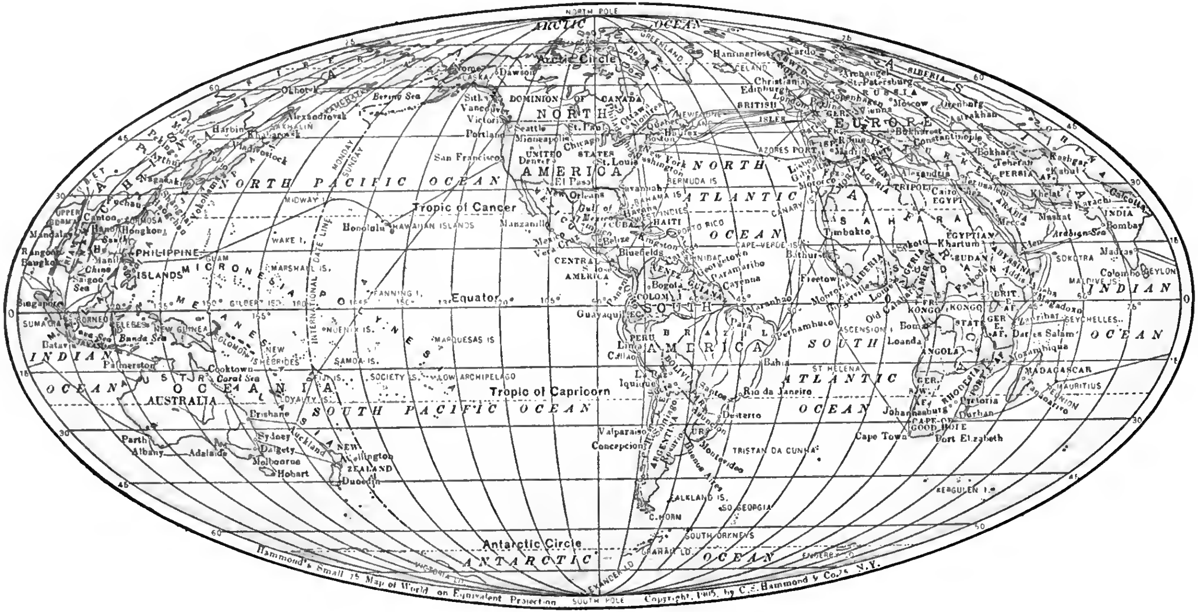
1910

JOSHUA HENDY IRON WORKS
Office and Salesroom: 75 Fremont Street, San Francisco, Cal.

ALPHABETICAL LIST OF STATES AND COUNTRIES

Indicating the Maps in the Atlas on which they are shown


THE WORLD
United States
Great Britain
Germany
France
Italy
Netherlands
Spain
Portugal
Denmark
Telegraph Cables
Oceanic Routes and Distances
C. S. HAMMOND & CO., N. Y.



MAP OF THE WORLD ON THE EQUIVALENT PROJECTION

EXPLANATORY NOTE

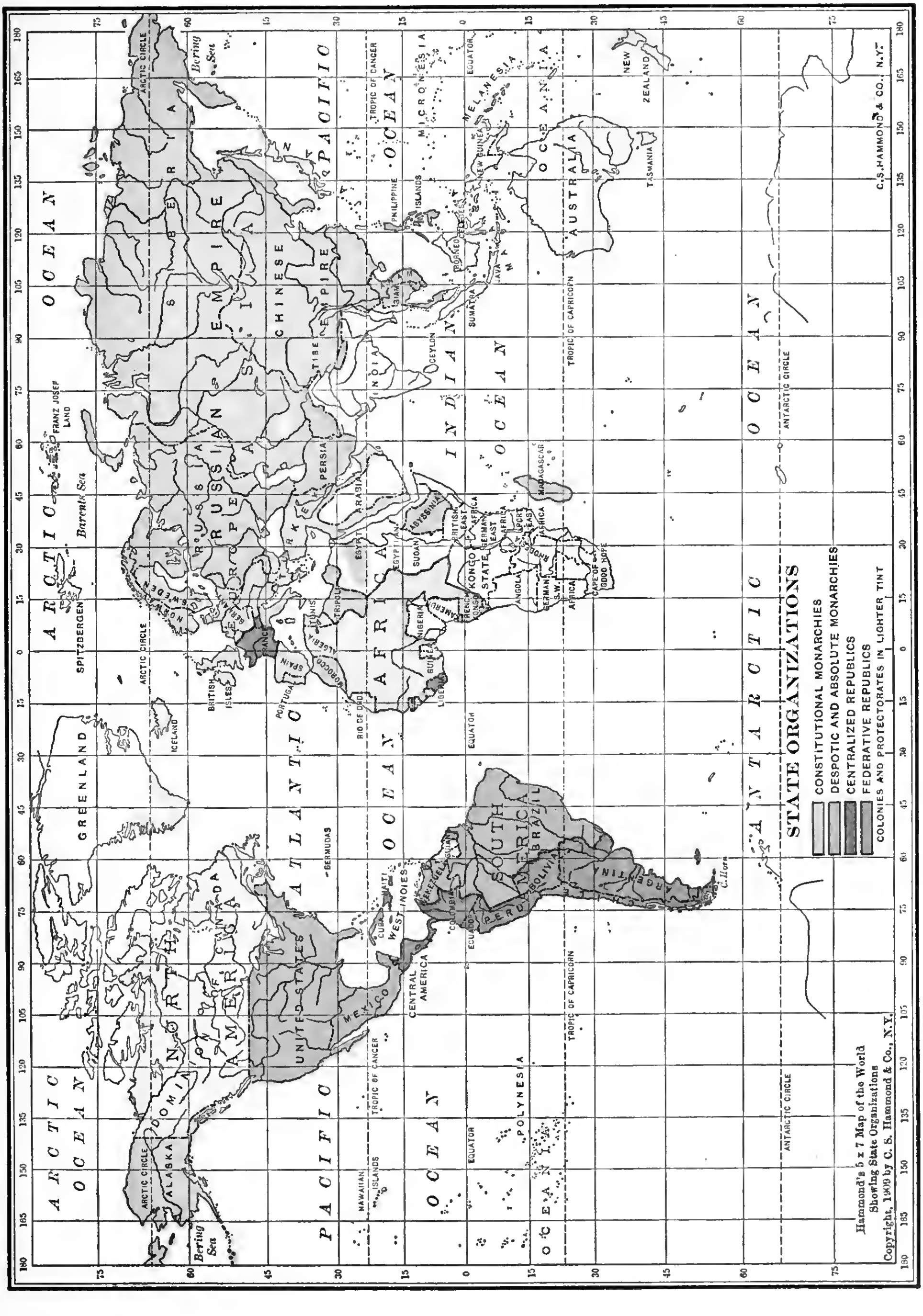
This new map presents a comprehensive view of the superficial area of the earth, not unlike that which would be displayed by the printed cover of a globe, if removed and flattened.

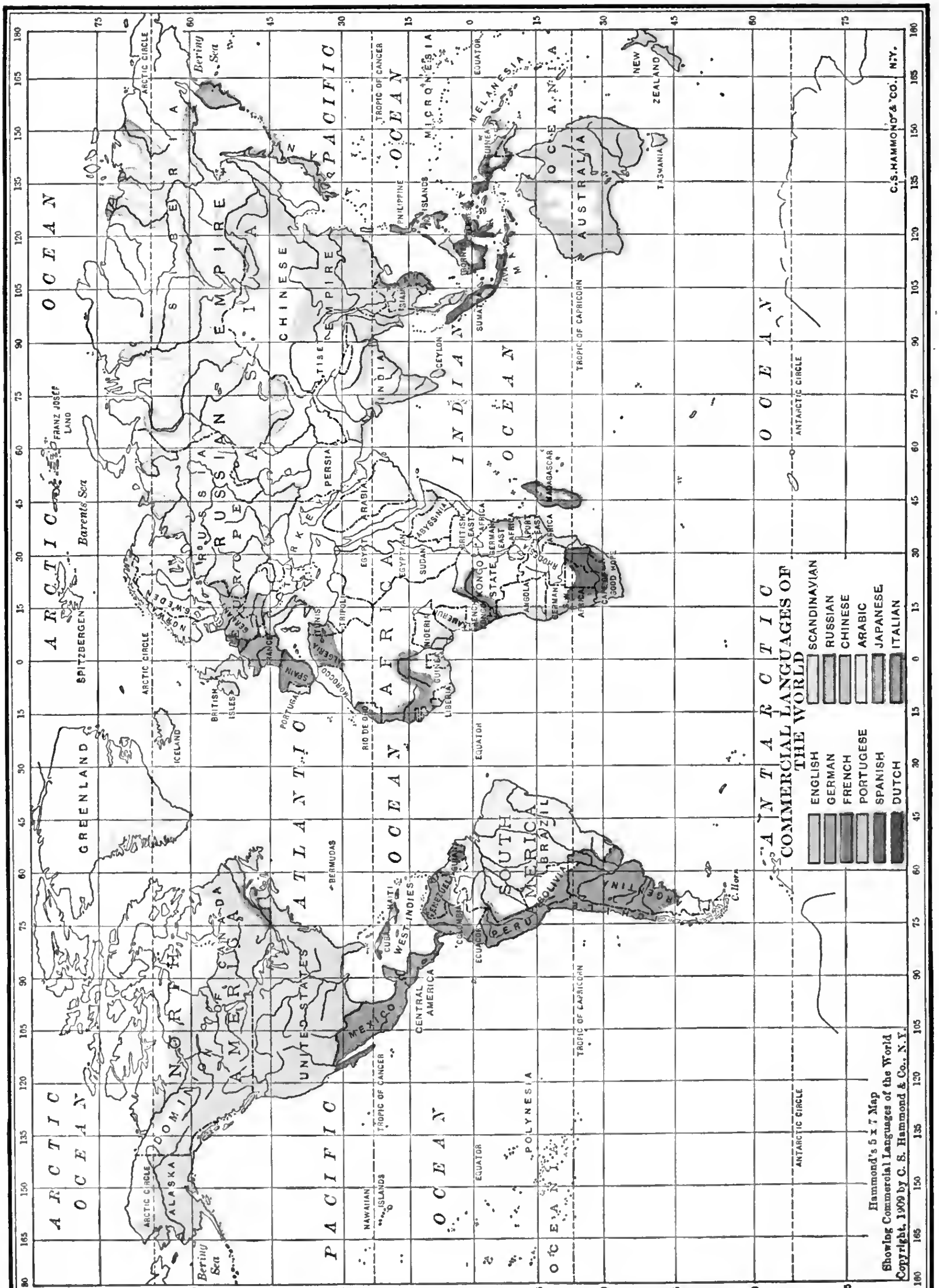
On this map all areas appear in their true proportion. For example, Greenland, which, on Mercator's Projection, seems to be larger than South America, here is shown in its relative proportion of size to that continent, having less than one-eighth of the latter's area. In fact, this is the only projection in which are shown the equivalent areas, or correct sizes, of all parts of the globe, in their proper relative position.

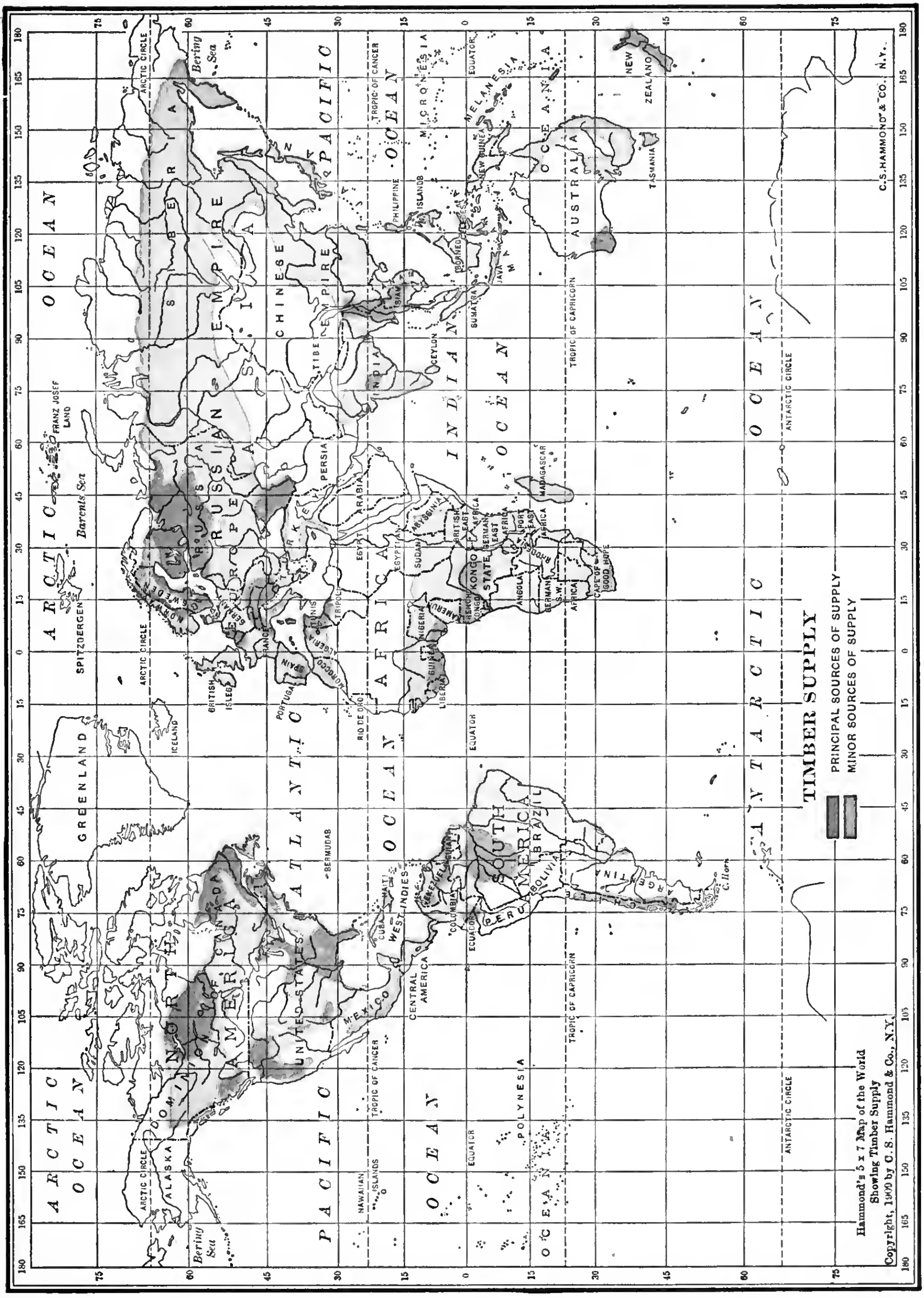
The meridians are placed fifteen degrees apart, and, since this interval is equal to one hour of time, meridians and intervals make a standard time-map for the whole earth. On the line of the Equator is given the time at each meridian, corresponding to noon at Greenwich. These figures will be found convenient for quick reference; and the approximate difference in time between any two points may be readily obtained, by simply counting the meridians, and allowing one hour for each.

FEATURES

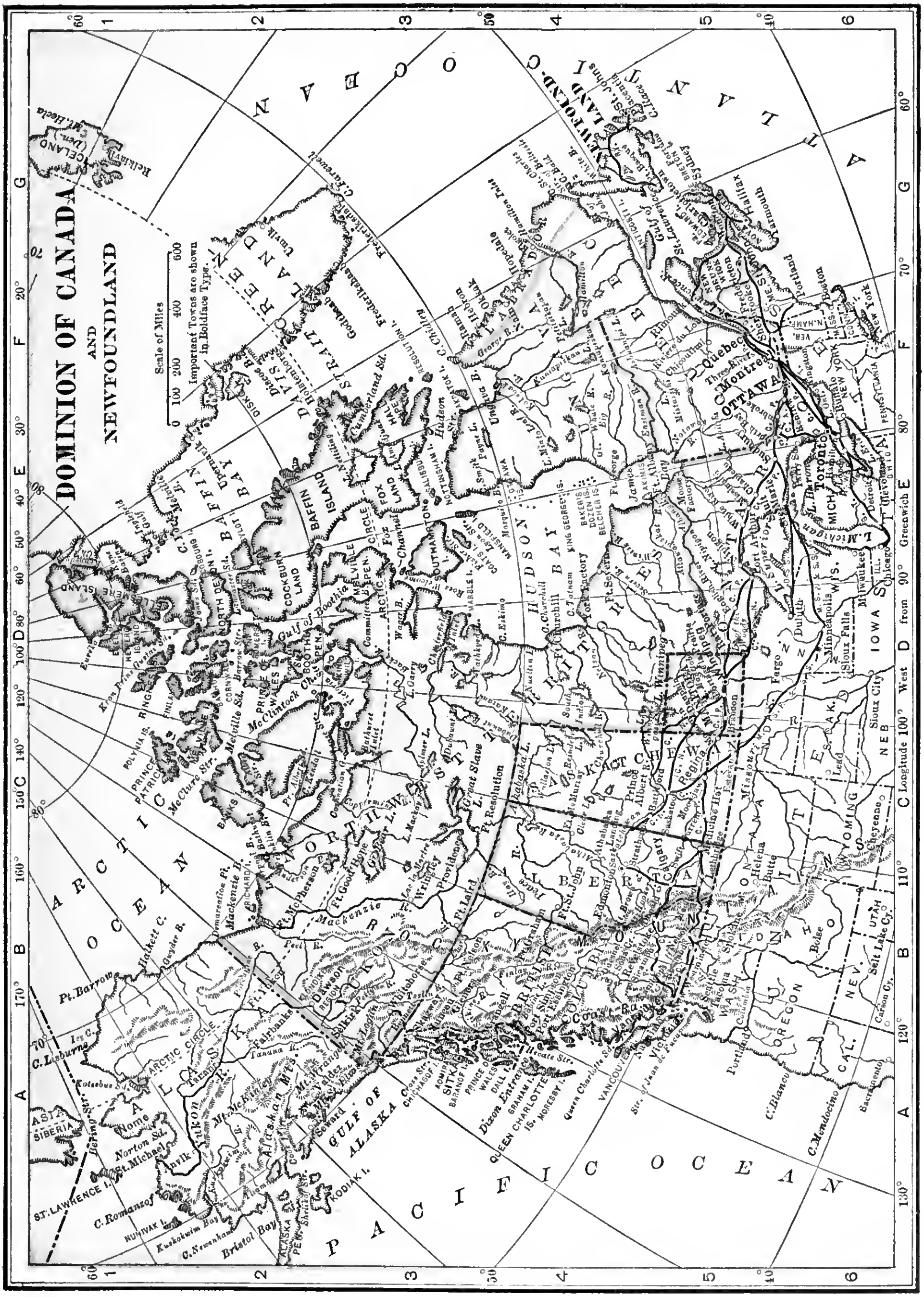
Submarine Cables, shown in fine black lines.
The International Date Line, as agreed upon by leading nations, shown in heavy broken line.
Colonial possessions of European powers in Africa, Asia and Oceania, shown in colors corresponding with those used for mother countries.

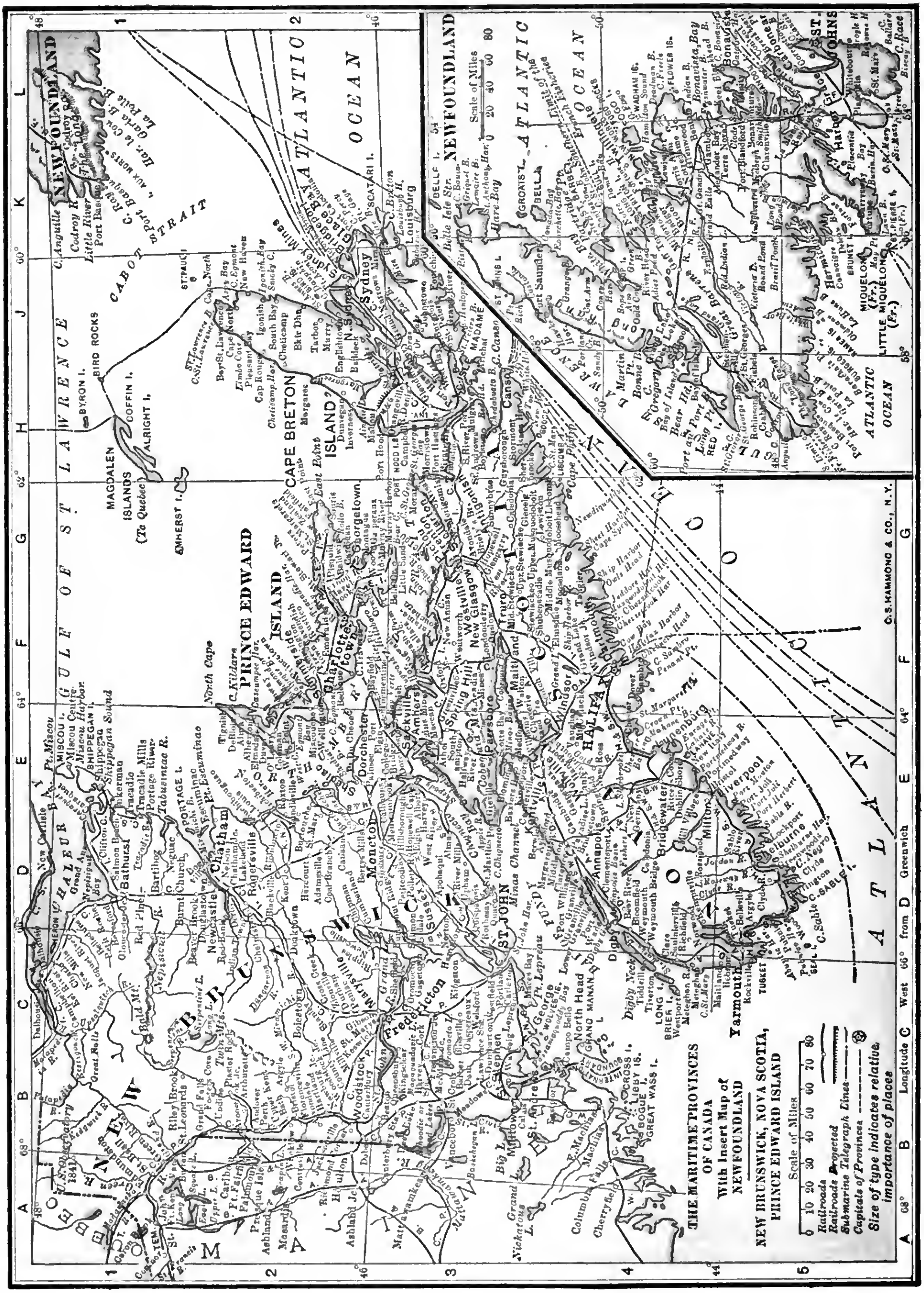

STATE ORGANIZATIONS
CONSTITUTIONAL MONARCHIES
DESPOTIC AND ABSOLUTE MONARCHIES
CENTRALIZED REPUBLICS
FEDERATIVE REPUBLICS
COLONIES AND PROTECTORATES IN LIGHTER TINT
Hammond's 5 x 7 Map of the World
Showing State Organizations
Copyright, 1909 by C. S. Hammond & Co., N.Y.
C.S.HAMMOND & CO. N.Y.
ARCTIC OCEAN
PACIFIC OCEAN
ATLANTIC OCEAN
INDIAN OCEAN
ANTARCTIC OCEAN
NORTH AMERICA
SOUTH AMERICA
AFRICA
AUSTRALIA
RUSSIAN EMPIRE
CHINESE EMPIRE
UNITED STATES
MEXICO
DOMINION OF CANADA
GREENLAND
ALASKA
ICELAND
BRITISH ISLES
SPAIN
PORTUGAL
PERSIA
INDIA
SIAM
NEW ZEALAND
TASMANIA
MADAGASCAR
BRAZIL
ARGENTINA
PERU
BOLIVIA
TROPIC OF CANCER
TROPIC OF CAPRICORN
EQUATOR
ARCTIC CIRCLE
ANTARCTIC CIRCLE

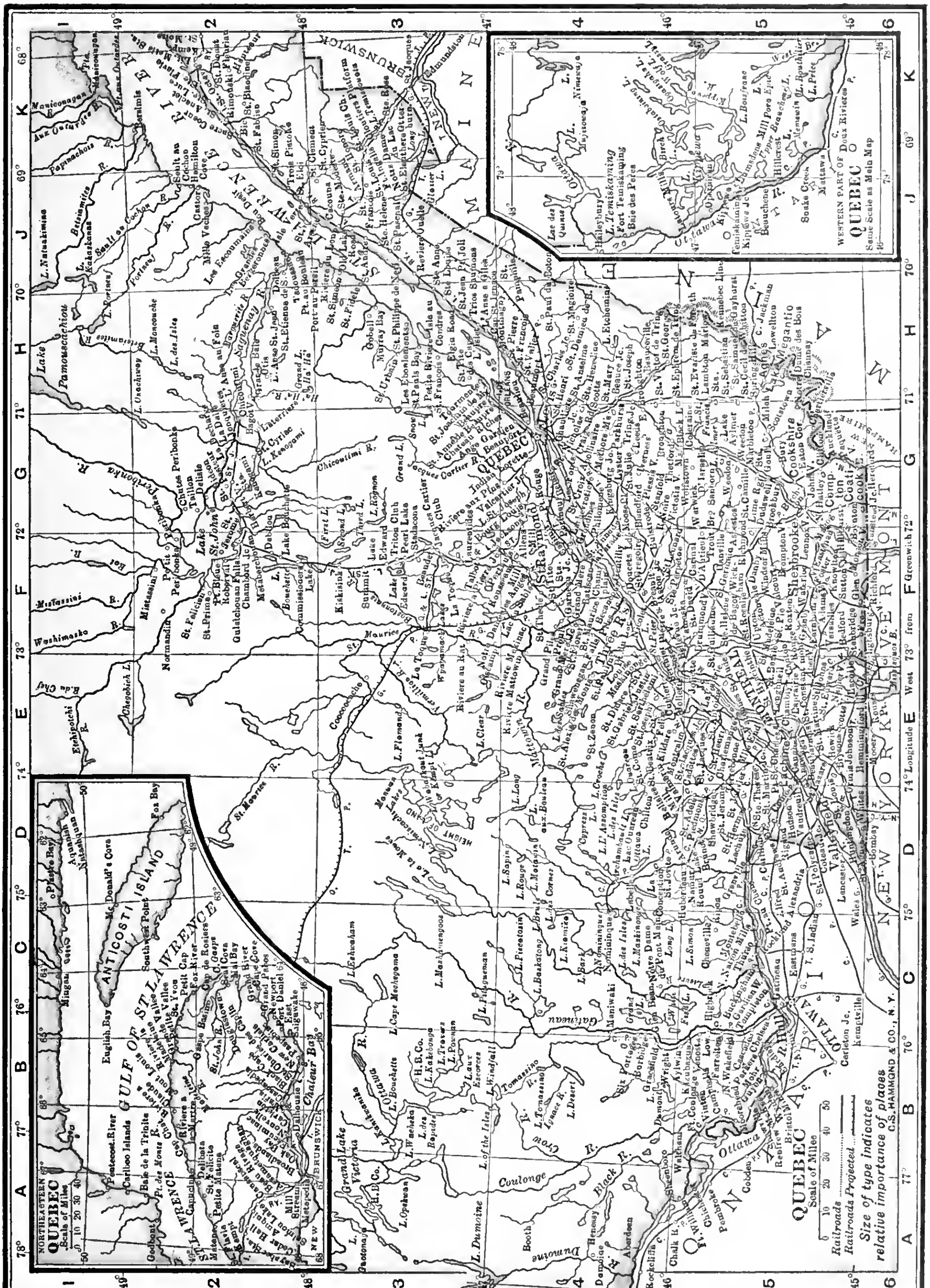

COMMERCIAL LANGUAGES OF THE WORLD
ENGLISH
GERMAN
FRENCH
PORTUGESE
SPANISH
DUTCH
SCANDINAVIAN
RUSSIAN
CHINESE
ARABIC
JAPANESE
ITALIAN
Hammond's 5 x 7 Map
Showing Commercial Languages of the World
Copyright, 1909 by C. S. Hammond & Co., N.Y.
C.S.HAMMOND & CO. N.Y.
ARCTIC OCEAN
PACIFIC OCEAN
ATLANTIC OCEAN
INDIAN OCEAN
ANTARCTIC OCEAN
GREENLAND
DOMINION OF CANADA
NORTH AMERICA
UNITED STATES
MEXICO
SOUTH AMERICA
BRAZIL
AFRICA
EUROPE
RUSSIAN EMPIRE
CHINESE EMPIRE
INDIA
AUSTRALIA
OCEANIA
NEW ZEALAND
TROPIC OF CANCER
EQUATOR
TROPIC OF CAPRICORN
ARCTIC CIRCLE
ANTARCTIC CIRCLE

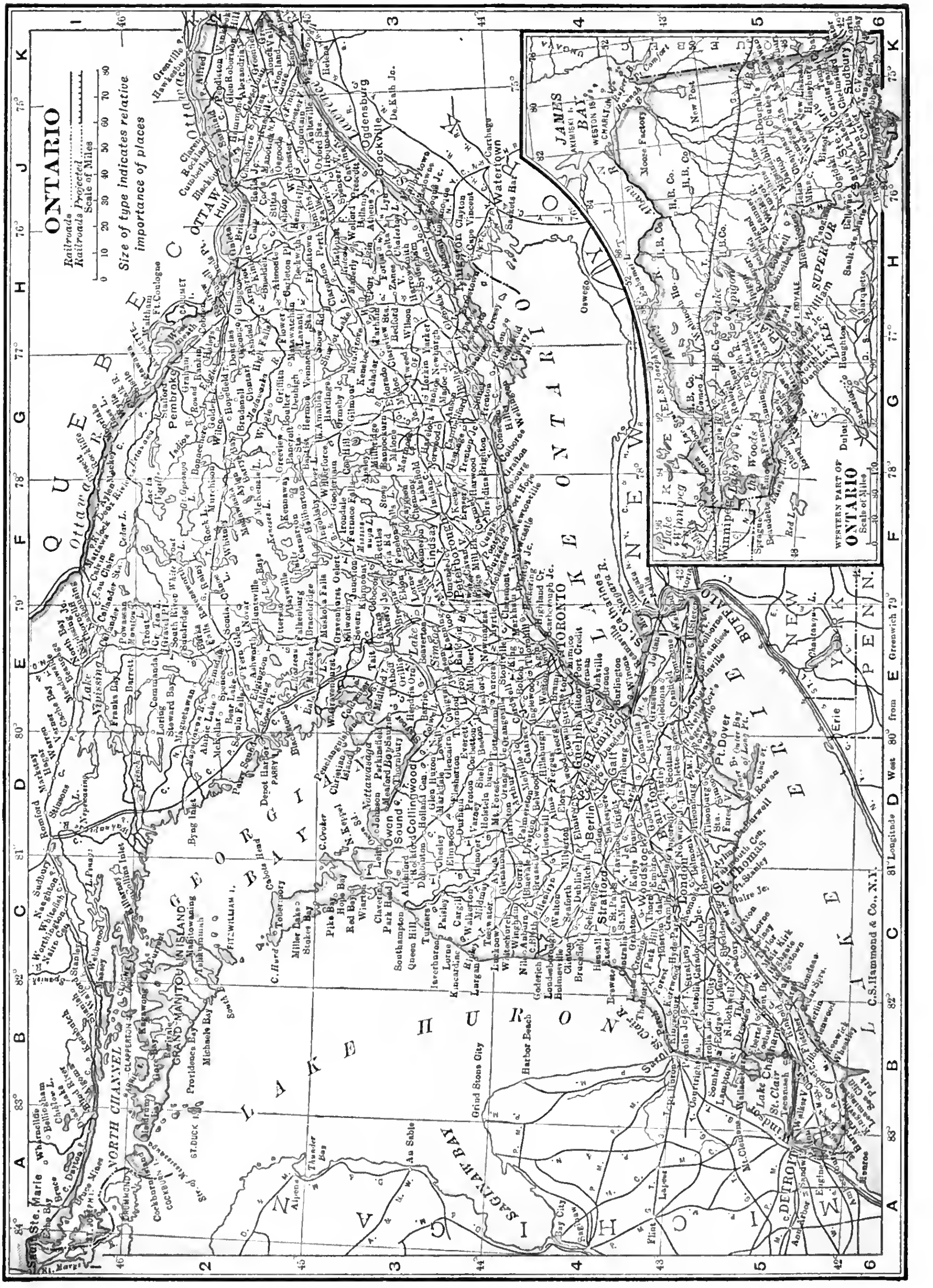

TIMBER SUPPLY
PRINCIPAL SOURCES OF SUPPLY
MINOR SOURCES OF SUPPLY
Hammond's 5 x 7 Map of the World
Showing Timber Supply
Copyright, 1909 by C. S. Hammond & Co., N.Y.
C.S. HAMMOND & CO. N.Y.

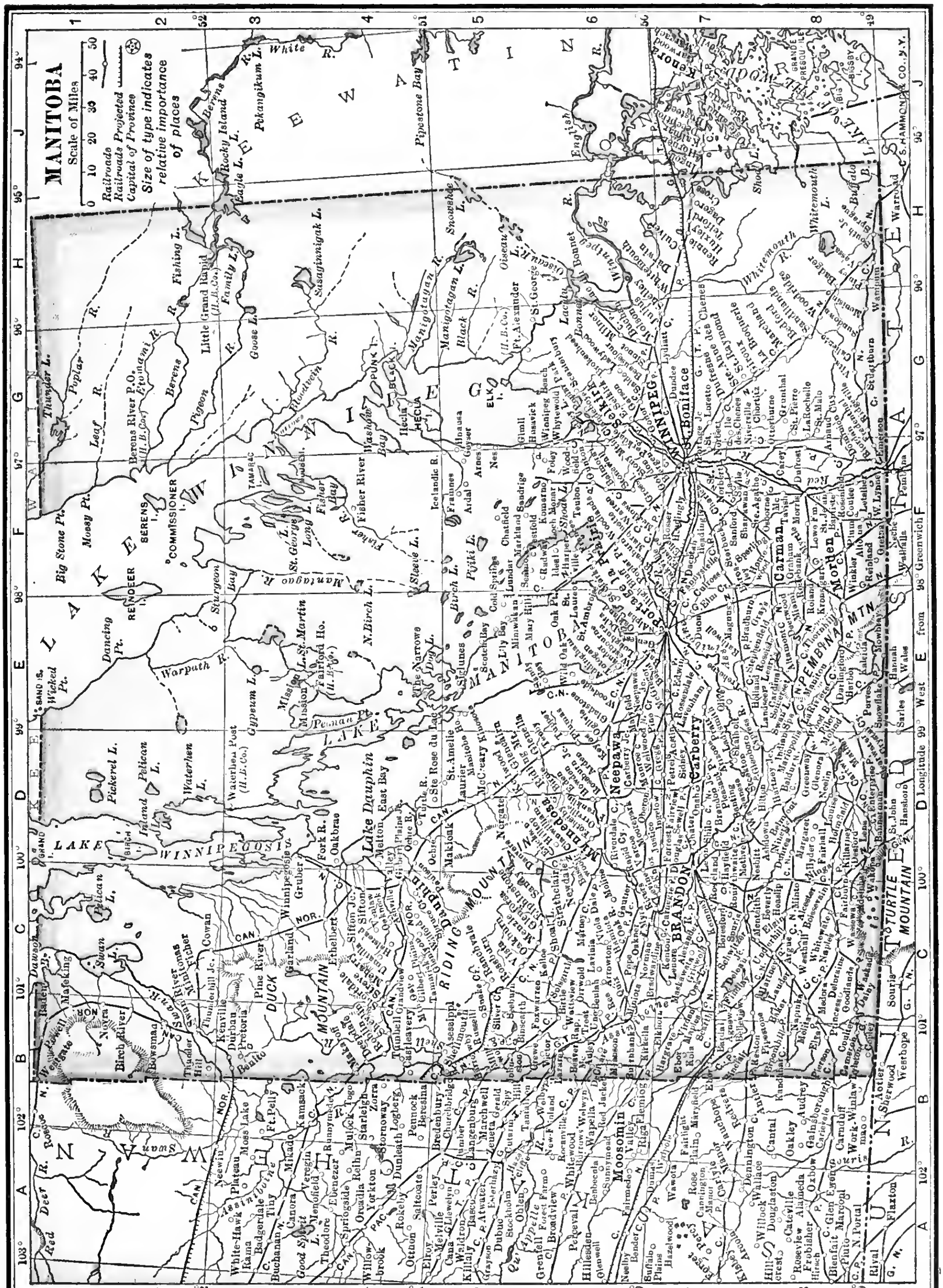

NORTH AMERICA
Scale of Miles
0 200 400 600 800 1000
Important towns are shown in heavy face type
ARCTIC OCEAN
PACIFIC OCEAN
ATLANTIC OCEAN
GREENLAND (To Denmark)
DOMINION OF CANADA
UNITED STATES
MEXICO
CENTRAL AMERICA
WEST INDIES
SOUTH AMERICA
HUDSON BAY
BAFFIN BAY
GULF OF MEXICO
CARIBBEAN SEA
ALASKA
BERING SEA
TROPIC OF CANCER
EQUATOR
ARCTIC CIRCLE
Washington
New York
Boston
Philadelphia
Chicago
St. Louis
New Orleans
San Francisco
Los Angeles
Seattle
Portland
Denver
Montreal
Quebec
Ottawa
Toronto
Winnipeg
Havana
Mexico
110 Longitude West 100° from Greenwich 90°

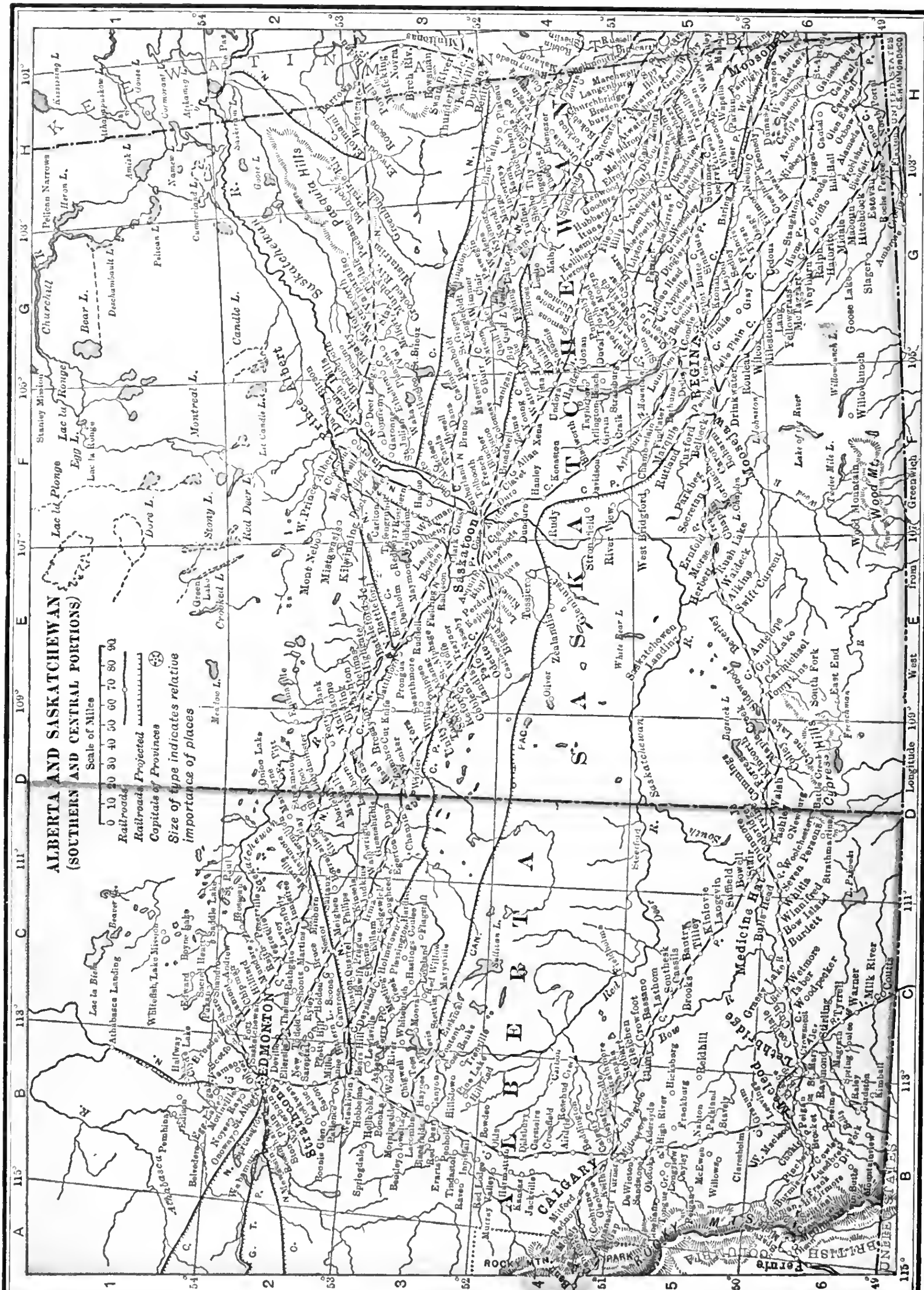

DOMINION OF CANADA
AND
NEWFOUNDLAND
Scale of Miles
0 100 200 400 600
Important Towns are shown in Boldface Type.
ARCTIC OCEAN
ATLANTIC OCEAN
PACIFIC OCEAN
HUDSON BAY
BAFFIN BAY
BAFFIN ISLAND
GREENLAND
ALASKA
GULF OF ALASKA
YUKON
BRITISH COLUMBIA
ALBERTA
NORTH W. T.
ONTARIO
QUEBEC
LABRADOR
NEWFOUNDLAND
OTTAWA
Montreal
Quebec
Toronto
Winnipeg
Regina
Dawson
Longitude West from Greenwich

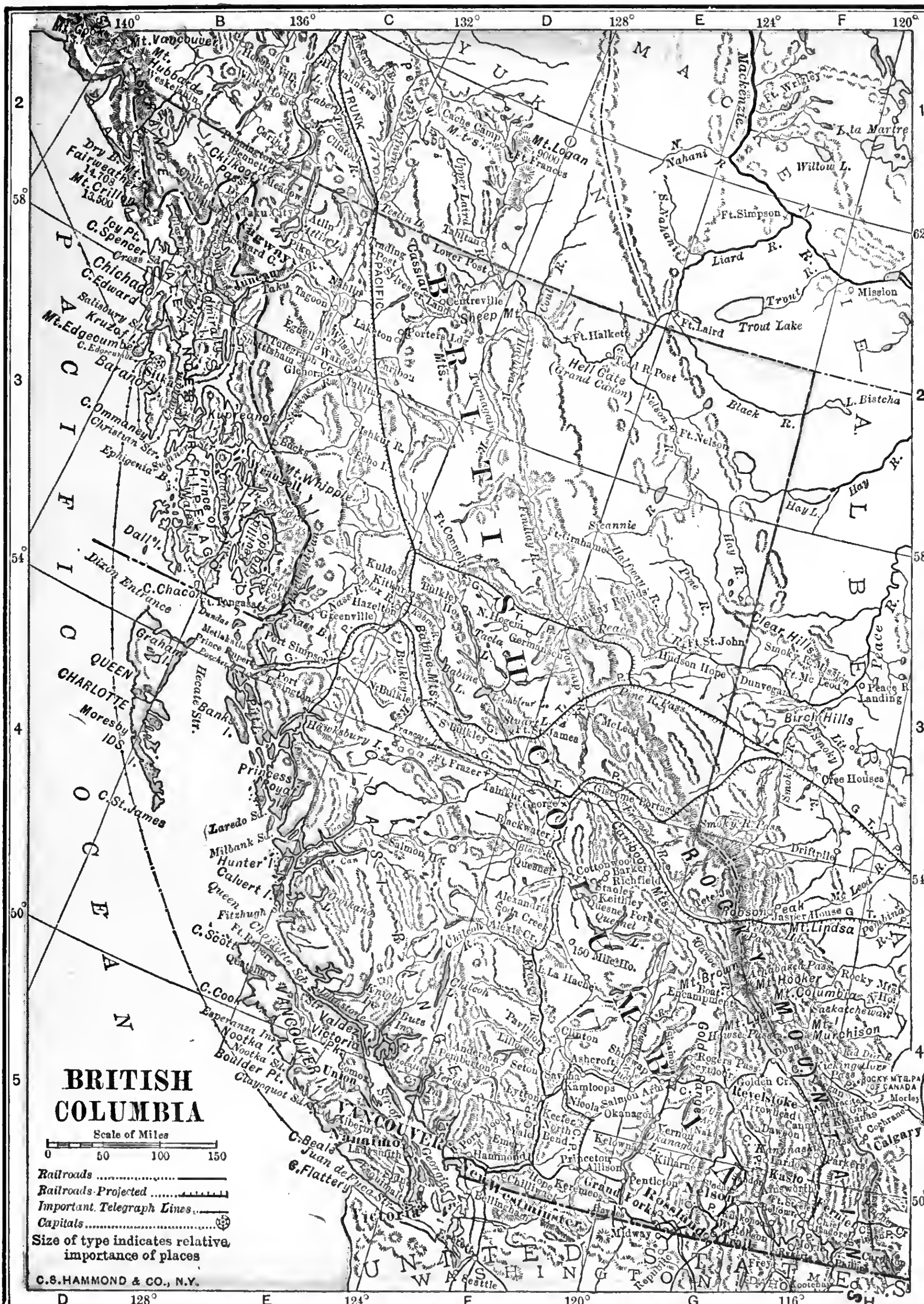

THE MARITIME PROVINCES OF CANADA
With Insert Map of NEWFOUNDLAND
NEW BRUNSWICK, NOVA SCOTIA, PRINCE EDWARD ISLAND
Scale of Miles
0 10 20 30 40 50 60 70 80
Railroads
Railroads Projected
Submarine Telegraph Lines
Capitals of Provinces
Size of type indicates relative importance of places
C. S. HAMMOND & CO., N.Y.
Longitude C West 66° from D Greenwich
NEWFOUNDLAND
Scale of Miles
0 20 40 60 80
GULF OF ST LAWRENCE
ATLANTIC OCEAN
PRINCE EDWARD ISLAND
CAPE BRETON ISLAND
CABOT STRAIT
BAY OF FUNDY
MAGDALEN ISLANDS (To Quebec)

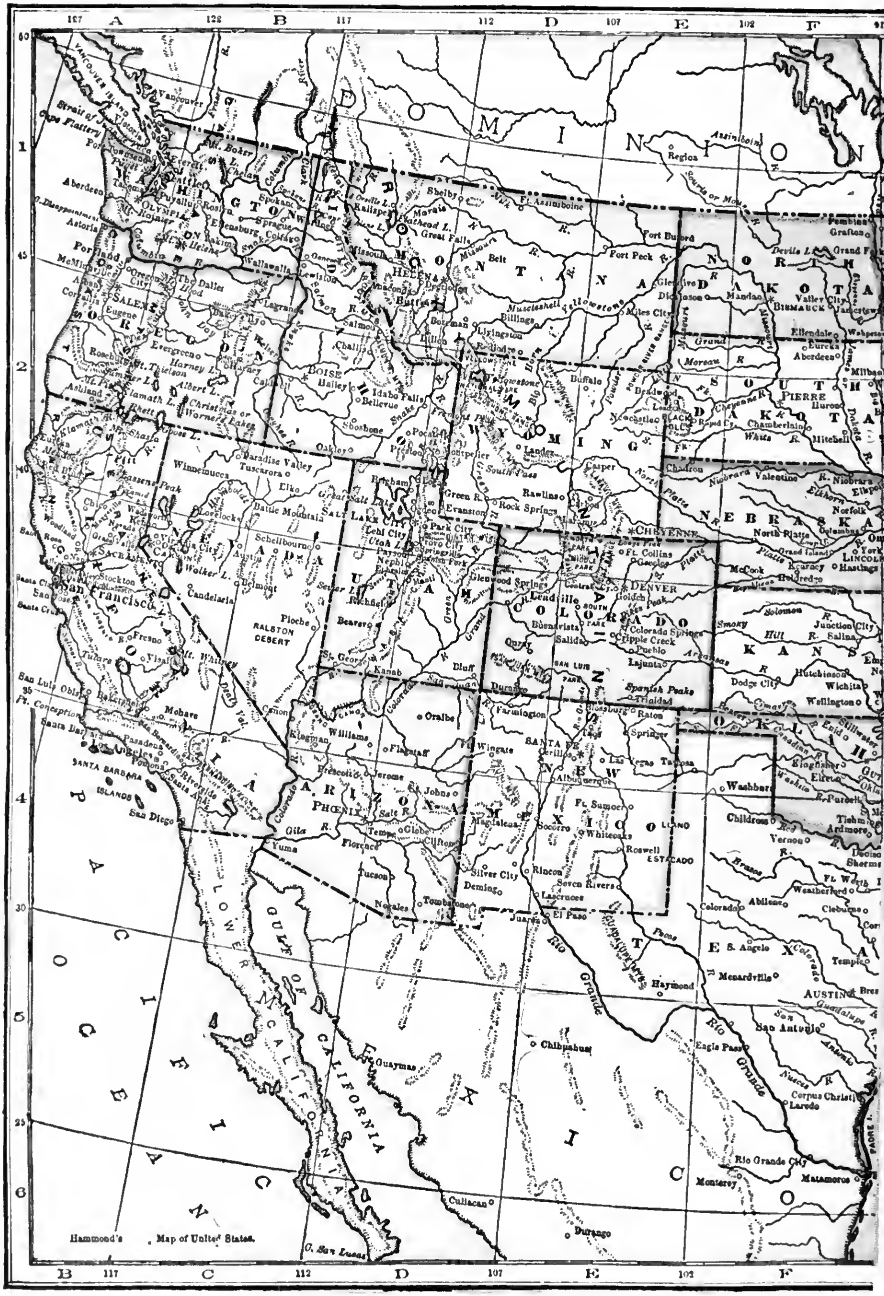

QUEBEC
Scale of Miles
Railroads
Railroads Projected
Size of type indicates relative importance of places
C.S. HAMMOND & CO., N.Y.
NORTHEASTERN QUEBEC
Scale of Miles
WESTERN PART OF QUEBEC
Same Scale as Main Map
GULF OF ST. LAWRENCE
ANTICOSTI ISLAND
ST. LAWRENCE R.
MAINE
NEW BRUNSWICK
VERMONT
NEW YORK
ONTARIO
QUEBEC
MONTREAL
OTTAWA
Three Rivers
Sherbrooke


ONTARIO
Railroads
Railroads Projected
Scale of Miles
Size of type indicates relative importance of places
WESTERN PART OF ONTARIO
Scale of Miles
LAKE HURON
GEORGIAN BAY
LAKE ONTARIO
LAKE ERIE
QUEBEC
NEW YORK
PENN.
MICHIGAN
SAGINAW BAY
JAMES BAY
LAKE SUPERIOR
TORONTO
OTTAWA
C.S.Hammond & Co., N.Y.
Longitude West 80° from Greenwich

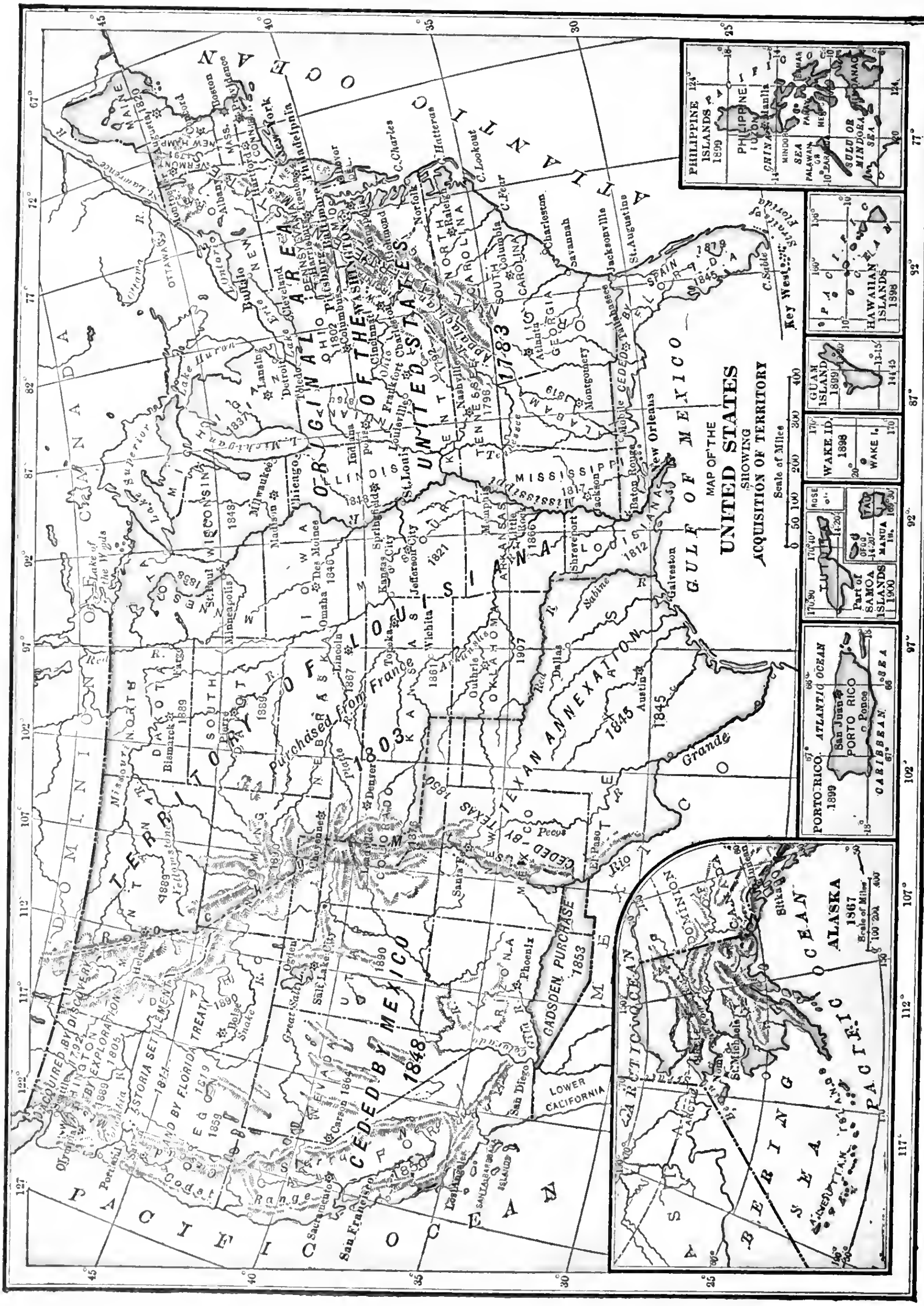

MANITOBA
Scale of Miles
0 10 20 30 40 50
Railroads
Railroads Projected
Capital of Province
Size of type indicates relative importance of places
Longitude 99° West from 98° Greenwich
S. HAMMOND & CO., N.Y.

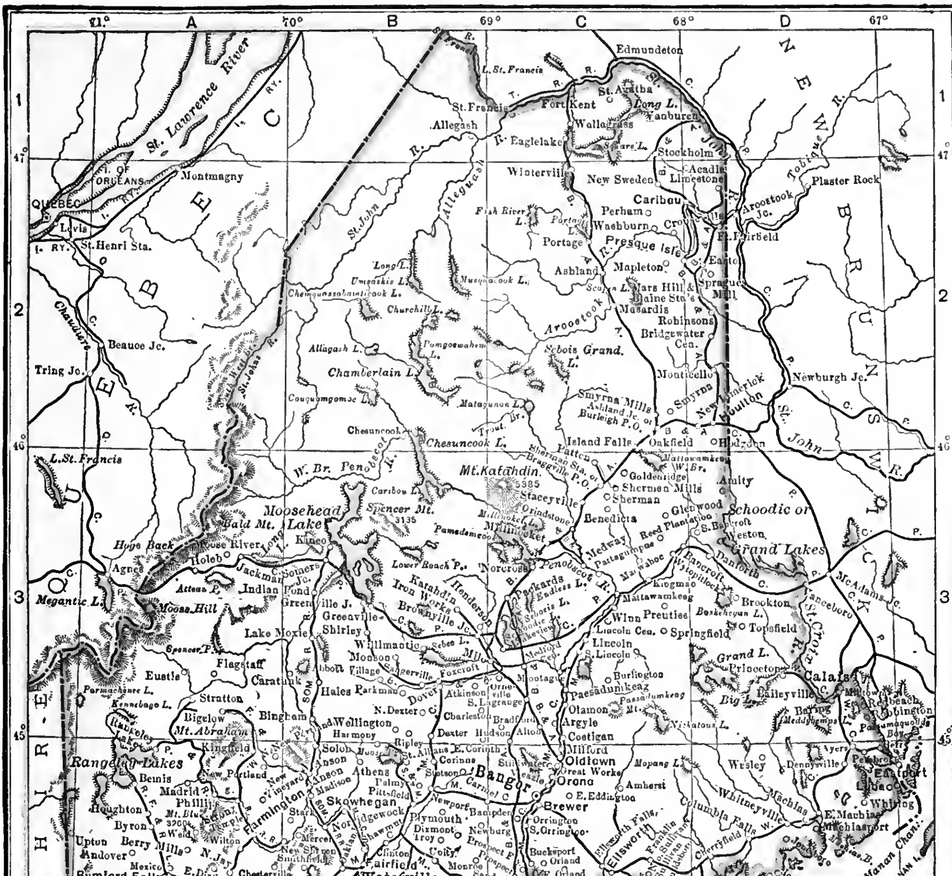

ALBERTA AND SASKATCHEWAN
(SOUTHERN AND CENTRAL PORTIONS)
Scale of Miles
0 10 20 30 40 50 60 70 80 90
Railroads
Railroads Projected
Capitals of Provinces
Size of type indicates relative importance of places
Longitude West from Greenwich
EDMONTON
CALGARY
REGINA
Saskatoon
Prince Albert
Medicine Hat
Lethbridge
Moose Jaw
Moosomin
Swift Current
Red Deer
Battleford
Macleod
Yorkton
Wetaskiwin
Strathcona
Lloydminster
Cypress Hills
Wood Mt.
Porcupine Hills
Saskatchewan
Churchill
Lac la Ronge
Lac la Plonge
Montreal L.
Red Deer L.
Bear L.
Candle L.
Pelican Narrows
Lac la Biche
Athabasca Landing
Athabasca
BRITISH COLUMBIA
UNITED STATES
MANITOBA
ALBERTA
SASKATCHEWAN
KEEWATIN
ROCKY MTS.
ROCKY MTN. PARK

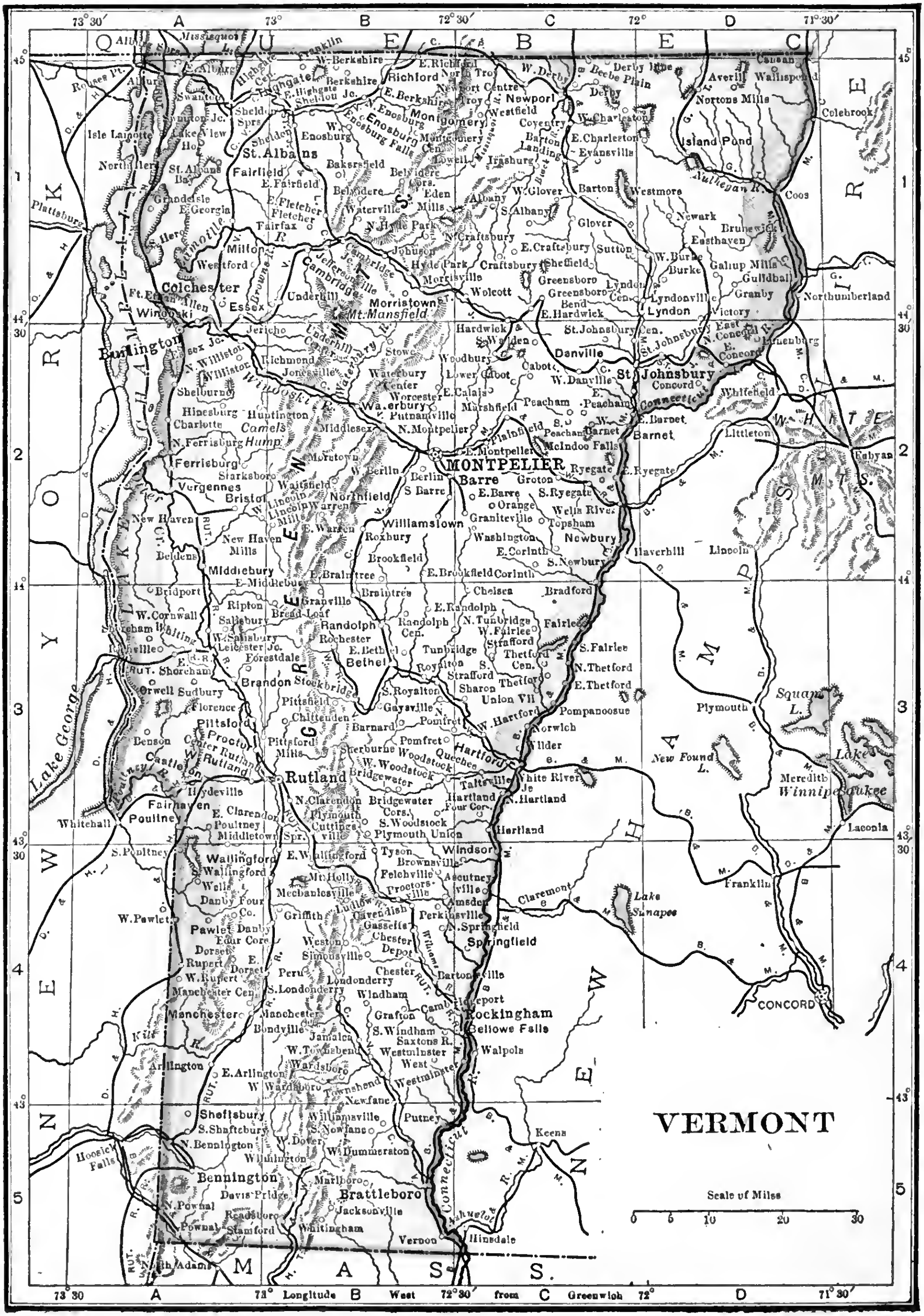

BRITISH
COLUMBIA
Scale of Miles
0 50 100 150
Railroads
Railroads Projected
Important Telegraph Lines
Capitals
Size of type indicates relative importance of places
C.S.HAMMOND & CO., N.Y.
PACIFIC OCEAN
BRITISH COLUMBIA
ROCKY MOUNTAINS
YUKON
MACKENZIE
ALBERTA
UNITED STATES
WASHINGTON
QUEEN CHARLOTTE IDS.
VANCOUVER
Victoria
New Westminster
Nanaimo
Kamloops
Calgary
Mt. Logan
Mt. Vancouver
Mt. Hubbard
Mt. Fairweather
Mt. Crillon
Mt. Whipple
Mt. Brown
Mt. Hooker
Mt. Columbia
Mt. Murchison
Mt. Lindsa
Robson Peak
Juneau
Skagway
Sitka
Baranof I.
Kupreanof I.
Prince of Wales I.
Dall I.
Dixon Entrance
Graham I.
Moresby I.
Hecate Str.
Banks I.
Princess Royal I.
Hunter I.
Calvert I.
Queen Charlotte Sd.
C. Scott
C. Cook
Nootka I.
Clayoquot Sd.
Juan de Fuca Str.
C. Flattery
Prince Rupert
Port Simpson
Port Essington
Hazelton
Ft. St. James
Ft. George
Quesnel
Barkerville
Clinton
Ashcroft
Lillooet
Okanagan
Vernon
Kelowna
Penticton
Grand Forks
Rossland
Trail
Nelson
Kaslo
Revelstoke
Golden
Fernie
Ft. Simpson
Ft. Laird
Ft. Nelson
Ft. St. John
Hudson Hope
Dunvegan
Peace R.
Liard R.
Trout Lake
Hay R.
Fraser R.
Skeena R.
Stikine R.
Telegraph Cr.
Atlin
Cassiar Mts.
Yellowhead Pass
Kicking Horse Pass
Crow's Nest Pass
Tete Jaune Cache
Seattle
Bellingham
140° 136° 132° 128° 124° 120° 116°
58° 54° 50° 62°

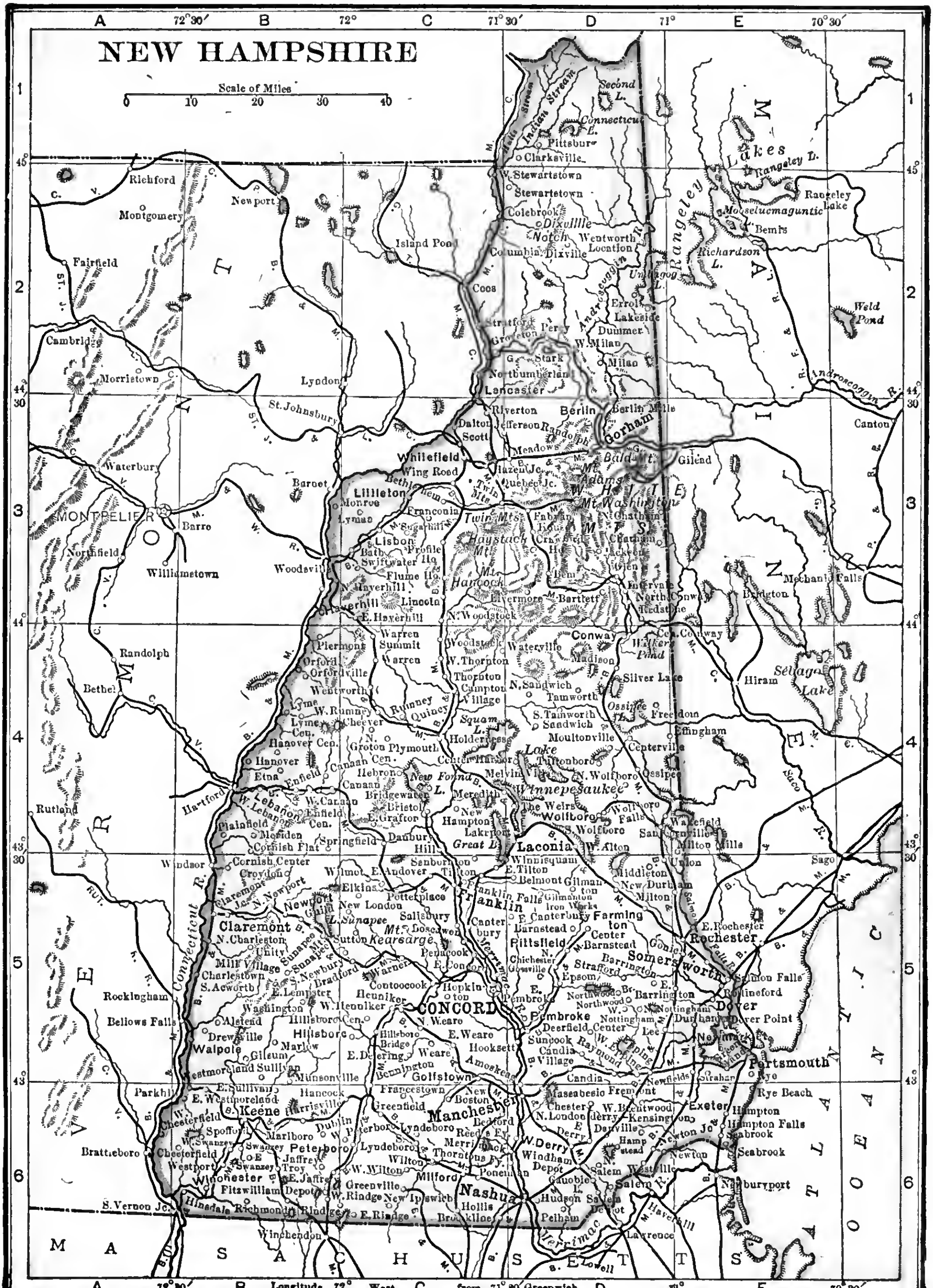

PACIFIC OCEAN
DOMINION
WASHINGTON
OREGON
CALIFORNIA
NEVADA
IDAHO
MONTANA
WYOMING
UTAH
COLORADO
ARIZONA
NEW MEXICO
NORTH DAKOTA
SOUTH DAKOTA
NEBRASKA
KANSAS
TEXAS
MEXICO
LOWER CALIFORNIA
GULF OF CALIFORNIA
Vancouver
OLYMPIA
Seattle
Tacoma
Spokane
Walla Walla
Portland
SALEM
Eugene
The Dalles
San Francisco
SACRAMENTO
Stockton
Fresno
Los Angeles
San Diego
Santa Barbara
CARSON
Virginia City
Winnemucca
Belmont
Candelaria
Pioche
RALSTON DESERT
BOISE
HELENA
Butte
Great Falls
Missoula
Billings
Miles City
Fort Benton
Fort Buford
Fort Peck
Regina
Assiniboine
BISMARCK
Mandan
Valley City
Jamestown
Grafton
Devils L.
Grand Forks
Ellendale
Aberdeen
PIERRE
Huron
Chamberlain
Mitchell
Deadwood
Lead City
Rapid City
Chadron
Valentine
Niobrara
Norfolk
Columbus
North Platte
Grand Island
Kearney
Holdrege
McCook
Hastings
LINCOLN
Salt Lake City
Ogden
Provo City
Park City
Beaver
St. George
Kanab
Richfield
Nephi
Evanston
Green R.
Rock Springs
Rawlins
Lander
South Pass
Casper
Buffalo
CHEYENNE
Laramie
Ft. Collins
DENVER
Leadville
Glenwood Springs
Buena Vista
Salida
Colorado Springs
Cripple Creek
Pueblo
Lajunta
Trinidad
Durango
Ouray
Spanish Peaks
Raton
SANTA FE
Albuquerque
Las Vegas
Socorro
Silver City
Deming
Las Cruces
El Paso
Juarez
Roswell
LLANO ESTACADO
PHOENIX
Prescott
Jerome
Flagstaff
Williams
Kingman
Yuma
Tucson
Tombstone
Nogales
Florence
Tempe
Globe
Oraibe
Bluff
Farmington
Fort Wingate
Dodge City
Hutchinson
Wichita
Wellington
Junction City
Salina
AUSTIN
San Antonio
Eagle Pass
Laredo
Corpus Christi
Rio Grande City
Matamoros
Monterey
Chihuahua
Durango
Culiacan
Guaymas
Abilene
Colorado
S. Angelo
Menardville
Rio Grande
Hammond's Map of United States.

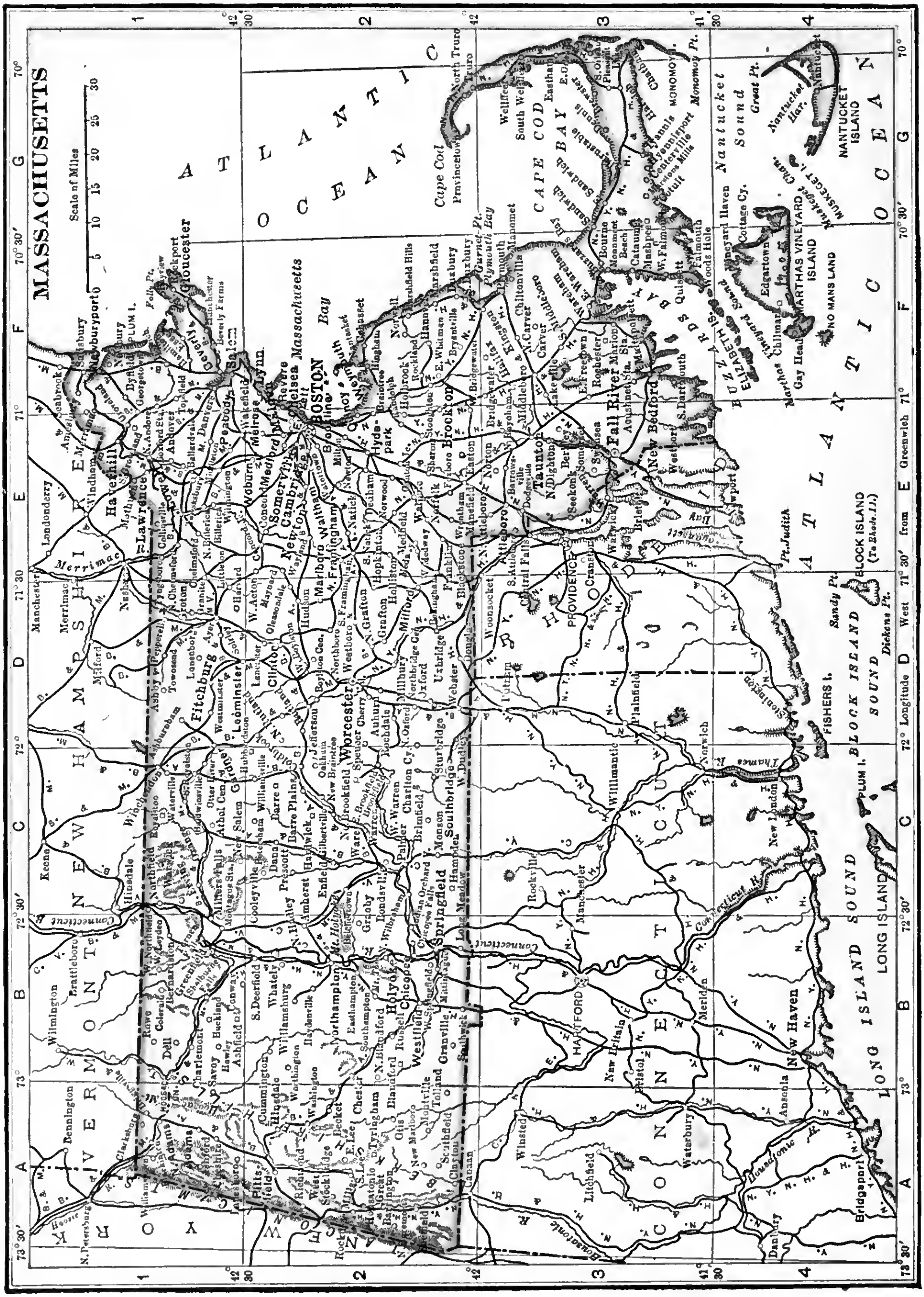

C A N A D A
UNITED STATES
Scale of Miles
0 50 100 200 300 400
G U L F O F M E X I C O
A T L A N T I C O C E A N
LAKE SUPERIOR
L. ERIE
LAKE ONTARIO
OTTAWA
Chicago
Cleveland
Pittsburg
Philadelphia
New York
Boston
Buffalo
Cincinnati
St. Louis
New Orleans
Charleston
Savannah
Milwaukee
Detroit
WASHINGTON
CUBA
C. Hatteras
C. Lookout
Delaware Bay
Tampa Bay
Florida Strait
BAHAMA IS.


MAP OF THE UNITED STATES SHOWING ACQUISITION OF TERRITORY
Scale of Miles
ORIGINAL AREA OF THE UNITED STATES 1783
TERRITORY OF LOUISIANA Purchased from France 1803
CEDED BY MEXICO 1848
TEXAN ANNEXATION 1845
GADSDEN PURCHASE 1853
CEDED BY TEXAS 1850
ACQUIRED BY FLORIDA TREATY 1819
PHILIPPINE ISLANDS 1899
HAWAIIAN ISLANDS 1898
GUAM ISLAND 1899
WAKE ID. 1898
Part of SAMOA ISLANDS 1900
PORTO RICO 1899
ALASKA 1867
ATLANTIC OCEAN
PACIFIC OCEAN
GULF OF MEXICO
DOMINION OF CANADA

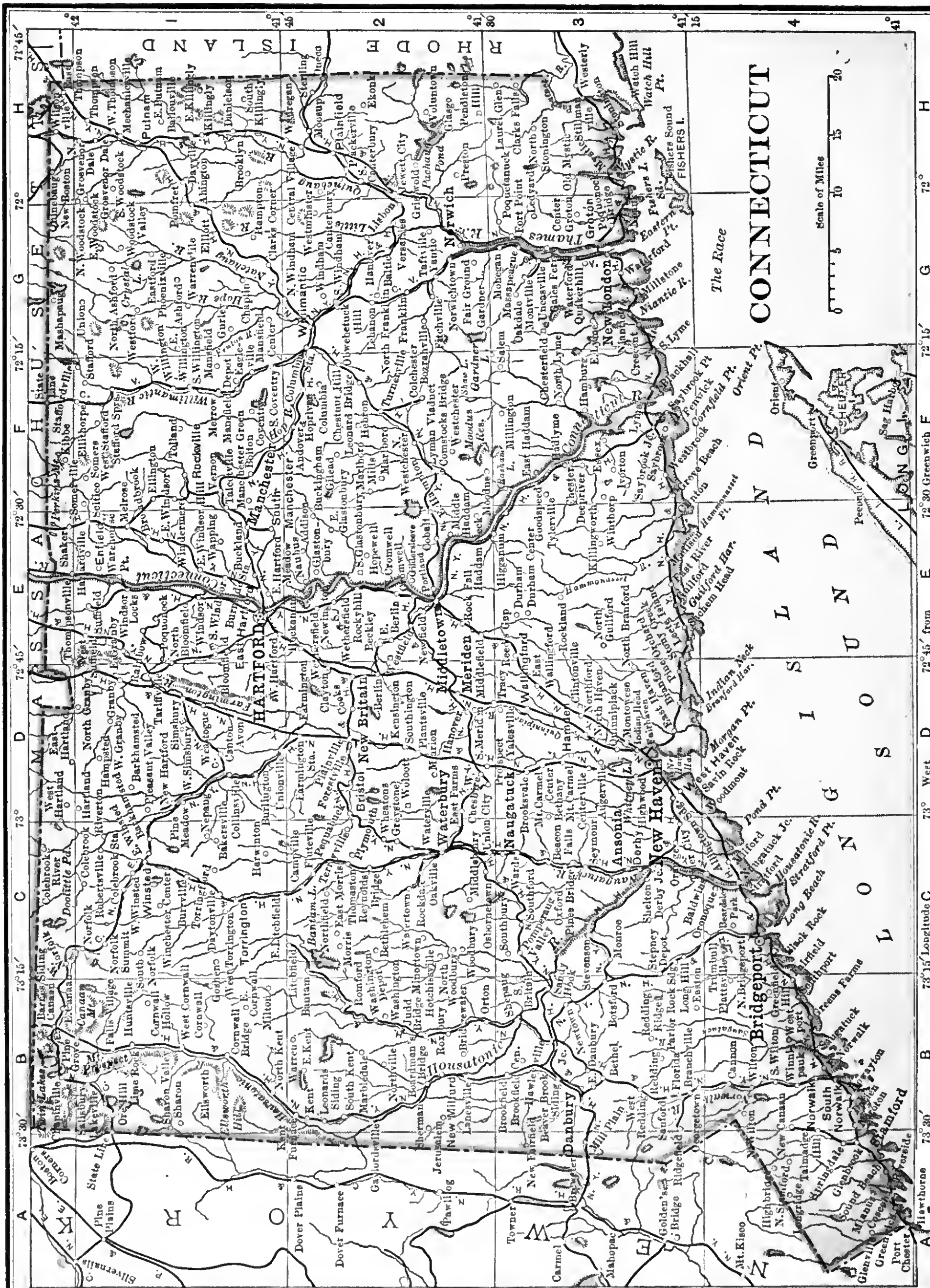

MAINE
Scale of Miles
0 5 10 20 30 40
Size of type indicates relative importance of towns
C.S.HAMMOND & CO., N.Y.
Longitude West from Greenwich
ATLANTIC OCEAN
NEW HAMPSHIRE
QUEBEC
NEW BRUNSWICK
St. Lawrence River
Mt.Katahdin.
Moosehead Lake
Rangeley Lakes
Chesuncook L.
Chamberlain L.
Grand Lakes
Schoodic or
Penobscot Bay
Grand Manan Chan.
AUGUSTA
Bangor
Portland
Lewiston
Auburn
Biddeford
Saco
Waterville
Bath
Brunswick
Rockland
Belfast
Calais
Eastport
Houlton
Presque Isle
Caribou
Oldtown
Orono
Brewer
Ellsworth
Skowhegan
Farmington
Gardiner
Westbrook
Sanford
Fort Kent
Van Buren
Machias
Rumford Falls
Dover
Foxcroft
Millinocket
Eden
Bar Harbor
Kittery

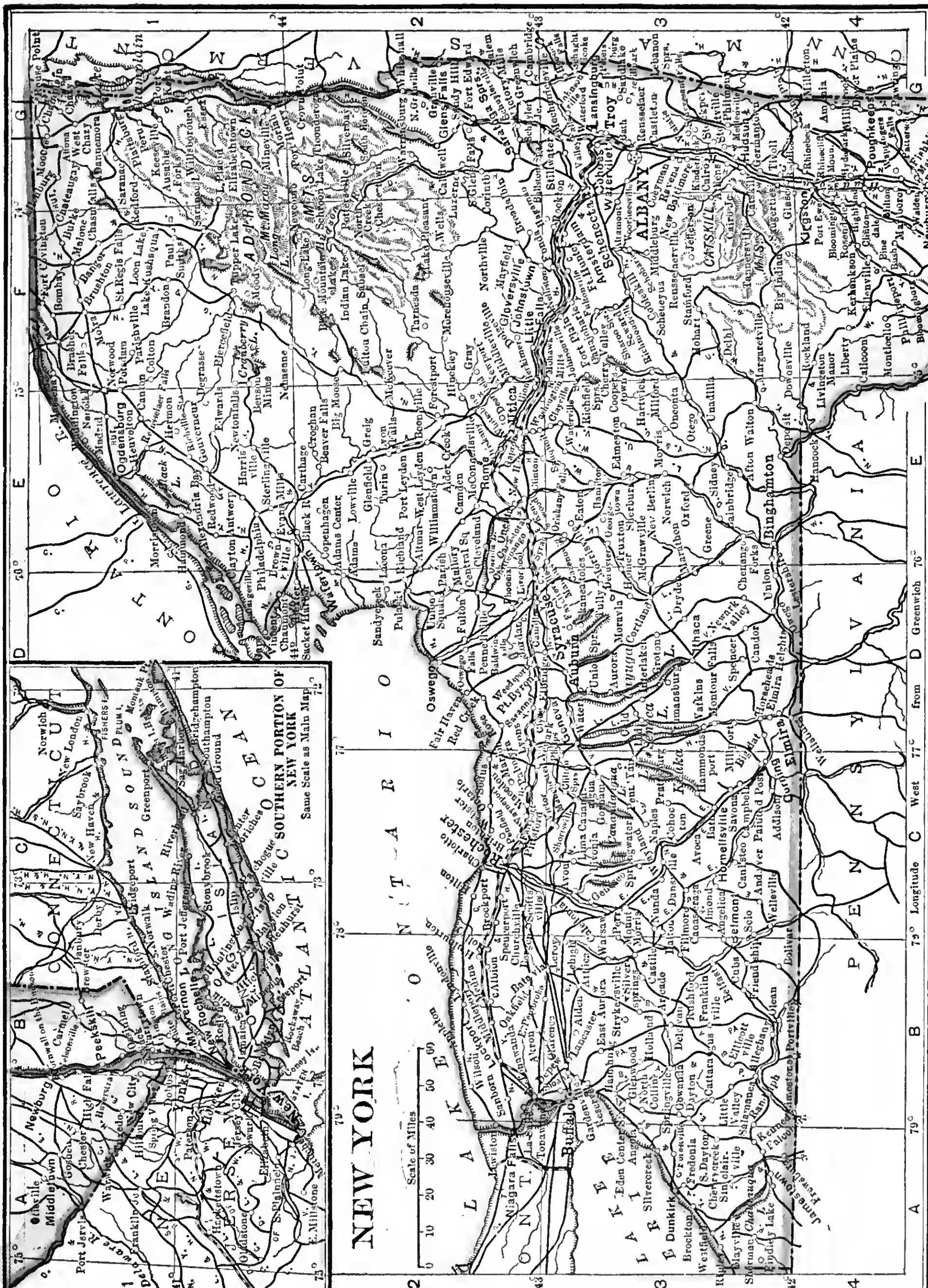

VERMONT
Scale of Miles
0 5 10 20 30
73° 30′
73°
72° 30′
72°
71° 30′
Longitude West from Greenwich
QUEBEC
NEW YORK
NEW HAMPSHIRE
MASS.
LAKE CHAMPLAIN
GREEN MTS.
WHITE MTS.
MONTPELIER
Burlington
St. Albans
Rutland
Barre
Bennington
Brattleboro
St. Johnsbury
Newport
Middlebury
Brandon
Randolph
Northfield
Springfield
Windsor
Bellows Falls
Rockingham
Manchester
Wallingford
Woodstock
Hartford
White River Jc.
Bradford
Newbury
Island Pond
Lyndonville
Morristown
Mt. Mansfield
Camels Hump
Winooski
Colchester
Swanton
Enosburg Falls
Richford
Vergennes
Bristol
Fairhaven
Poultney
Castleton
Proctor
Pittsford
Ludlow
Chester
Londonderry
Wilmington
Pownal
Hinsdale
Vernon
Walpole
Keene
Claremont
CONCORD
Franklin
Laconia
Plymouth
Littleton
Whitefield
Haverhill
Lancaster
Colebrook
Coos
Plattsburg
Whitehall
Lake George
North Adams
Hoosick Falls
Lake Winnipesaukee
Squam L.
New Found L.
Lake Sunapee
Connecticut R.

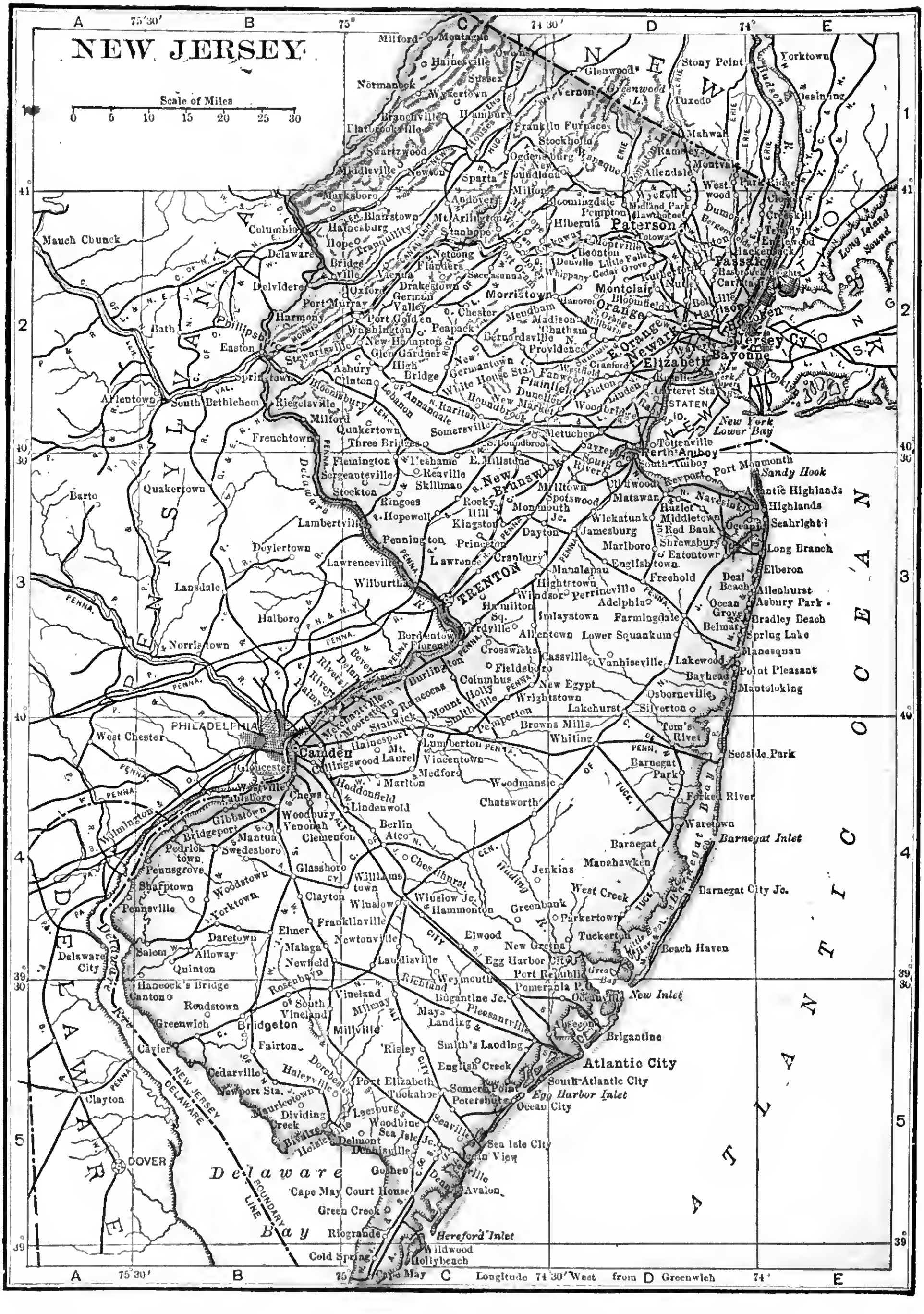

NEW HAMPSHIRE
Scale of Miles
0 10 20 30 40
Longitude 72° West from 71° 30′ Greenwich
CONCORD
Manchester
Nashua
Portsmouth
Dover
Rochester
Somersworth
Keene
Claremont
Concord
Franklin
Laconia
Lebanon
Berlin
Gorham
Lancaster
Littleton
Whitefield
Exeter
Milford
Peterboro
Winchester
Walpole
Newport
Conway
Colebrook
Pittsburg
Hanover
Plymouth
Lisbon
Woodsville
Haverhill
Wolfboro
Pittsfield
Farmington
Goffstown
Derry
Hampton
Seabrook
Salem
Hudson
Hollis
Jaffrey
Hinsdale
Fitzwilliam
Rindge
Connecticut R.
Merrimac R.
Androscoggin R.
Winnepesaukee Lake
Squam L.
New Found L.
L. Sunapee
Mt. Kearsarge
Mt. Washington
Mt. Adams
Twin Mts.
Haystack Mt.
Mt. Hancock
Ossipee L.
Great B.
Connecticut L.
Second L.
Umbagog L.
Rangeley Lakes
Rangeley L.
Mooselucmaguntic Lake
Richardson L.
Weld Pond
Sebago Lake
MONTPELIER
St. Johnsbury
Newport
Richford
Montgomery
Fairfield
Cambridge
Morristown
Lyndon
Waterbury
Barre
Barnet
Northfield
Williamstown
Randolph
Bethel
Rutland
Windsor
Hartford
Rockingham
Bellows Falls
Brattleboro
S. Vernon Jc.
Winchendon
Lowell
Lawrence
Haverhill
Newburyport
Canton
Gilead
Bridgton
Hiram
Mechanic Falls
Saco R.
Sago
V E R M O N T
M A I N E
M A S S A C H U S E T T S
A T L A N T I C O C E A N

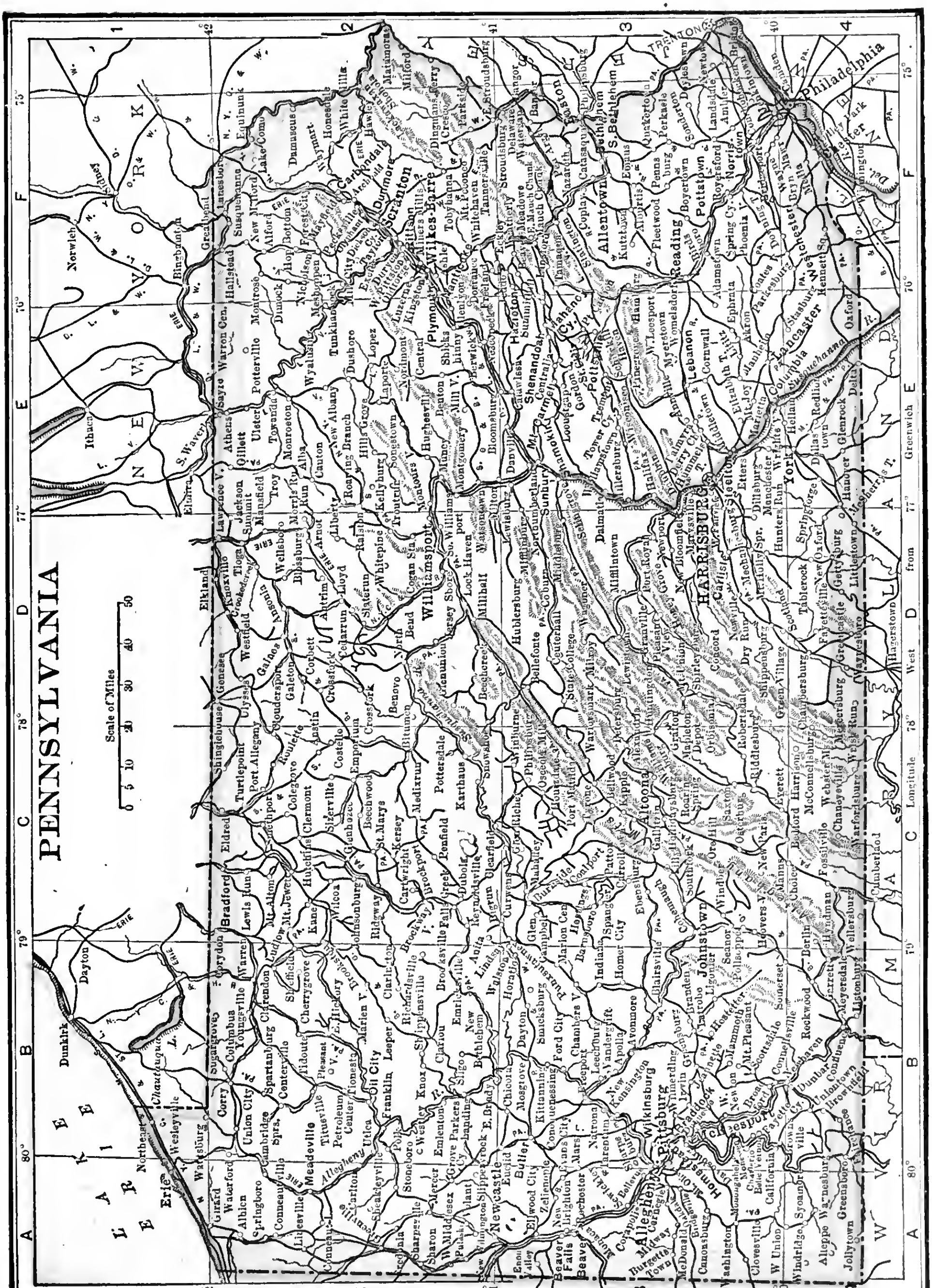

MASSACHUSETTS
Scale of Miles
ATLANTIC OCEAN
Massachusetts Bay
CAPE COD BAY
Nantucket Sound
NANTUCKET ISLAND
MARTHAS VINEYARD ISLAND
NO MANS LAND
BLOCK ISLAND (To Rhode I.)
BLOCK ISLAND SOUND
LONG ISLAND SOUND
LONG ISLAND
NEW HAMPSHIRE
VERMONT
NEW YORK
RHODE ISLAND
CONNECTICUT
BOSTON
Worcester
Springfield
Fall River
New Bedford
Lowell
Lawrence
Haverhill
Brockton
Taunton
Holyoke
Fitchburg
PROVIDENCE
HARTFORD
New Haven
New London
Bridgeport
Longitude West from Greenwich

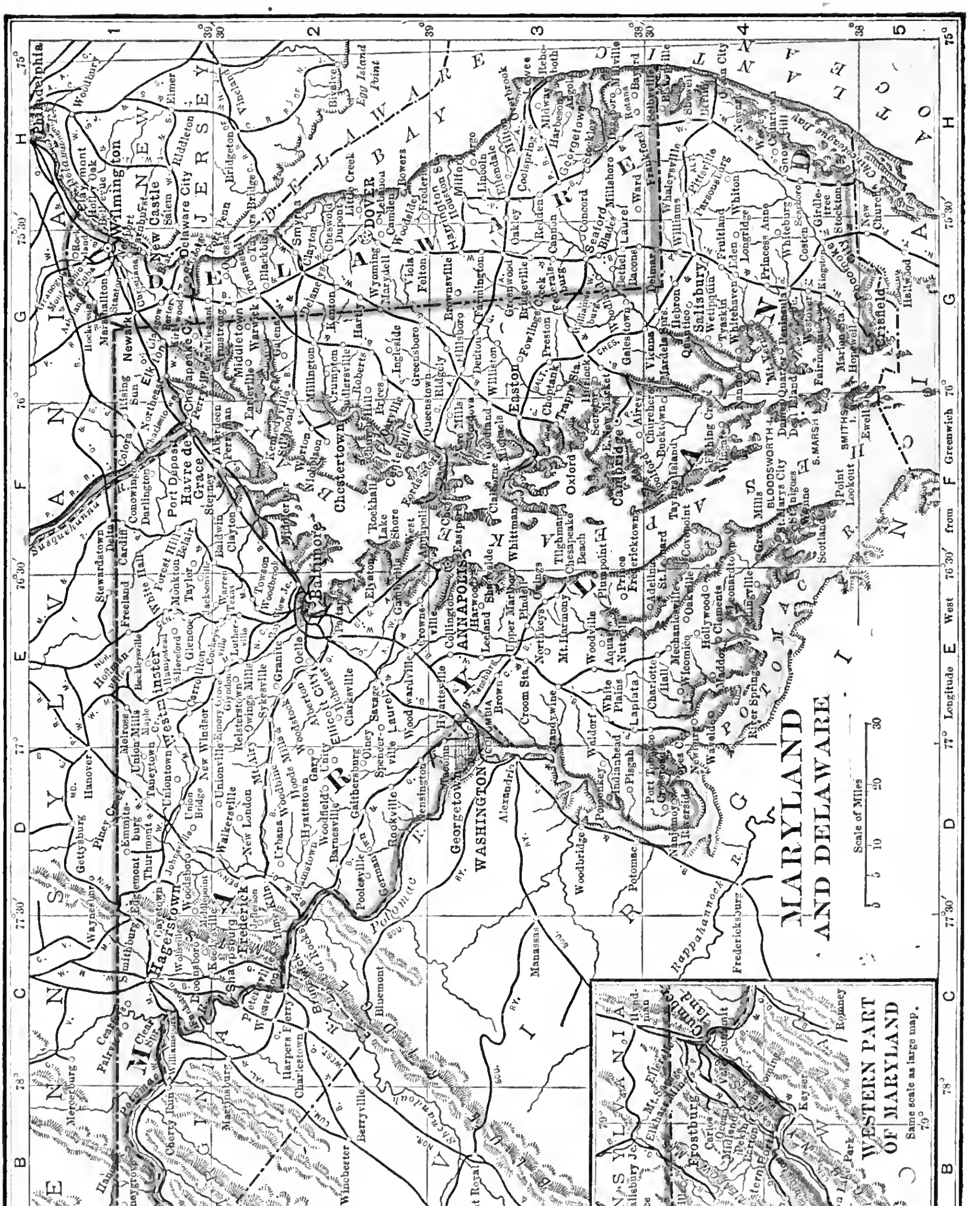

RHODE ISLAND
Scale of Miles
0 1 2 3 4 5 10
Longitude West 71° 30′ from Greenwich
A
B
C
D
1
2
3
4
5
42°
41° 30′
M A S S A C H U S E T T S
C O N N E C T I C U T
A T L A N T I C O C E A N
BLOCK ISLAND SOUND
NARRAGANSETT BAY
Douglass Jc.
E.Thompson
Thompson
Blackstone
Woonsocket Jc.
Woonsocket
Forestdale
N.Attleboro
Diamond Hill
Attleboro
Attleboro Jc.
Glendale
Whipple
Harrisville
Slatersville
Nasonville
Bridgeton
Pascoag
Oakland
Tarkiln
Fields Sta.
Primrose
Manville
Albion
Arnold Mills
Abbott Run
Ashton
Berkeley
Cumberland Mills
Whittenton Jc
Lime Rock
Smithfield
Stillwater Res.
W.Gloucester
Chepachet
Lonsdale
Valley Falls
East Jc.
Weir Jc.
Smith & Sayles Res.
Harmony
Stillwater
Saylesv.
Darlington
Waterman Reservoir
Georgia V.
Pawtucket
Central Falls
Enfield
Woodlawn
Killingly Pond
Greenville
Greystone
Moswansicut Pond
Centerdale
Foster
Chopmist Hill
Allendale
Phillipsdale
Rumford
N.Scituate
Lymansville
Manton
PROVIDENCE
Pawtuxet
Dyerville
Olneyville
Arlington
India Pt.
E.Providence
Foster Center
Ashland
Thornton
Cranston
Roger Williams Park
Silver Spring
Bennett Hill
Rockland
S.Scituate
Knightsville
Riverside
Meshanticut
Auburn
S.Auburn
Somerset Jc.
Lakewood
Drownville
Warren
Mt.Misery
Fiskeville
Hope
Oaklawn
Norwood
Bowenville
Moosup Valley
Coventry
Arkwright
Pontiac
Phenix
Howard
Hills Grove
Barrington
Fall River
Taunton R.
Summit
Greene
Arctic
Centerville
Quidnick
Anthony
Natick
Shawomet
Mt. Hope
River Pt.
Apponaug
Greenwood
Warwick
Bristol
Bay
Washington
Crompton
Cowesett
Greenwich Bay
Buttonwoods
North Pt.
Weeks Hill
East Greenwich
PATIENCE I.
N.Tiverton
HOG I.
Bristol Ferry
Tiverton
W.Greenwich Center
Carr Pond
Escoheag
Nooseneck Hill
Davisville
HOPE I.
PRUDENCE I.
Prudence
Portsmouth
Austin
La Fayette
Quonset Pt.
Tiverton Four Corners
Wickford Jc.
Bradford
Pine Hill
Wickford
DYERS I.
Exeter
Belleville
Noquit Pond
Wood R.
Allenton
Adamsville
Arcadia
GOULD I.
Middletown
Hamilton
Saunderstown
RHODE I.
Sakonnet R.
Rockville
Liberty
Slocum
CONANICUT I.
Little Compton
Wyoming
Hope Valley
Usquepaugh
Jamestown
Shannock Hill
W.Kingston
Kingston
Canonchet Sta.
Kenyon
Newport
ISLAND ROCKS
Woodville
Carolina
Gould
Sakonnet Pt.
Hopkinton
Peace Dale
Alton
Wakefield
Brenton Reef
Ashaway
Wordens Pond
Potter Hill
Wood River Jc.
Carolina Sta.
Shannock
Narragansett Pier
White Rock
Perryville
Point Judith Pond
Pawcatuck
Niantic
Charlestown
Point Judith Neck
Watchaug Pond
Greenhill
Westerly
Squid Ledge
Pt.Judith
Quonochontaug
Pawtucket Pond
Rocky Pt.
Avondale
Noyes Pt.
Weekapaug
Watch Hill
Napatree Pt.
Sandy Pt.
Salt Pd.
BLOCK I.
Block I.

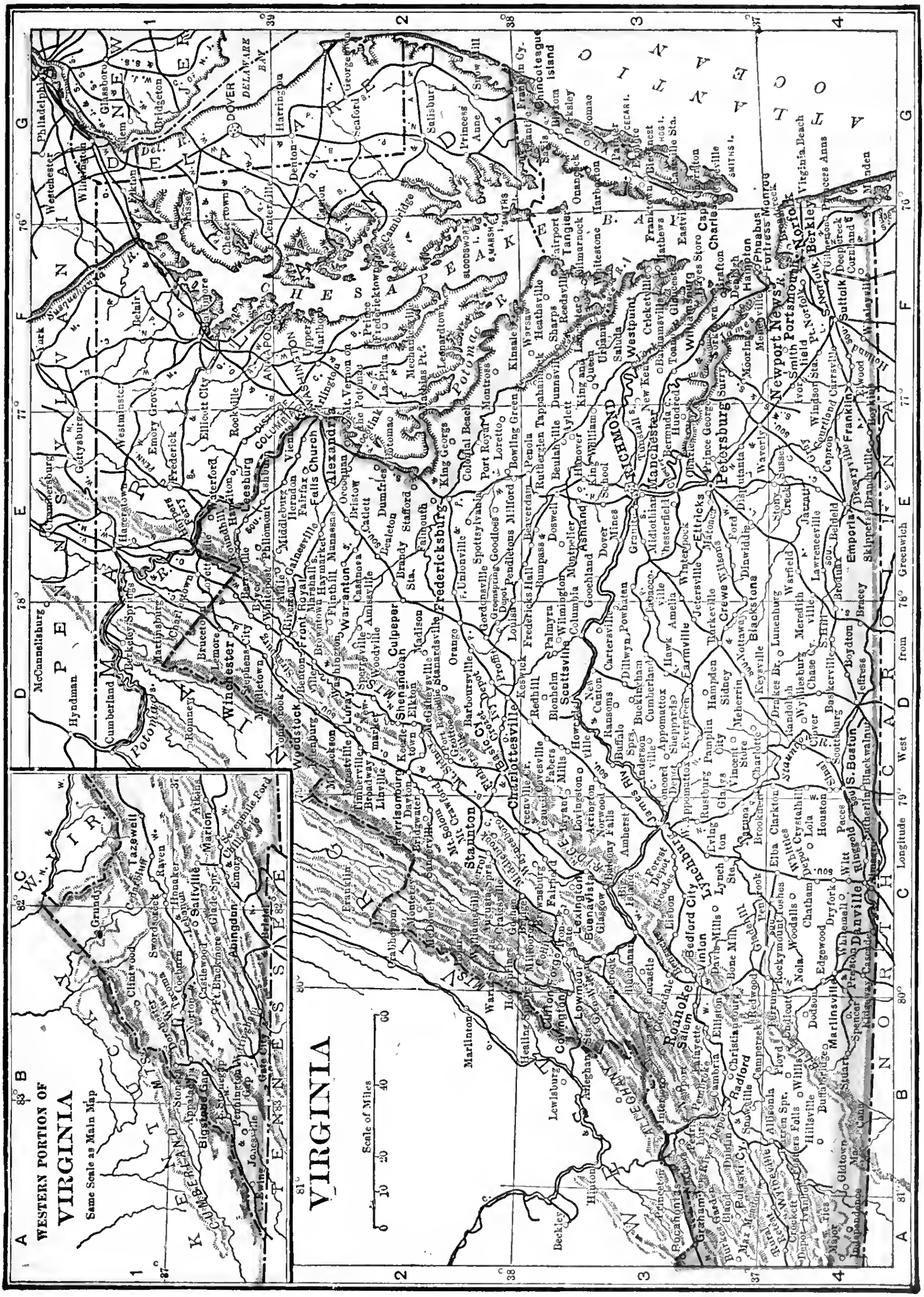

CONNECTICUT
Scale of Miles
The Race
HARTFORD
New Haven
Bridgeport
Waterbury
New Britain
Meriden
Middletown
Norwich
New London
Danbury
Stamford

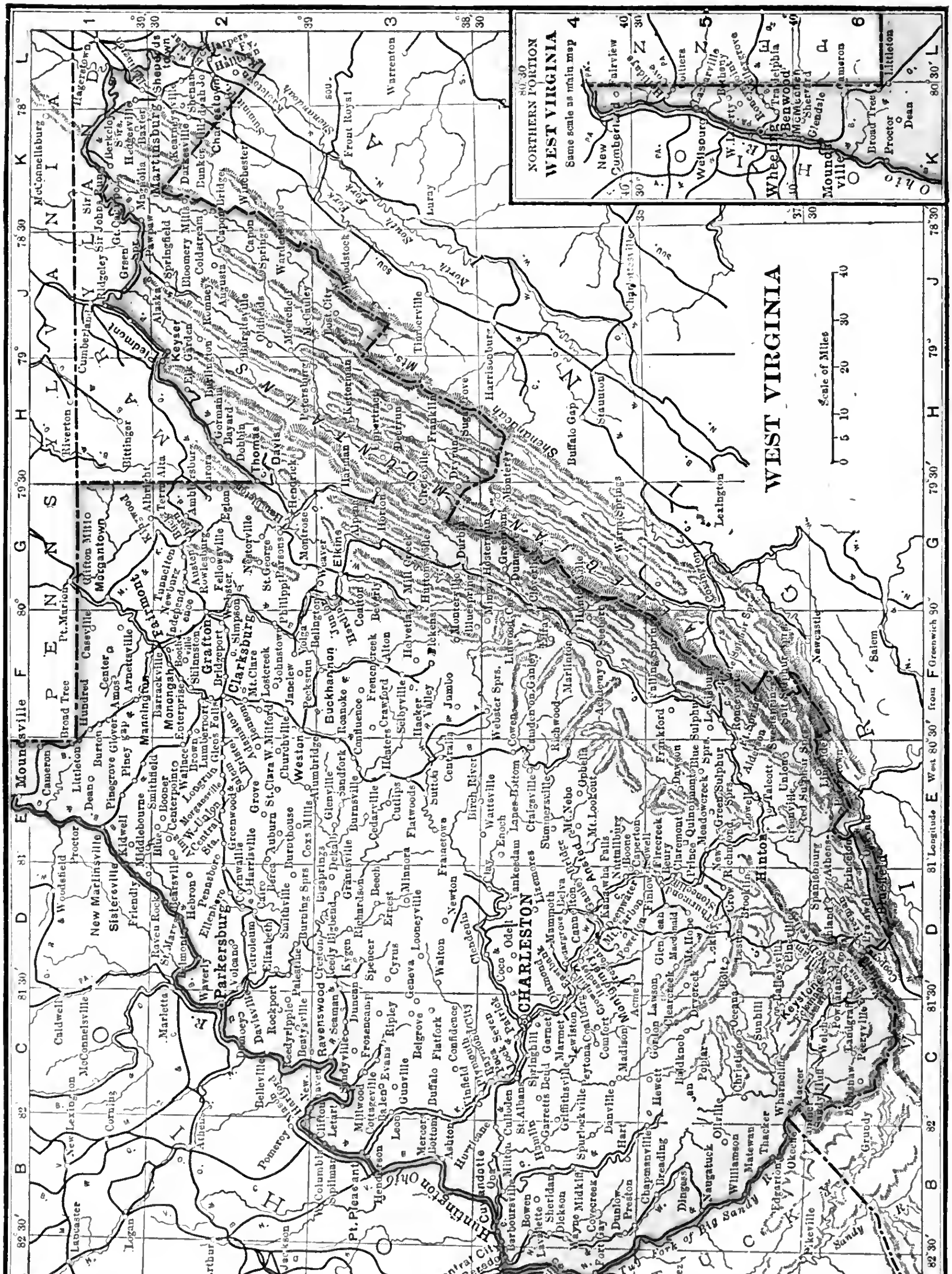

NEW YORK
Scale of Miles
SOUTHERN PORTION OF NEW YORK
Same Scale as Main Map
LAKE ONTARIO
LAKE ERIE
PENNSYLVANIA
ATLANTIC OCEAN
LONG ISLAND SOUND
CONNECTICUT
NEW JERSEY
Longitude West from Greenwich
ADIRONDACK MTS.
CATSKILL MTS.
Albany
Syracuse
Rochester
Buffalo
Utica
Binghamton
Elmira
Oswego
Troy
Schenectady
Ithaca
Auburn

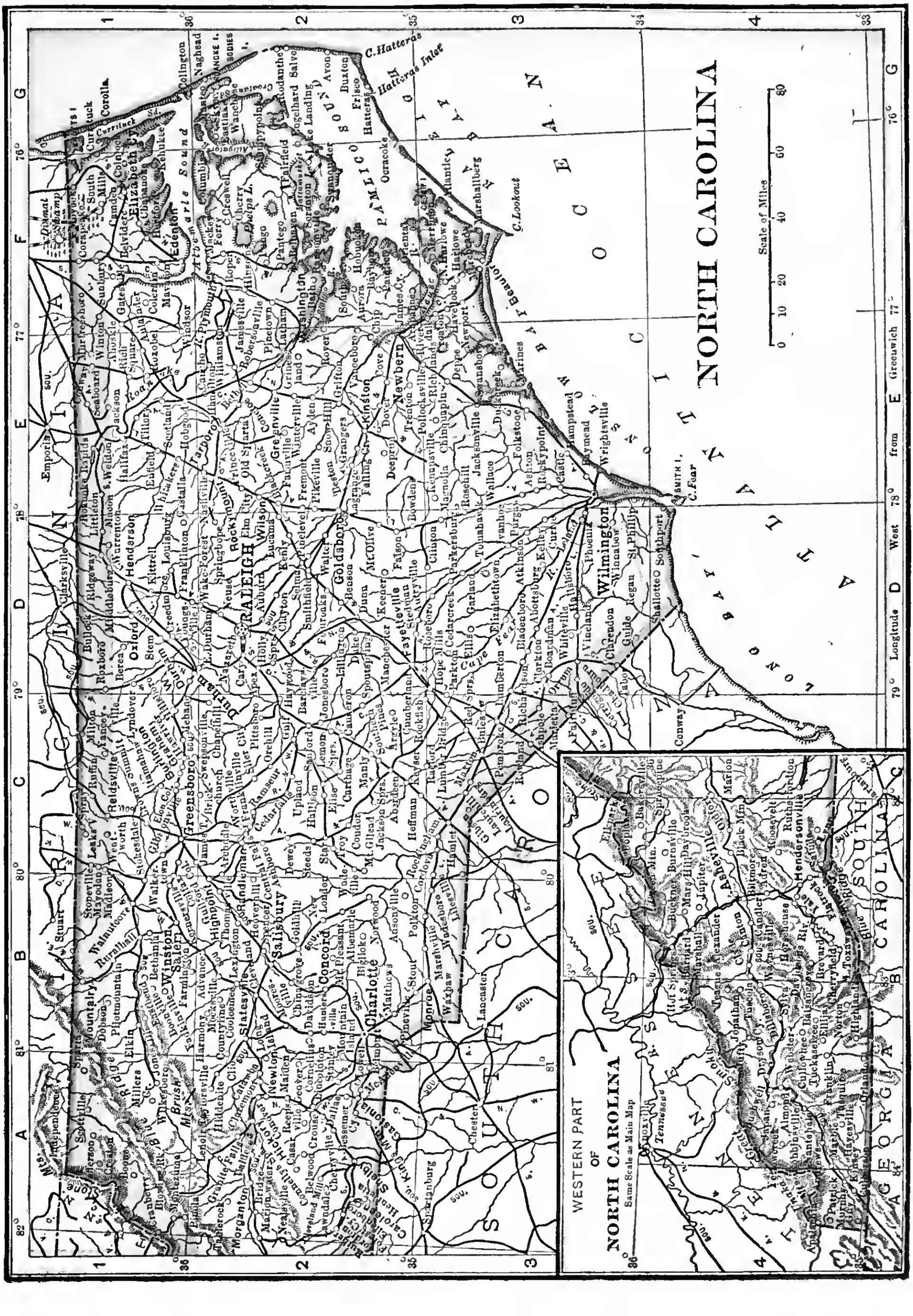

NEW JERSEY
Scale of Miles
0 5 10 15 20 25 30
A B C D E
75°30′ 75° 74°30′ 74°
1 2 3 4 5
41 40 30 40 39 30 39
Longitude 74°30′ West from Greenwich
N E W Y O R K
P E N N S Y L V A N I A
D E L A W A R E
A T L A N T I C O C E A N
Delaware Bay
Milford
Montague
Hainesville
Sussex
Normanock
Wykertown
Branchville
Hamburg
Flatbrookville
Swartzwood
Middleville
Newton
Sparta
Franklin Furnace
Stockholm
Ogdensburg
New Foundland
Milton
Glenwood
Vernon
Greenwood L.
Stony Point
Tuxedo
Yorktown
Ossining
Mahwah
Ramsey
Montvale
Allendale
Park Ridge
West wood
Wyckoff
Midland Park
Hawthorne
Dumont
Closter
Cresskill
Tenafly
Englewood
Hackensack
Long Island Sound
Marksboro
Blairstown
Hainesburg
Columbia
Delaware
Hope
Tranquility
Andover
Mt. Arlington
Stanhope
Netcong
Flanders
Bloomingdale
Pompton
Hibernia
Paterson
Totowa
Boonton
Denville
Little Falls
Whippany
Cedar Grove
Passaic
Hasbrouck Heights
Carlstadt
Rutherford
Nutley
Montclair
Bloomfield
Orange
Belleville
Harrison
Hoboken
Jersey Cy.
Bayonne
Newark
E. Orange
Elizabeth
Mauch Chunck
Delvidere
Bridgeville
Vienna
Oxford
Drakestown
German Valley
Port Murray
Harmony
Port Colden
Washington
Stewartsville
New Hampton
Glen Gardner
Chester
Morristown
Hanover
Mendham
Madison
Chatham
Millburn
Peapack
Bernardsville
Providence
Summit
Cranford
Westfield
Fanwood
Plainfield
Dunellen
Picton
Linden
Roselle
Carteret Sta.
Rahway
Woodbridge
STATEN ID.
New York Lower Bay
Bath
Phillipsburg
Easton
Springtown
Allentown
South Bethlehem
Riegelsville
Bloomsbury
Asbury
Clinton
High Bridge
Lebanon
Annandale
N. Branch
Raritan
New Germantown
White House Sta.
Boundbrook
New Market
Somerville
Milford
Quakertown
Three Bridges
Frenchtown
Metuchen
S. Boundbrook
Tottenville
Perth Amboy
South Amboy
Sayreville
South River
Port Monmouth
Sandy Hook
Atlantic Highlands
Highlands
Seabright
Flemington
Sergeantsville
Stockton
Reaville
Skillman
E. Millstone
New Brunswick
Milltown
Spotswood
Old Bridge
Keyport
Matawan
Hazlet
Navesink
Middletown
Red Bank
Oceanic
Shrewsbury
Eatontown
Long Branch
Barto
Quakertown
Ringoes
Hopewell
Rocky Hill
Kingston
Monmouth Jc.
Wickatunk
Jamesburg
Marlboro
Englishtown
Lambertville
Doylertown
Pennington
Princeton
Dayton
Lawrenceville
Lawrence
Cranbury
Manalapan
Freehold
Deal Beach
Elberon
Allenhurst
Asbury Park
Ocean Grove
Bradley Beach
Belmar
Spring Lake
Manasquan
Point Pleasant
Mantoloking
Lansdale
Wilburtha
TRENTON
Hightstown
Windsor
Perrineville
Adelphia
Hamilton Sq.
Imlaystown
Farmingdale
Lower Squankum
Halboro
Yardville
Allentown
Crosswicks
Cassville
Vanhiseville
Lakewood
Bayhead
Norristown
Bordentown
Florence
Fieldsboro
Burlington
Columbus
New Egypt
Wrightstown
Osborneville
Beverly
Delanco
Riverside
Riverton
Palmyra
Rancocas
Mount Holly
Smithville
Lakehurst
Silverton
PHILADELPHIA
West Chester
Merchantville
Moorestown
Stanwick
Pemberton
Browns Mills
Whiting
Tom's River
Seaside Park
Camden
Hainesport
Mt. Laurel
Lumberton
Vincentown
Medford
Gloucester
Westville
Paulsboro
Collingswood
Marlton
Woodmansie
Barnegat Park
Forked River
Chews
Haddonfield
Lindenwold
Chatsworth
Wilmington
Gibbstown
Bridgeport
Mantua
Woodbury
Venomah
Clementon
Berlin
Atco
Waretown
Barnegat Inlet
Barnegat
Pedrick town
Swedesboro
Glassboro
Chesilhurst
Jenkins
Manahawken
Pennsgrove
Sharptown
Woodstown
Williams town
Clayton
Winslow
Winslow Jc.
Hammonton
West Creek
Barnegat City Jc.
Pennsville
Yorktown
Franklinville
Greenbank
Parkertown
Tuckerton
Daretown
Elmer
Newtonville
Elwood
New Gretna
Beach Haven
Little Egg Harbor
Delaware City
Salem
Alloway
Quinton
Malaga
Newfield
Landisville
Egg Harbor City
Port Republic
Great Bay
Hancock's Bridge
Canton
Roadstown
Rosenhayn
South Vineland
Vineland
Milmay
Richland
Weymouth
Pomerania P.O.
Oceanville
New Inlet
Bargantine Jc.
Pleasantville
Absecon
Brigantine
Greenwich
Bridgeton
Millville
Mays Landing
Fairton
Risley
Smith's Landing
Atlantic City
Cayler
Cedarville
Newport Sta.
Haleyville
Dorchester
Port Elizabeth
Tuckahoe
English Creek
Somers Point
Petersburg
South Atlantic City
Egg Harbor Inlet
Ocean City
Clayton
Mauricetown
Dividing Creek
Leesburg
Woodbine
Seaville
Bivalve
Heislerville
Delmont
Dennisville
Sea Isle Jc.
Sea Isle City
Ocean View
DOVER
Goshen
Dennisville
Avalon
Cape May Court House
Green Creek
Rio Grande
Hereford Inlet
Cold Spring
Wildwood
Hollybeach
Cape May
NEW JERSEY DELAWARE BOUNDARY LINE
Delaware Riv.
PENNA.
ERIE
CANAL
MORRIS
P. & R.
L. & N. E.
C. OF N.J.
D. L. & W.
LEH. VAL.
N. Y. C. & H. R.
N. Y. S. & W.
P. N. & N. Y.
W. J. & S.
CEN.
TUCK.
Hudson R.
Wading R.

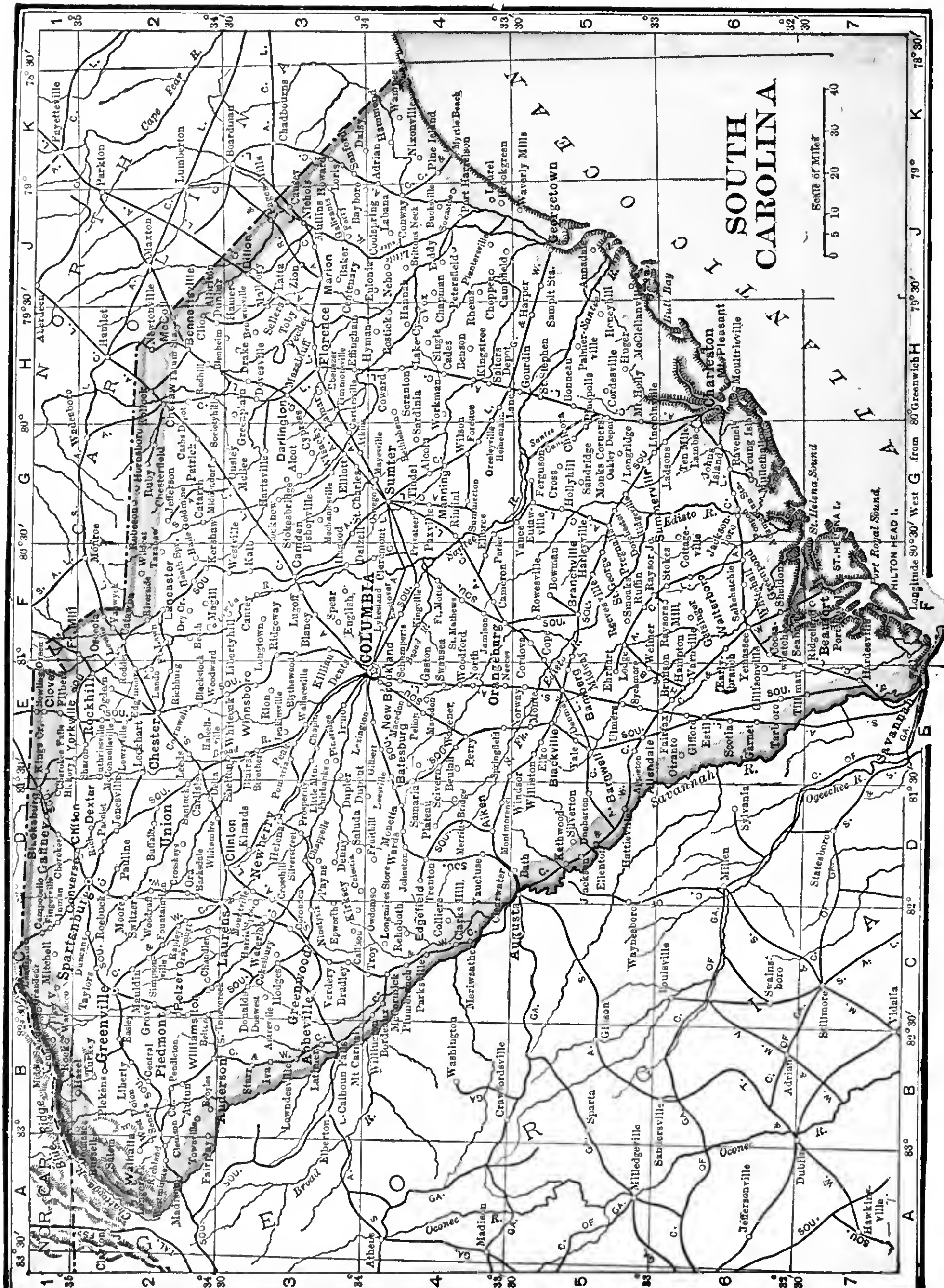

PENNSYLVANIA
Scale of Miles
0 5 10 20 30 40 50
Philadelphia
Pittsburg
Allegheny
HARRISBURG
Scranton
Wilkes-Barre
Williamsport
Altoona
Johnstown
Reading
Allentown
Lancaster
Erie
Newcastle
Lebanon
York
Meadville
L A K E   E R I E
N E W   Y O R K
N E W   J E R S E Y
M A R Y L A N D
W. V I R G I N I A
O H I O
Longitude West from Greenwich


MARYLAND
AND DELAWARE
Scale of Miles
0 5 10 20 30
Longitude West from Greenwich
WESTERN PART
OF MARYLAND
Same scale as large map.
PENNSYLVANIA
NEW JERSEY
DELAWARE
MARYLAND
VIRGINIA
WEST VIRGINIA
DELAWARE BAY
ATLANTIC OCEAN
WASHINGTON
Baltimore
ANNAPOLIS
DOVER
Wilmington
Philadelphia
Hagerstown
Frederick
Cumberland
Salisbury
Cambridge
Easton
Chestertown
Havre de Grace
Alexandria
Georgetown
Potomac
Susquehanna
Rappahannock

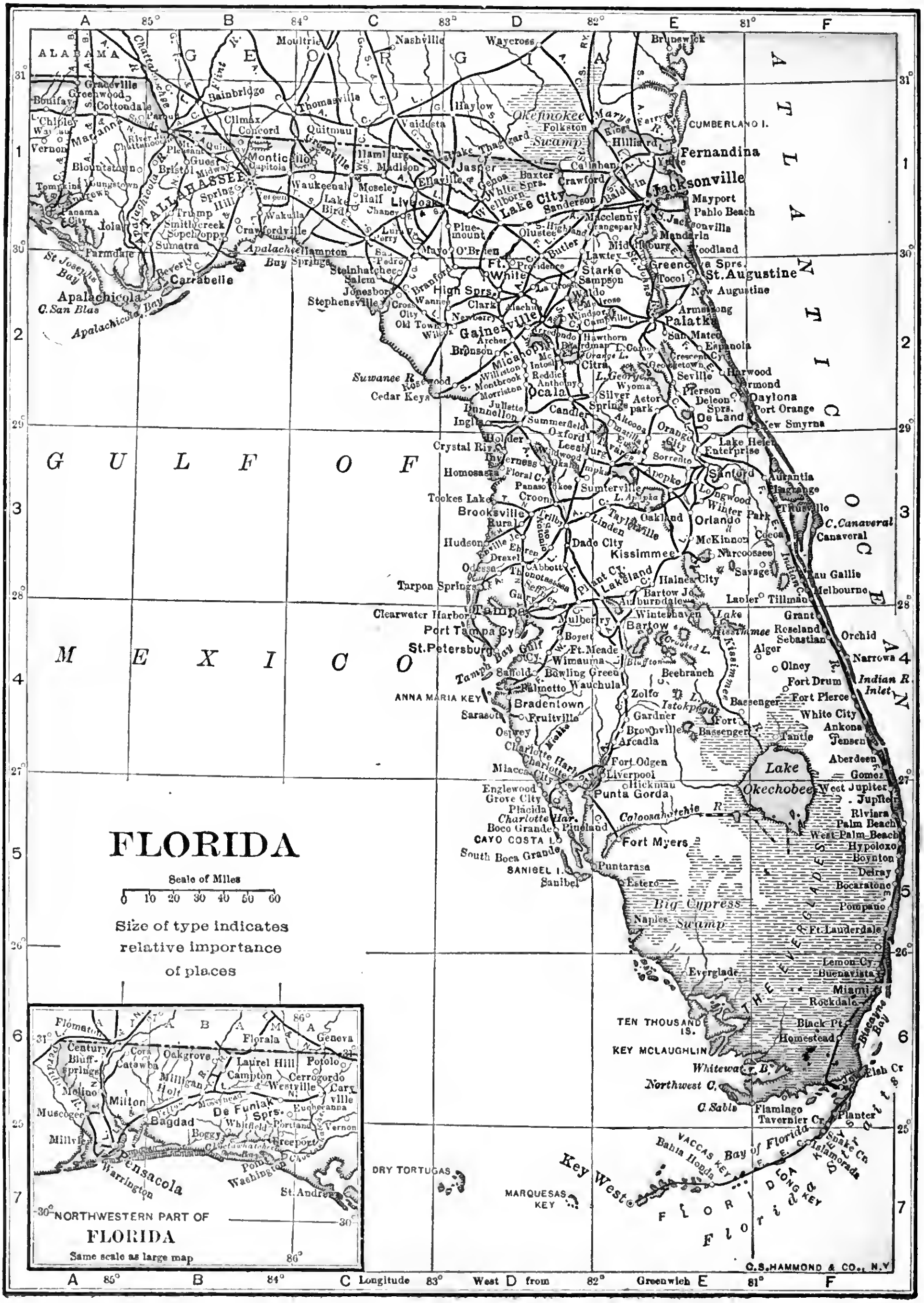

VIRGINIA
WESTERN PORTION OF VIRGINIA
Same Scale as Main Map
Scale of Miles
0 10 20 40 60
Longitude 79° West from Greenwich

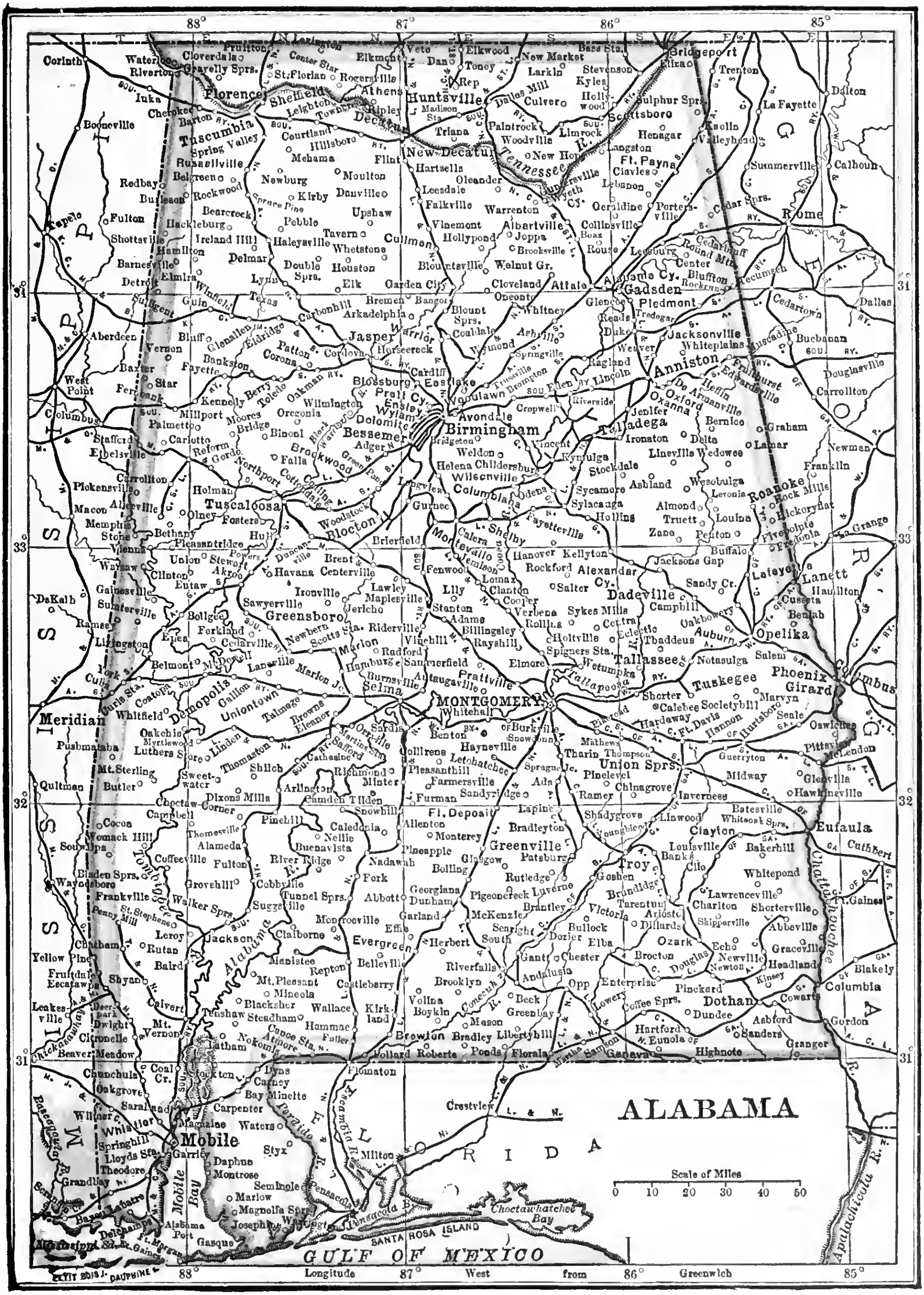

WEST VIRGINIA
Scale of Miles
NORTHERN PORTION
WEST VIRGINIA
Same scale as main map
CHARLESTON
Parkersburg
Wheeling
Huntington
Clarksburg
Fairmont
Morgantown
Martinsburg

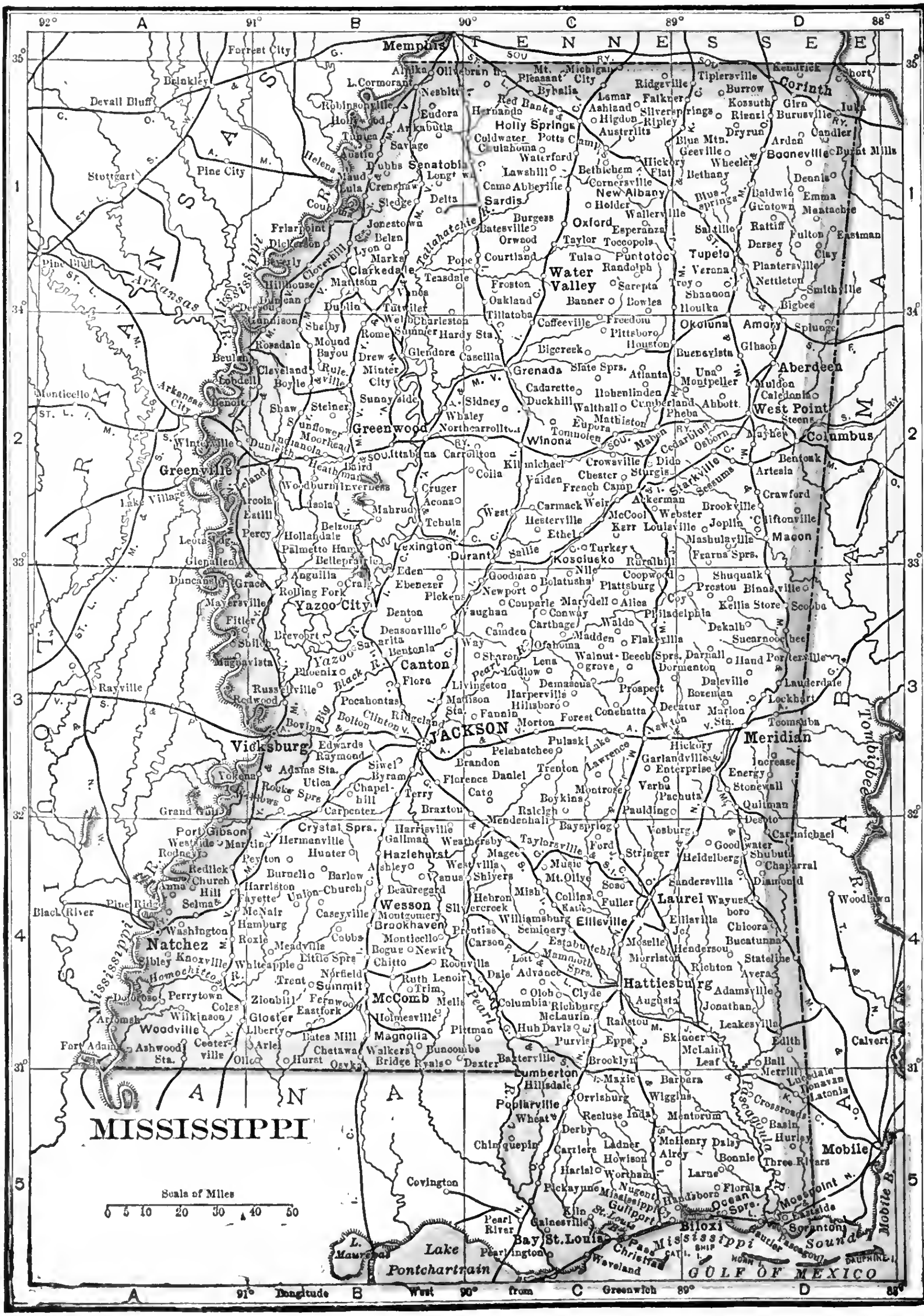

NORTH CAROLINA
Scale of Miles
0 10 20 40 60 80
Longitude West from Greenwich
WESTERN PART OF NORTH CAROLINA
Same Scale as Main Map
ATLANTIC OCEAN
SOUTH CAROLINA
VIRGINIA
TENNESSEE
GEORGIA
RALEIGH
Wilmington
Charlotte
Greensboro
Asheville
C. Hatteras
C. Lookout
C. Fear

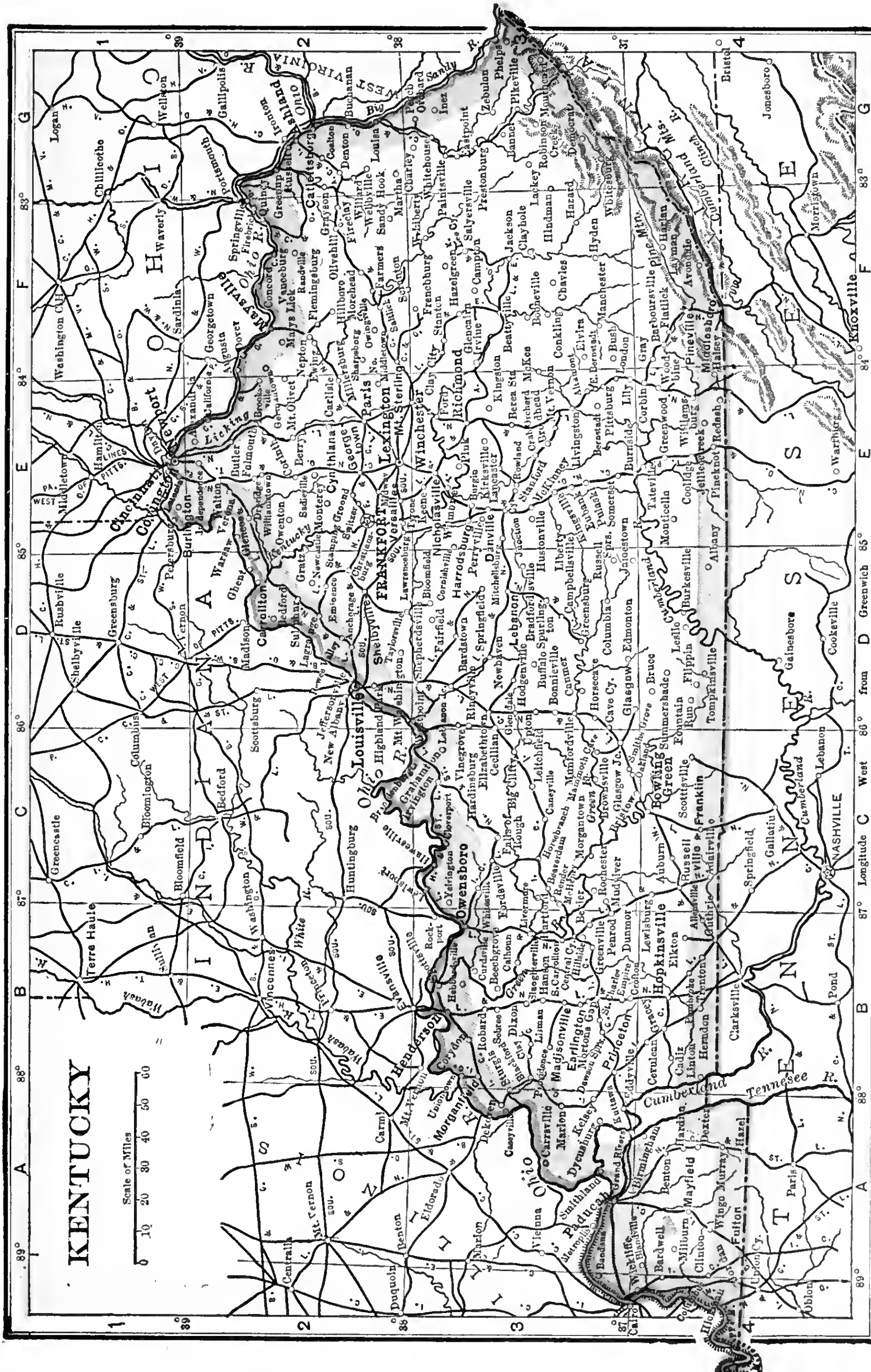

SOUTH CAROLINA
Scale of Miles
0 5 10 20 30 40
Longitude 80° 30' West G from 80° Greenwich H

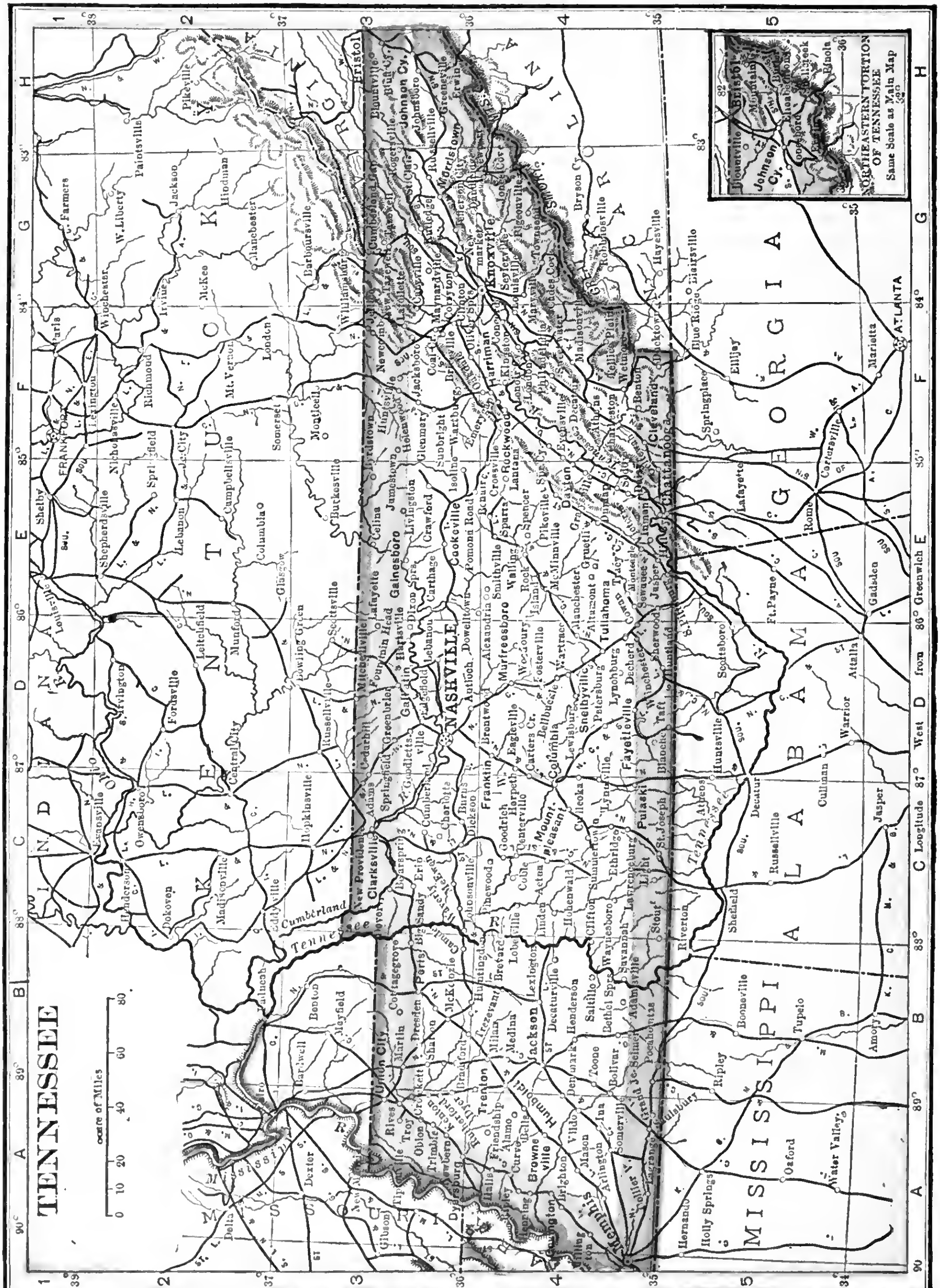

GEORGIA
Scale of Miles
0 10 20 30 40 50 60
TENNESSEE
NORTH CAROLINA
SOUTH CAROLINA
ALABAMA
FLORIDA
ATLANTIC OCEAN
Atlanta
Athens
Augusta
Macon
Columbus
Savannah
Rome
Dalton
Marietta
Griffin
Milledgeville
Americus
Albany
Thomasville
Waycross
Brunswick
Valdosta
Dublin
Cartersville
Gainesville
Tallahassee
Columbia
Longitude West from Greenwich
84°
83°
82°
81°
85°


FLORIDA
Scale of Miles
0 10 20 30 40 50 60
Size of type indicates relative importance of places
GULF OF MEXICO
ATLANTIC OCEAN
ALABAMA
GEORGIA
Tallahassee
Jacksonville
Fernandina
St. Augustine
Palatka
Gainesville
Ocala
Lake City
Live Oak
Apalachicola
Carrabelle
Cedar Keys
Sanford
Orlando
Kissimmee
Lakeland
Tampa
Port Tampa Cy.
St. Petersburg
Bradentown
Punta Gorda
Fort Myers
Key West
Miami
Lake Okechobee
Big Cypress Swamp
Okefinokee Swamp
The Everglades
Bay of Florida
Florida Keys
Florida Straits
Dry Tortugas
Marquesas Key
Ten Thousand Is.
C. Canaveral
C. Sable
Cumberland I.
NORTHWESTERN PART OF FLORIDA
Same scale as large map
Pensacola
Milton
De Funiak Sprs.
Bagdad
Warrington
Longitude West from Greenwich
C.S.HAMMOND & CO., N.Y.

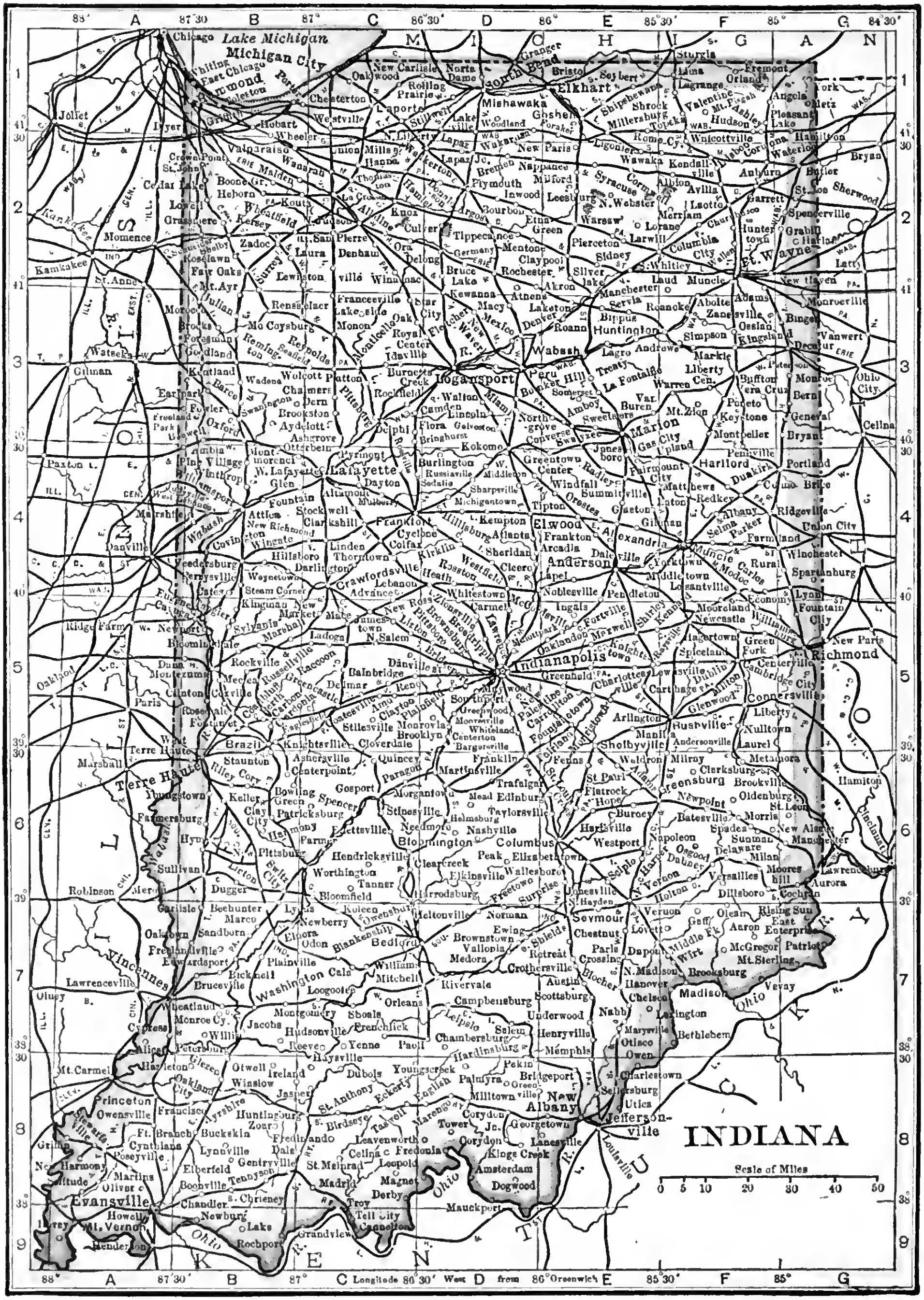

ALABAMA
Scale of Miles
0 10 20 30 40 50
Longitude West from Greenwich
88° 87° 86° 85°
35° 34° 33° 32° 31°
TENNESSEE
GEORGIA
MISSISSIPPI
FLORIDA
GULF OF MEXICO
MONTGOMERY
Birmingham
Mobile
Huntsville
Tuscaloosa
Selma
Anniston
Gadsden
Florence
Sheffield
Tuscumbia
Decatur
New Decatur
Bessemer
Talladega
Opelika
Phoenix
Girard
Columbus
Eufaula
Dothan
Troy
Greenville
Demopolis
Meridian
Jasper
Cullman
Albertville
Scottsboro
Bridgeport
Rome
Corinth
Tuscumbia
Montevallo
Tallassee
Tuskegee
Union Sprs.
Andalusia
Evergreen
Brewton
Pensacola
Mobile Bay
Pensacola B.
Choctawhatchee Bay
SANTA ROSA ISLAND
Tennessee R.
Tallapoosa
Warrior
Alabama R.
Tombigbee
Chattahoochee R.
Apalachicola R.
Conecuh R.
Escambia R.
Perdido


MISSISSIPPI
Scale of Miles
0 5 10 20 30 40 50
A
B
C
D
92°
91°
90°
89°
88°
35°
34°
33°
32°
31°
Longitude West from Greenwich
TENNESSEE
ARKANSAS
LOUISIANA
ALABAMA
Memphis
Corinth
Holly Springs
Oxford
Water Valley
Greenwood
Greenville
Grenada
Winona
Columbus
West Point
Aberdeen
Tupelo
Yazoo City
Canton
Vicksburg
JACKSON
Meridian
Natchez
Brookhaven
McComb
Laurel
Hattiesburg
Biloxi
Gulfport
Bay St. Louis
Mobile
Lake Pontchartrain
Mississippi Sound
GULF OF MEXICO

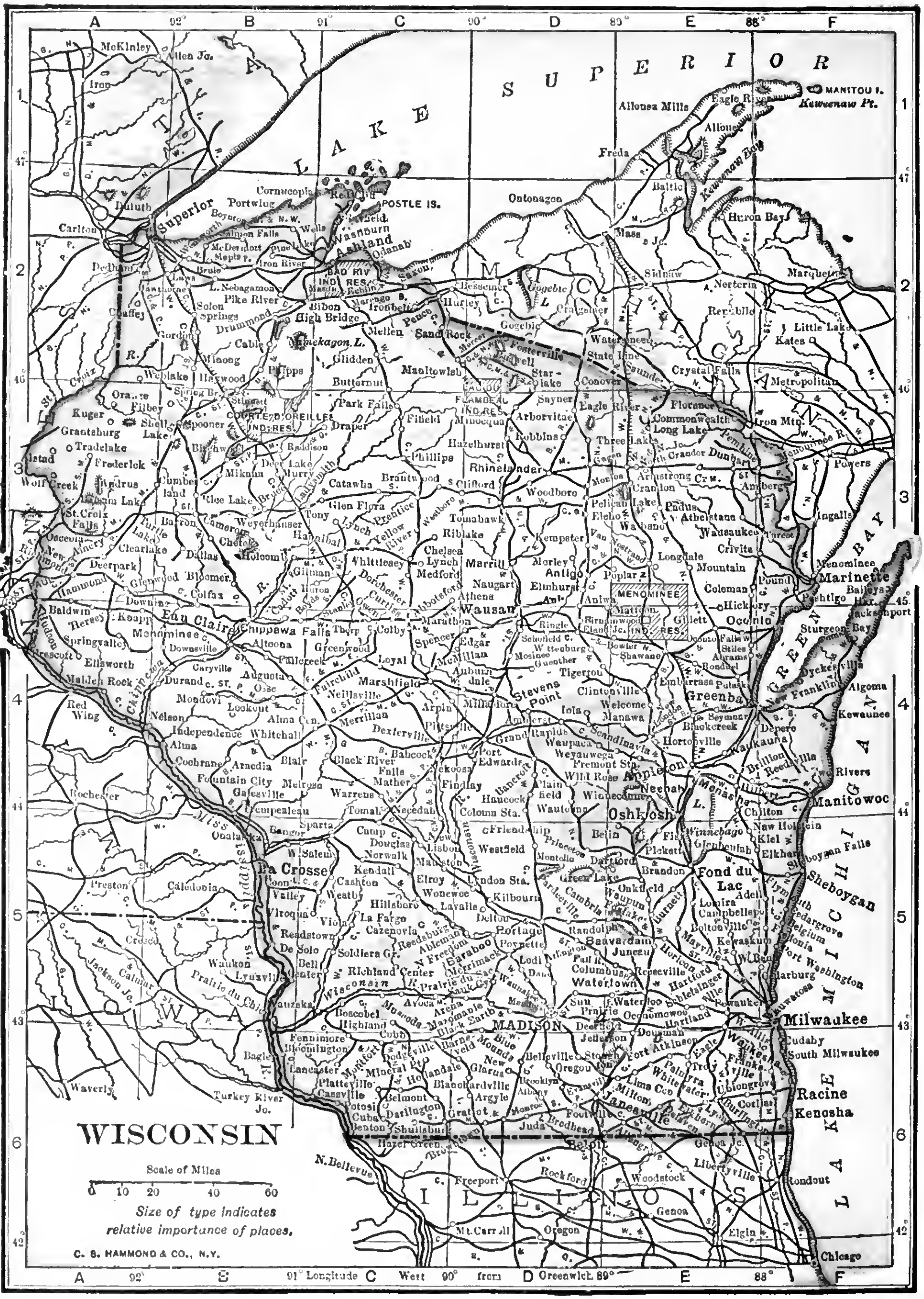

KENTUCKY
Scale of Miles
0 10 20 30 40 50 60
Longitude West from Greenwich
FRANKFORT
Louisville
Lexington
Covington
Newport
Cincinnati
Paducah
Owensboro
Henderson
Bowling Green
Ashland
Maysville
Frankfort
NASHVILLE
Knoxville
Cumberland
Tennessee R.
Ohio R.
Licking R.
Kentucky R.
Green R.
Cairo

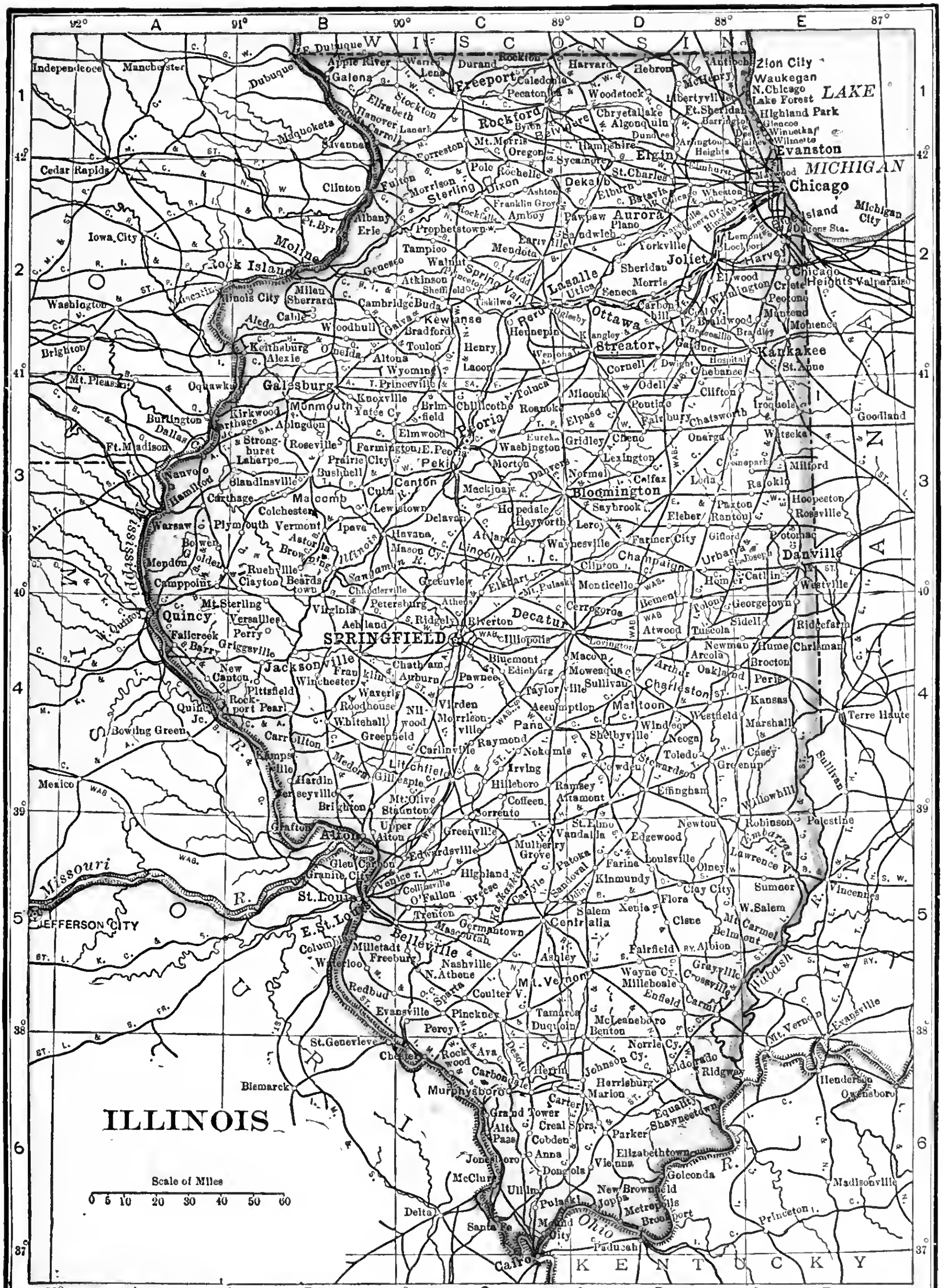

TENNESSEE
Scale of Miles
NORTHEASTERN PORTION OF TENNESSEE
Same Scale as Main Map
Longitude West from Greenwich
NASHVILLE
Knoxville
Chattanooga
Memphis
Jackson
KENTUCKY
VIRGINIA
NORTH CAROLINA
GEORGIA
ALABAMA
MISSISSIPPI
ARKANSAS
MISSOURI
INDIANA
ILLINOIS
ATLANTA
FRANKFORT

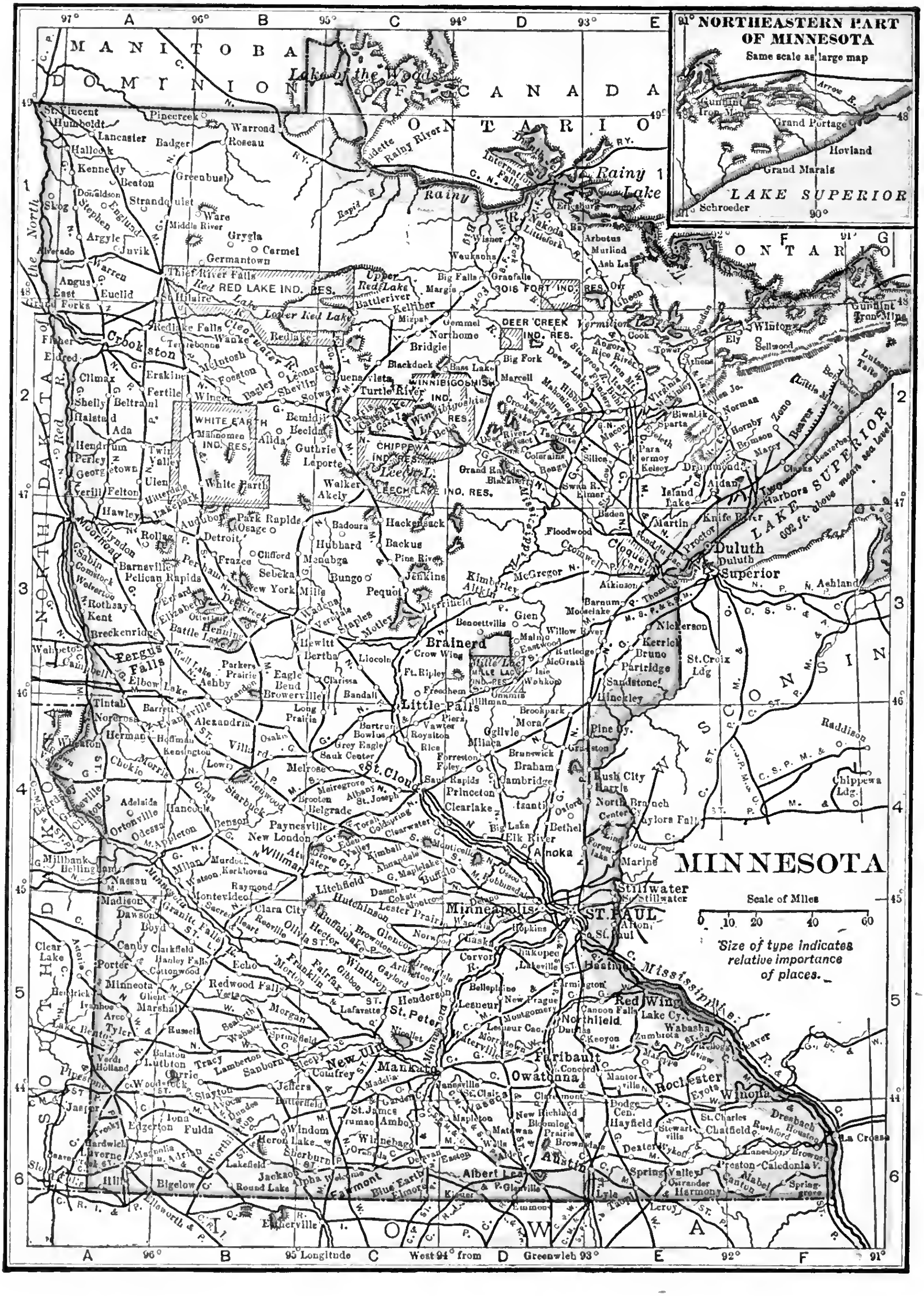

OHIO
Scale of Miles
0 10 20 30 40 50 60
Longitude 83° West from C Greenwich 82°
A
84°
B
83°
C
82°
D
81°
E
1
2
3
4
5
42°
41°
40°
39°
38°
MICHIGAN
ONTARIO
LAKE ERIE
Lake St. Clair
KENTUCKY
WEST VIRGINIA
Ohio
COLUMBUS
Toledo
Cleveland
Sandusky
Akron
Canton
Youngstown
Mansfield
Findlay
Lima
Marion
Springfield
Dayton
Cincinnati
Hamilton
Zanesville
Newark
Chillicothe
Portsmouth
Ironton
Marietta
Steubenville
Bellaire
Detroit
Ann Arbor
Jackson
Chatham
Parkersburg
Covington
Lexington
Paris
Maysville
Flemingsburg
Morehead
Williamstown
Georgetown
Winchester
Carlisle
Mt Sterling
Grayston
Kenova
Big Sandy
PT. PELEE
Put-in-Bay
Kelley's I.
Marblehead
Wooster
Massillon
Tiffin
Fostoria
Bucyrus
Delaware
Lancaster
Circleville
Athens
Pomeroy
Gallipolis
Xenia
Piqua
Sidney
Urbana
Wapakoneta
Bellefontaine
Kenton
Mt. Vernon
Coshocton
Cambridge
Cadiz
Painesville
Ashtabula
Conneaut
Warren
Elyria
Lorain
Norwalk
Ashland
Wellsville
E. Liverpool


INDIANA
Scale of Miles
0 5 10 20 30 40 50
Lake Michigan
M I C H I G A N
Chicago
Michigan City
South Bend
Elkhart
Ft. Wayne
Logansport
Lafayette
Kokomo
Marion
Muncie
Anderson
Indianapolis
Richmond
Terre Haute
Vincennes
Evansville
New Albany
Jeffersonville
Ohio
O H I O
K E N T U C K Y
Longitude West from Greenwich

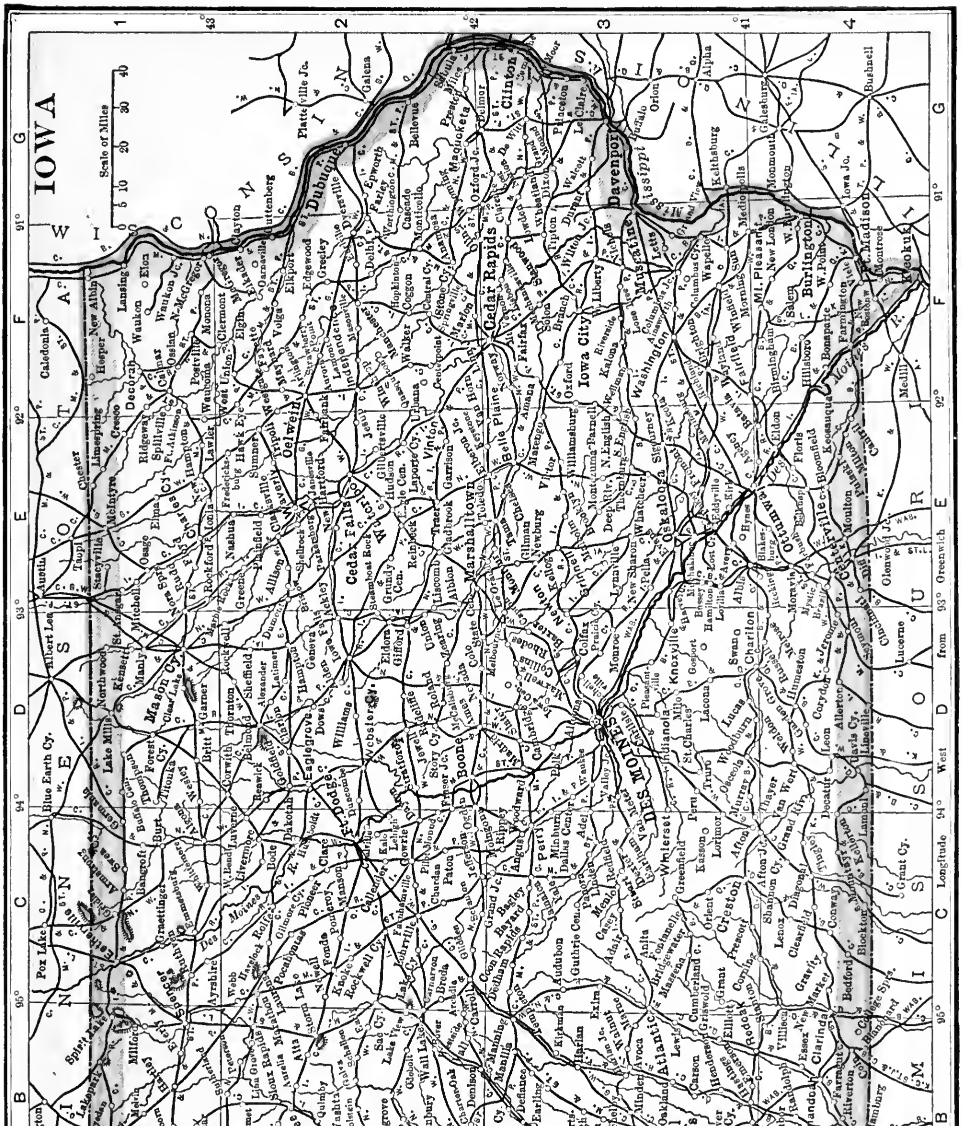

MICHIGAN
Scale of Miles
0 10 20 40 60 80
LAKE SUPERIOR
Elevation above Sea Level 602 feet
Same scale as main map
ISLE ROYALE
LAKE SUPERIOR
APOSTLE ISLANDS
LAKE MICHIGAN
Elevation above Sea Level 582 feet
LAKE HURON
Elevation above Sea Level 582 feet
GREEN BAY
Saginaw Bay
ONTARIO
WISCONSIN
INDIANA
OHIO
LAKE ERIE
Keweenaw Pt.
Whitefish Pt.
Grand Marais
Pte. Au Sable
GRAND I.
Marquette
Ishpeming
Negaunee
Michigamme
Republic
Munising
Seney
Newberry
Sault Ste. Marie
ST. JOSEPH I.
DRUMMOND
Pickford
Manistique
Escanaba
Gladstone
Menominee
Iron Mtn.
Ironwood
Bessemer
Ontonagon
Calumet
Red Jacket
Houghton
Hancock
L'Anse
GRAND MANITOULIN I.
THE DUCKS
MACKINAC I.
BOIS BLANC I.
BEAVER I.
N. MANITOU I.
S. MANITOU I.
Mackinaw
Chebnygan
Petoskey
Charlevoix
Alpena
North Pt.
Thunder Bay
Traverse Cy.
Frankfort
Manistee
Cadillac
Grayling
Ludington
Big Rapids
Muskegon
Grand Haven
Grand Rapids
Ionia
Holland
Bay City
W. Bay City
Saginaw
Midland
Flint
Owosso
Lapeer
Port Huron
Pontiac
Mt. Clemens
L. St. Clair
Detroit
Wyandotte
Monroe
Toledo
Ann Arbor
Ypsilanti
Jackson
LANSING
Albion
Battle Creek
Kalamazoo
Benton Harbor
St. Joseph
Niles
Coldwater
Hillsdale
Adrian
South Bend
Chicago
Milwaukee
Racine
Kenosha
Waukegan
Sheboygan
Manitowoc
Green Bay
Sturgeon Bay
Pte. Pelee
Pts. Aux Barques
Grindstone Cy.
Port Austin
Harrisville
Oscoda
Au Sable
E. Tawas
A 88° B 87° C 86° D 85° E
84° F 83° G
86° Longitude D West 85° from E Greenwich 84°

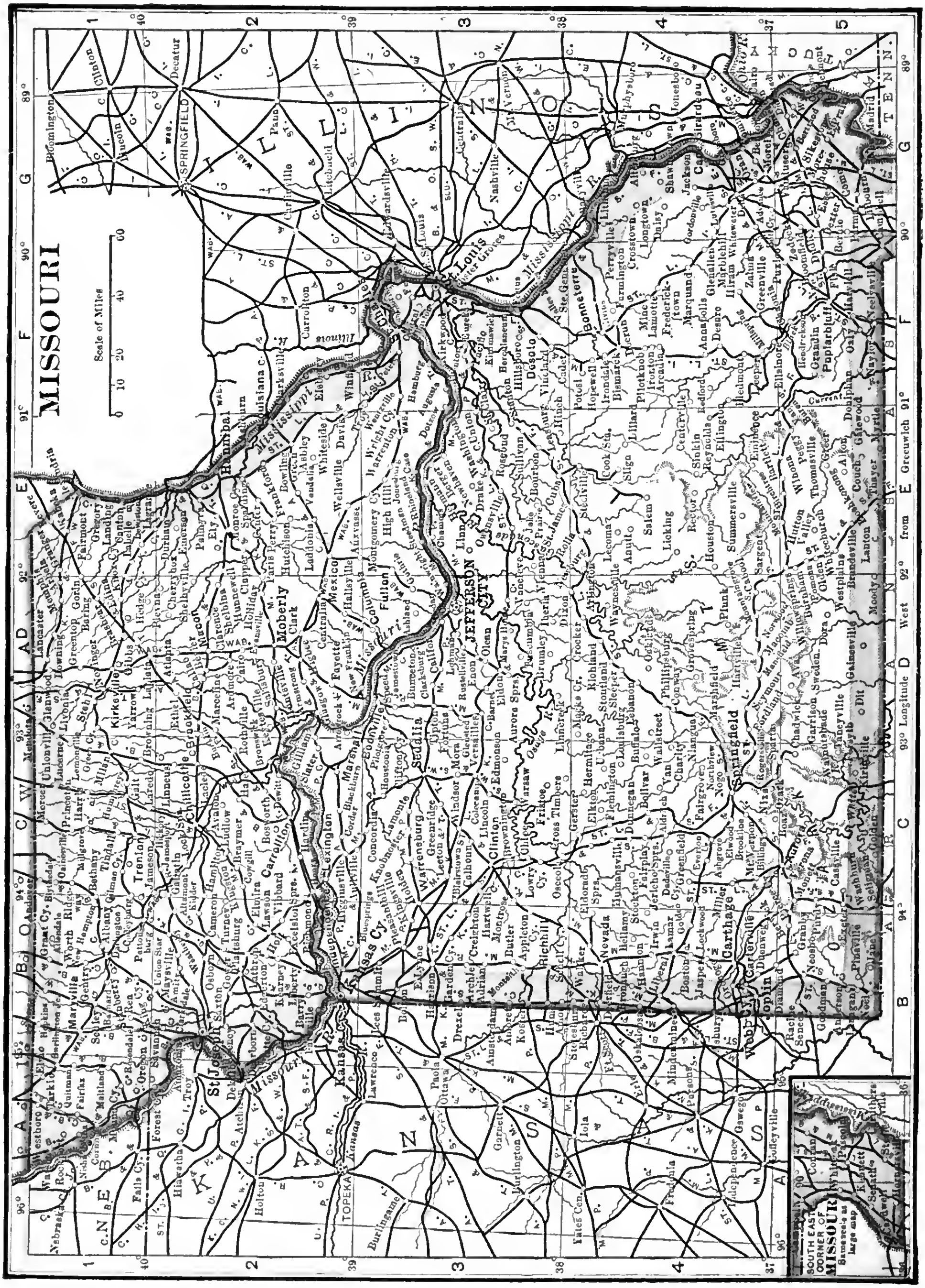

WISCONSIN
Scale of Miles
0 10 20 40 60
Size of type indicates relative importance of places.
C. S. HAMMOND & CO., N.Y.
LAKE SUPERIOR
LAKE MICHIGAN
GREEN BAY
MICHIGAN
IOWA
ILLINOIS
MINNESOTA
Longitude West 90° from Greenwich
Madison
Milwaukee
La Crosse
Eau Claire
Chippewa Falls
Oshkosh
Fond du Lac
Sheboygan
Manitowoc
Racine
Kenosha
Janesville
Superior
Ashland
Wausau
Stevens Point
Appleton
Marinette
Duluth
Chicago
Menominee Ind. Res.
Bad Riv. Ind. Res.
Lac Court Oreilles Ind. Res.
Flambeau Ind. Res.
Keweenaw Pt.
Apostle Is.
Manitou I.

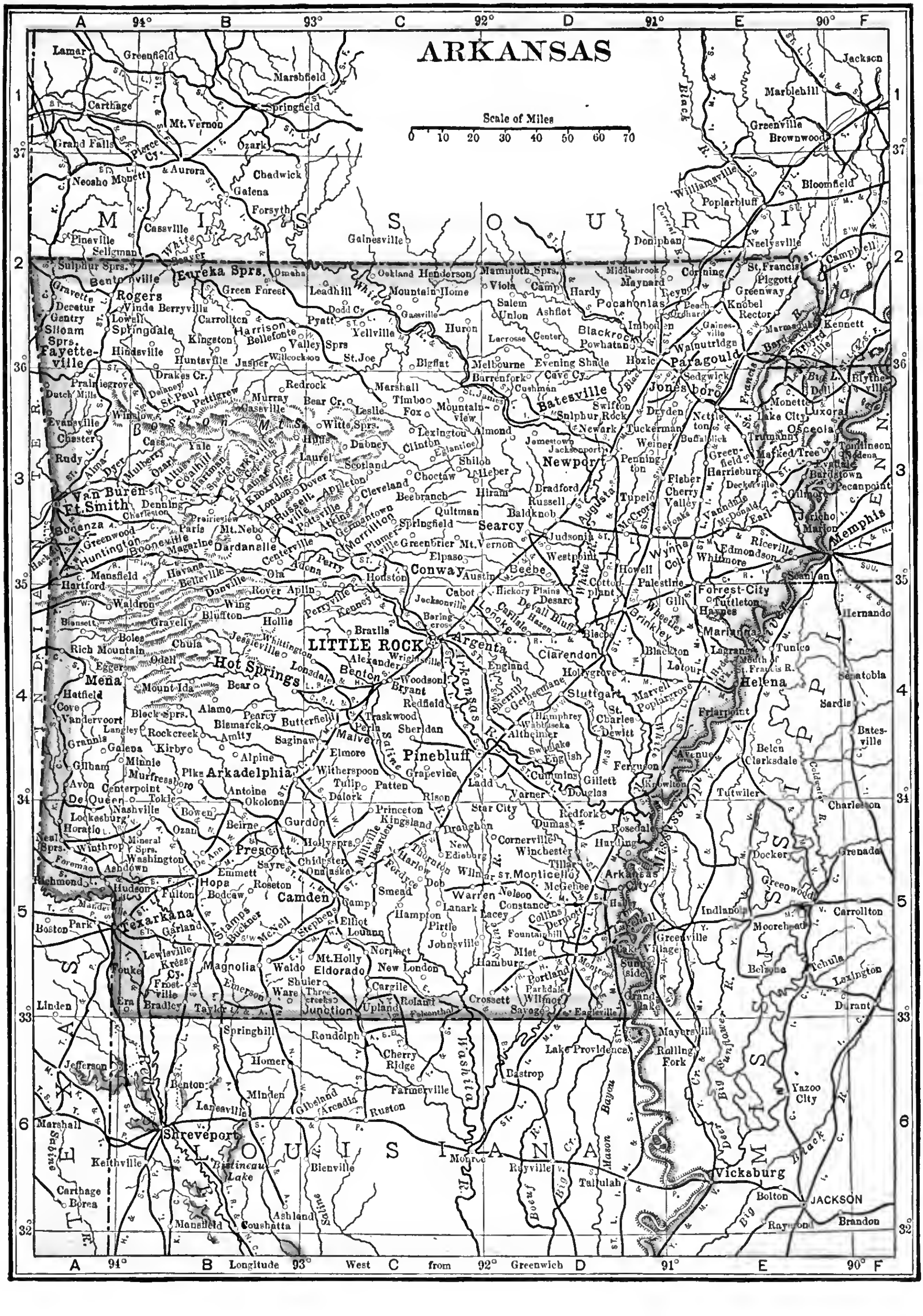

ILLINOIS
Scale of Miles
0 5 10 20 30 40 50 60
Longitude 90° West from 89° Greenwich
92° A 91° B 90° C 89° D 88° E 87°
WISCONSIN
LAKE MICHIGAN
KENTUCKY
INDIANA
MISSOURI
IOWA
Missouri R.
Ohio
Mississippi R.
Illinois R.
Sangamon R.
Kaskaskia R.
Wabash R.
Embarras R.
CHICAGO
SPRINGFIELD
Chicago
Evanston
Zion City
Waukegan
N. Chicago
Lake Forest
Highland Park
Elgin
Aurora
Joliet
Rockford
Freeport
Galena
Dubuque
Belvidere
Dixon
Sterling
Rock Island
Moline
Kewanee
Galesburg
Monmouth
Peoria
Pekin
Canton
Ottawa
Lasalle
Streator
Kankakee
Bloomington
Normal
Champaign
Urbana
Danville
Decatur
Jacksonville
Quincy
Macomb
Alton
E. St. Louis
St. Louis
Belleville
Centralia
Mt. Vernon
Carbondale
Murphysboro
Cairo
Mound City
Paducah
Evansville
Terre Haute
Vincennes
Mattoon
Charleston
Litchfield
Edwardsville
Cedar Rapids
Iowa City
Burlington
Keokuk
Clinton
Hannibal
Jefferson City
Mexico
Bowling Green
St. Genevieve
Bismarck
Henderson
Owensboro
Madisonville
Princeton
Terre Haute
Valparaiso
Goodland

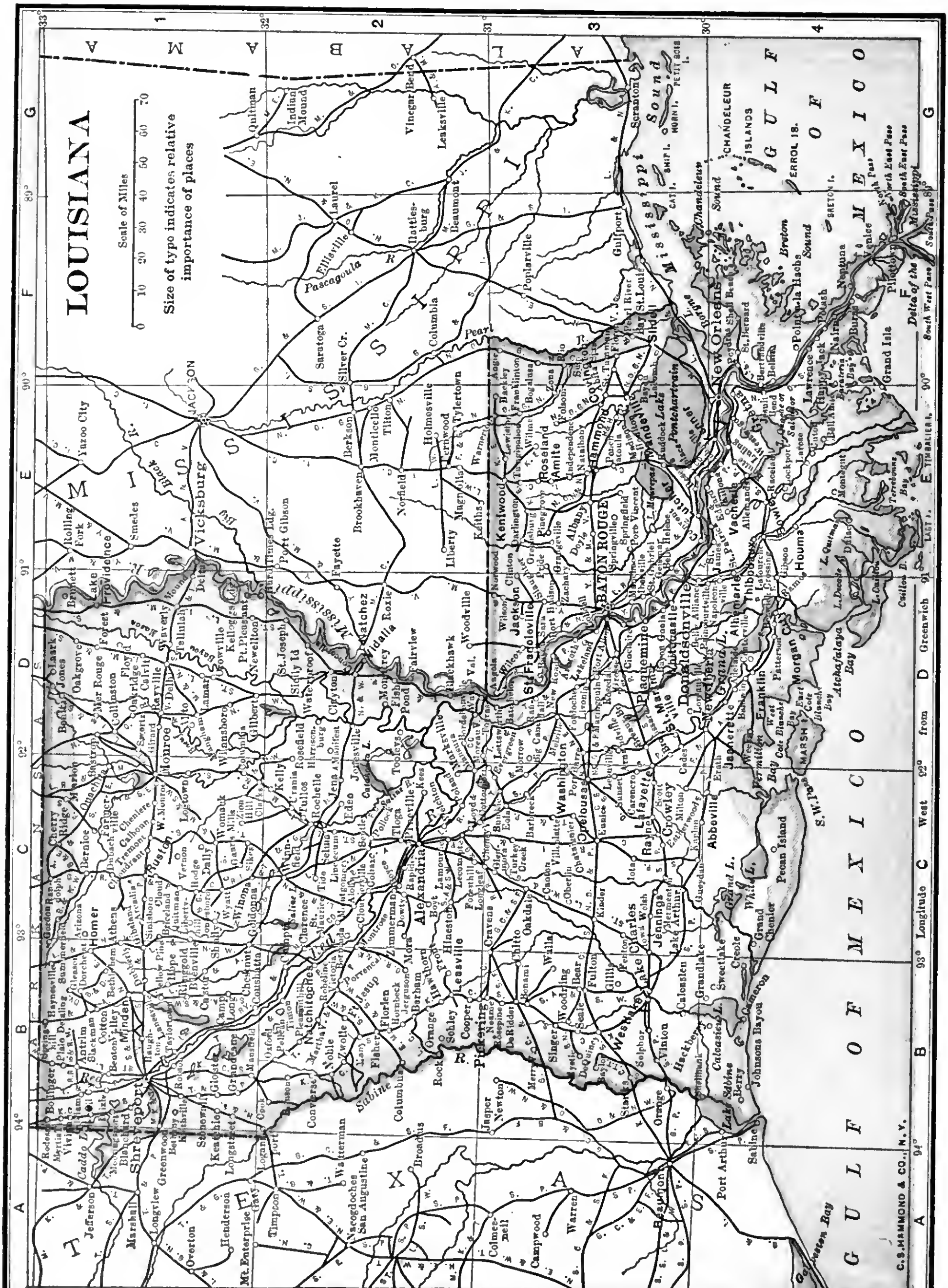


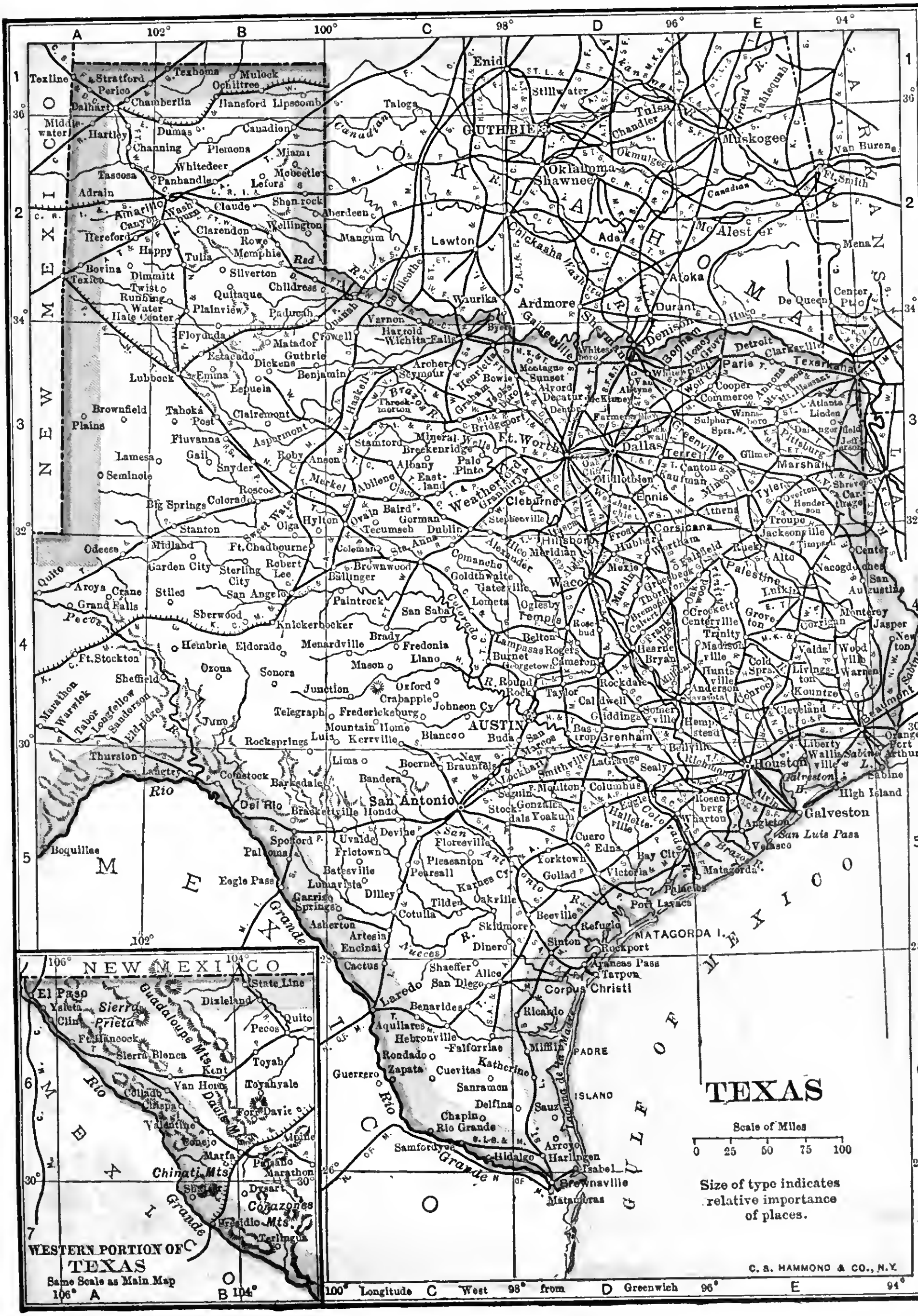
NORTHEASTERN PART OF MINNESOTA
Same scale as large map
LAKE SUPERIOR
MINNESOTA
Scale of Miles
0 10 20 40 60
Size of type indicates relative importance of places.
MANITOBA
DOMINION OF CANADA
ONTARIO
NORTH DAKOTA
SOUTH DAKOTA
WISCONSIN
IOWA
Lake of the Woods
Rainy Lake
Red Lake
Lower Red Lake
Leech L.
RED LAKE IND. RES.
WHITE EARTH IND. RES.
LEECH LAKE IND. RES.
DEER CREEK IND. RES.
Mississippi R.
LAKE SUPERIOR
602 ft. above mean sea level
Duluth
Superior
St. Paul
Minneapolis
Stillwater
Red Wing
Winona
Rochester
Faribault
Owatonna
Mankato
New Ulm
St. Peter
Albert Lea
Austin
St. Cloud
Little Falls
Brainerd
Fergus Falls
Crookston
Moorhead
Bemidji
Hibbing
Virginia
Two Harbors
Grand Marais
Grand Portage
Hovland
Schroeder
La Crosse
95 Longitude
West 94 from
Greenwich 93

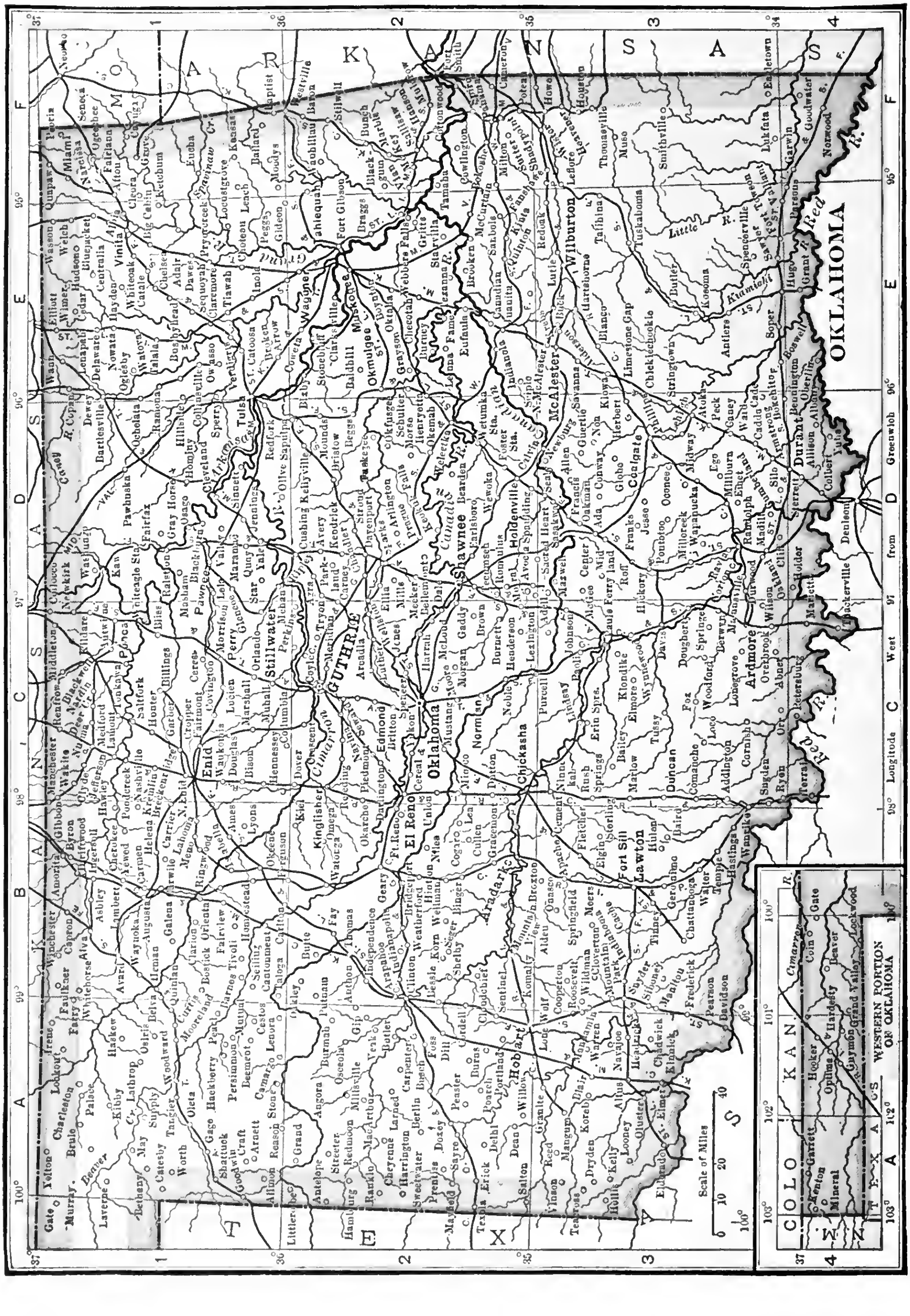

IOWA
Scale of Miles
0 5 10 20 30 40
Longitude 93° West from Greenwich
WISCONSIN
MINNESOTA
ILLINOIS
MISSOURI
NEBRASKA
DES MOINES
Davenport
Dubuque
Cedar Rapids
Iowa City
Clinton
Muscatine
Burlington
Keokuk
Ft. Madison
Ottumwa
Oskaloosa
Marshalltown
Waterloo
Cedar Falls
Mason Cy.
Ft. Dodge
Boone
Sioux City
Council Bluffs
Omaha
Atlantic
Creston
Centerville
Newton
Oelwein
Missouri R.
Mississippi R.
Des Moines R.

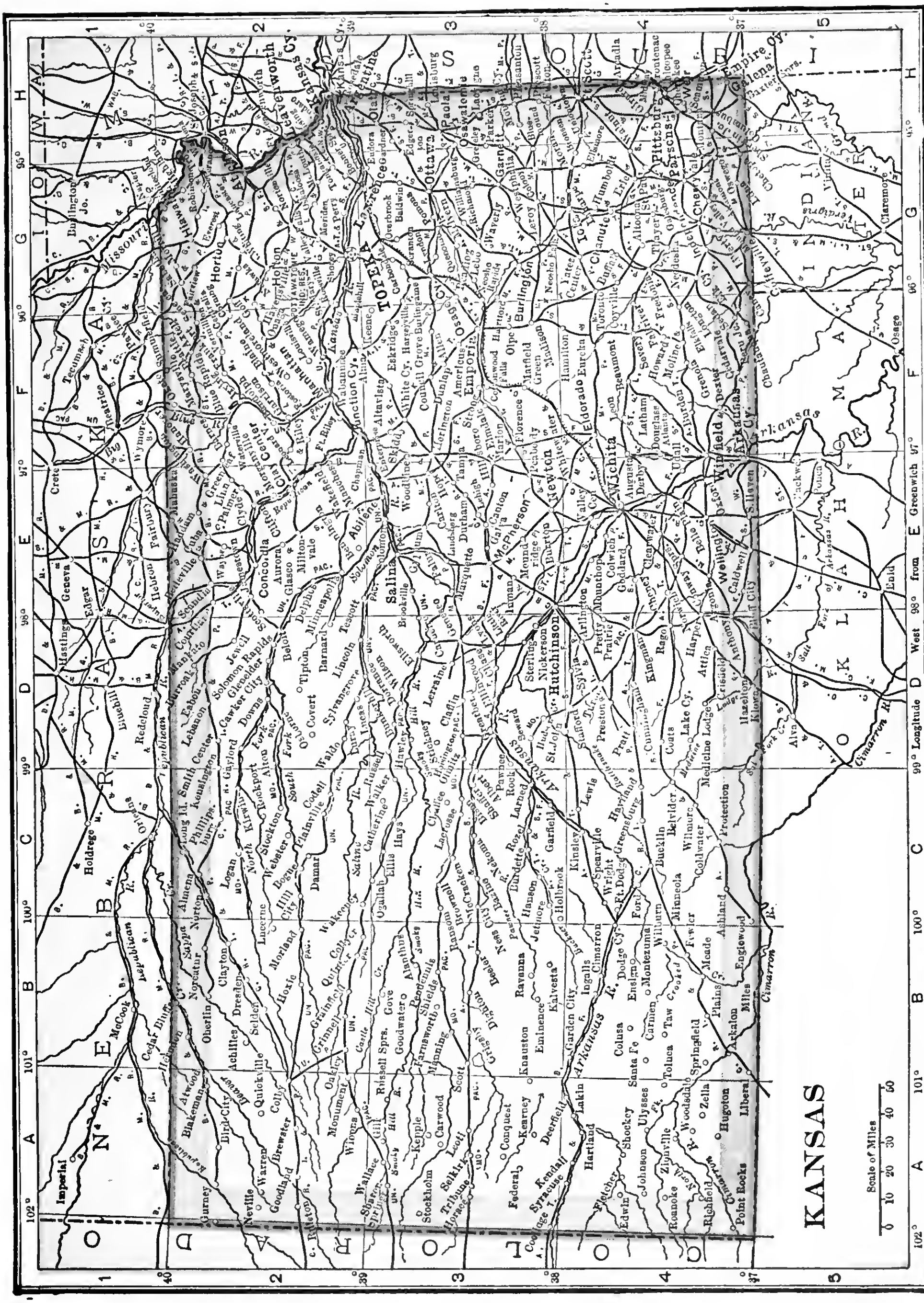

MISSOURI
Scale of Miles
0 10 20 40 60
SOUTH EAST CORNER OF MISSOURI
Same scale as large map
93° Longitude West 92° from Greenwich 91°

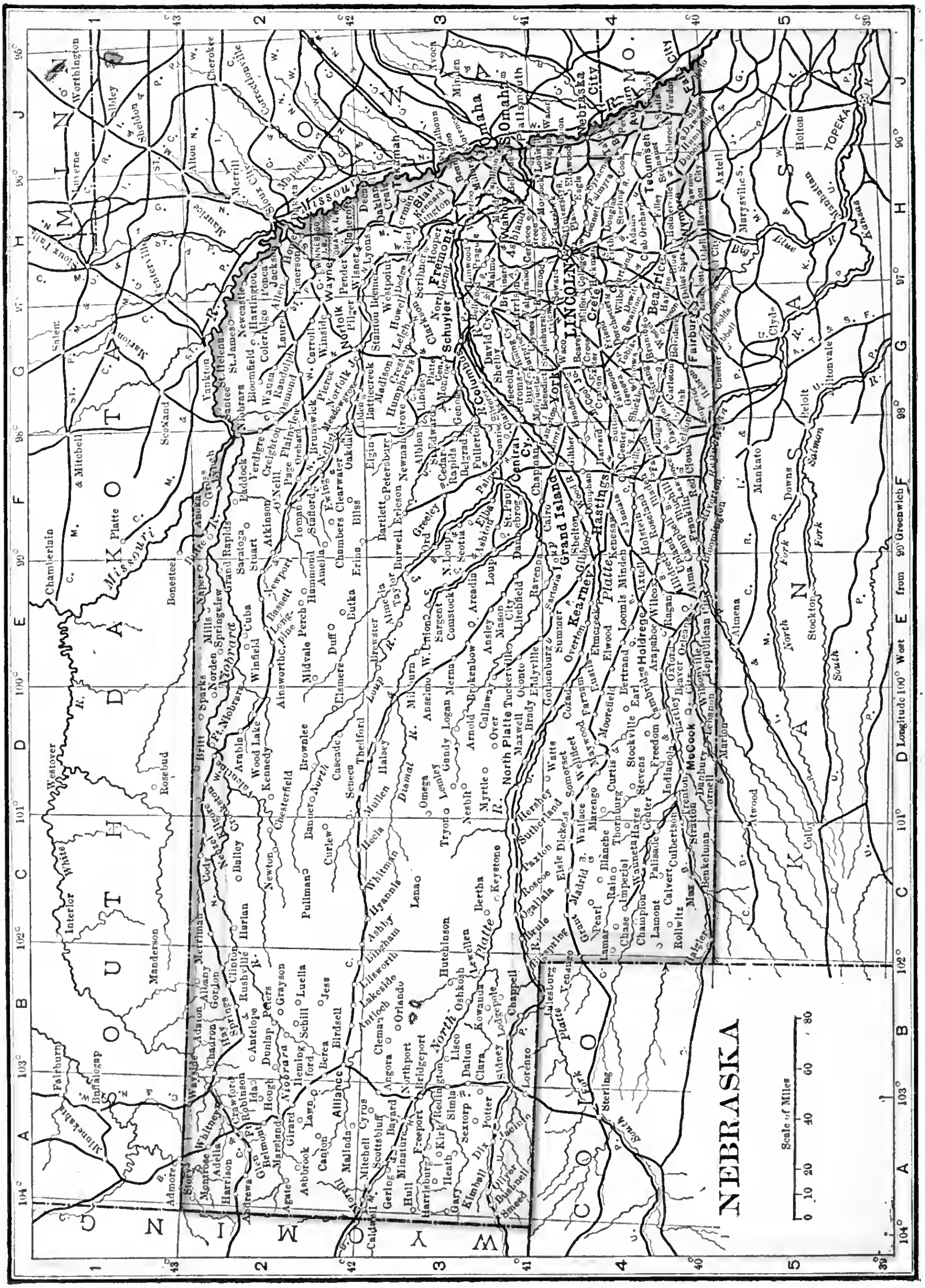

ARKANSAS
Scale of Miles
0 10 20 30 40 50 60 70
MISSOURI
LOUISIANA
TEXAS
MISSISSIPPI
TENN.
Longitude West from Greenwich
LITTLE ROCK
Argenta
Hot Springs
Pinebluff
Fort Smith
Van Buren
Texarkana
Camden
Helena
Memphis
Batesville
Jonesboro
Paragould
Newport
Searcy
Conway
Arkadelphia
Prescott
Fayetteville
Bentonville
Rogers
Eureka Sprs.
Springdale
Dardanelle
Morrillton
Russellville
Mena
Malvern
Benton
Stuttgart
Eldorado
Magnolia
Monticello
Arkansas City
Forrest City
Marianna
Clarendon
Lonoke
Augusta
Springfield
Shreveport
Vicksburg
JACKSON
Greenville
Yazoo City
Monroe
Ruston
Minden
Bastrop
Lake Providence
Poplarbluff
Doniphan
Galena
Forsyth
Neosho
Carthage
Lamar
Boston Mts.
Arkansas R.
White R.
Black R.
Red R.
Mississippi R.
Washita R.
Saline R.
St. Francis R.

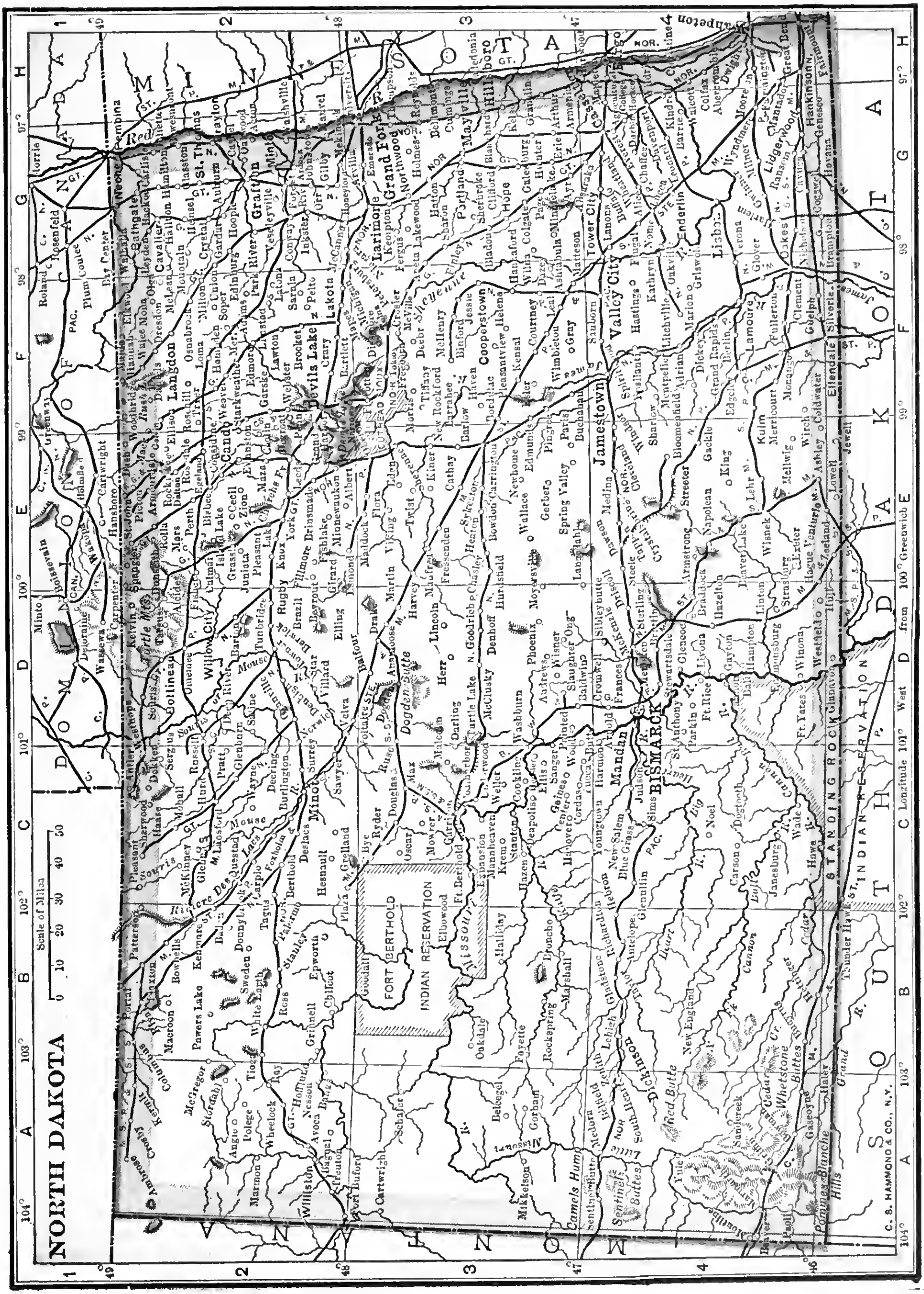

LOUISIANA
Scale of Miles
0 10 20 30 40 50 60 70
Size of typo indicates relative importance of places
MISSISSIPPI
ALABAMA
ARKANSAS
TEXAS
GULF OF MEXICO
Longitude West from Greenwich
C.S. HAMMOND & CO., N.Y.

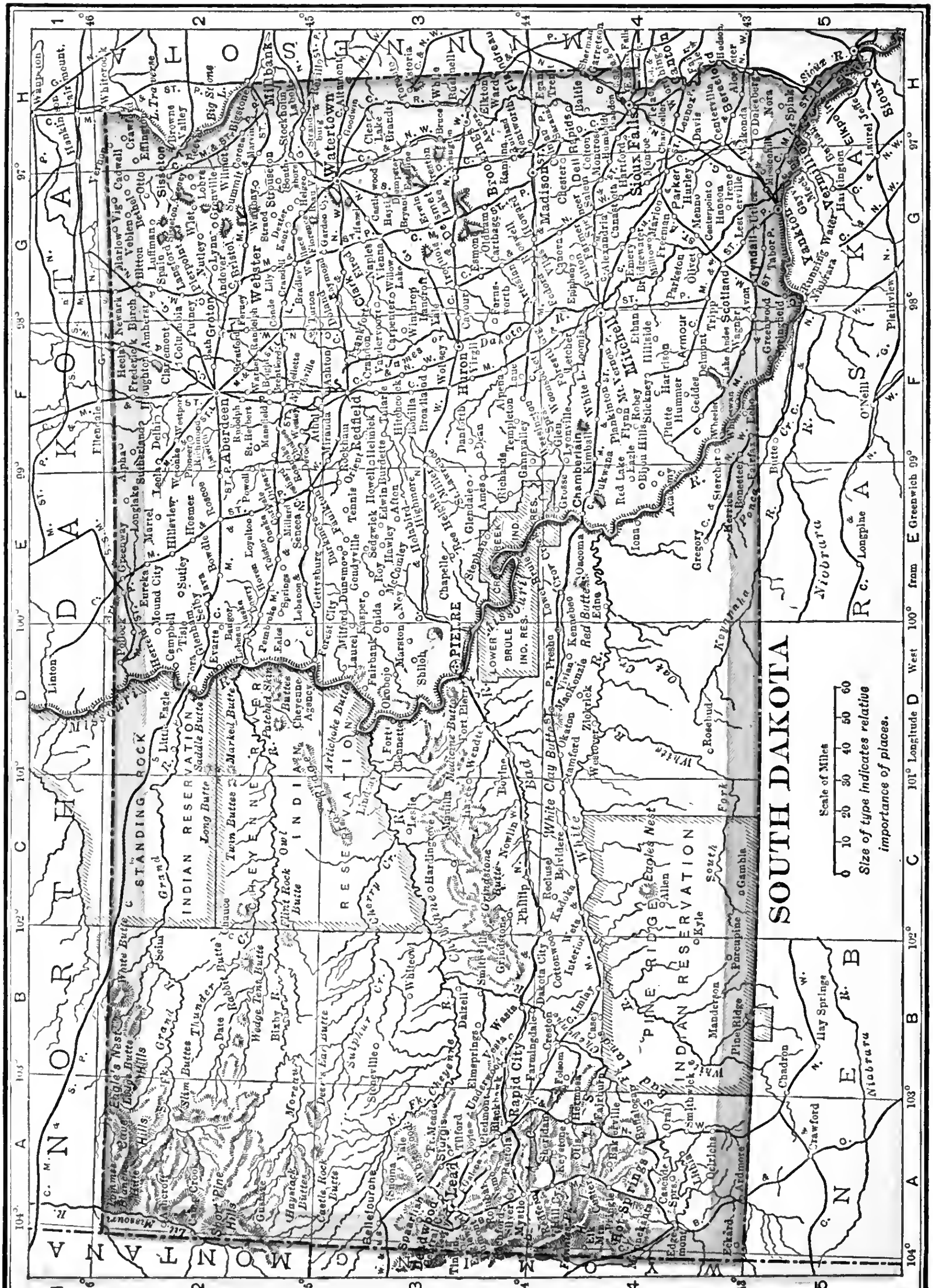

TEXAS
Scale of Miles
0 25 50 75 100
Size of type indicates relative importance of places.
WESTERN PORTION OF TEXAS
Same Scale as Main Map
NEW MEXICO
OKLAHOMA
ARKANSAS
MEXICO
GULF OF MEXICO
Rio Grande
Red R.
Pecos
Nueces
Colorado R.
Brazos R.
Guadaloupe Mts.
Davis Mts.
Chinati Mts.
Corazones Mts.
Sierra Prieta
El Paso
Amarillo
Fort Worth
Dallas
Waco
Austin
San Antonio
Houston
Galveston
Corpus Christi
Laredo
Brownsville
Beaumont
Texarkana
Paris
Denison
Sherman
Tyler
Marshall
Corsicana
Abilene
San Angelo
Del Rio
Eagle Pass
Guthrie
Oklahoma
Muskogee
Tulsa
Enid
Lawton
Ardmore
Ft. Smith
MATAGORDA I.
PADRE ISLAND
Longitude West from Greenwich
C. S. HAMMOND & CO., N.Y.

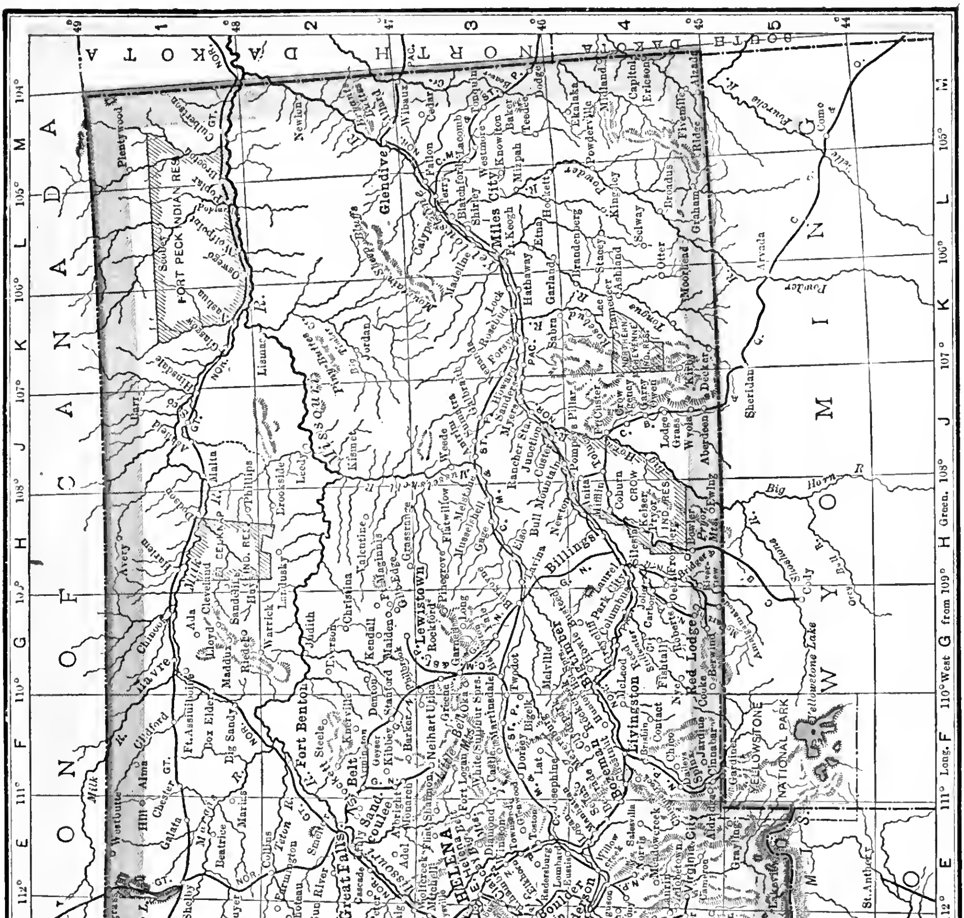

OKLAHOMA
WESTERN PORTION OF OKLAHOMA
Scale of Miles
Longitude West from Greenwich
KANSAS
ARKANSAS
TEXAS
MISSOURI
Oklahoma
Guthrie
Tulsa
Muskogee
Enid
El Reno
Shawnee
McAlester
Ardmore
Lawton
Chickasha
Okmulgee
Stillwater
Perry
Hobart
Durant
Red R.
Cimarron
Canadian R.
Arkansas R.

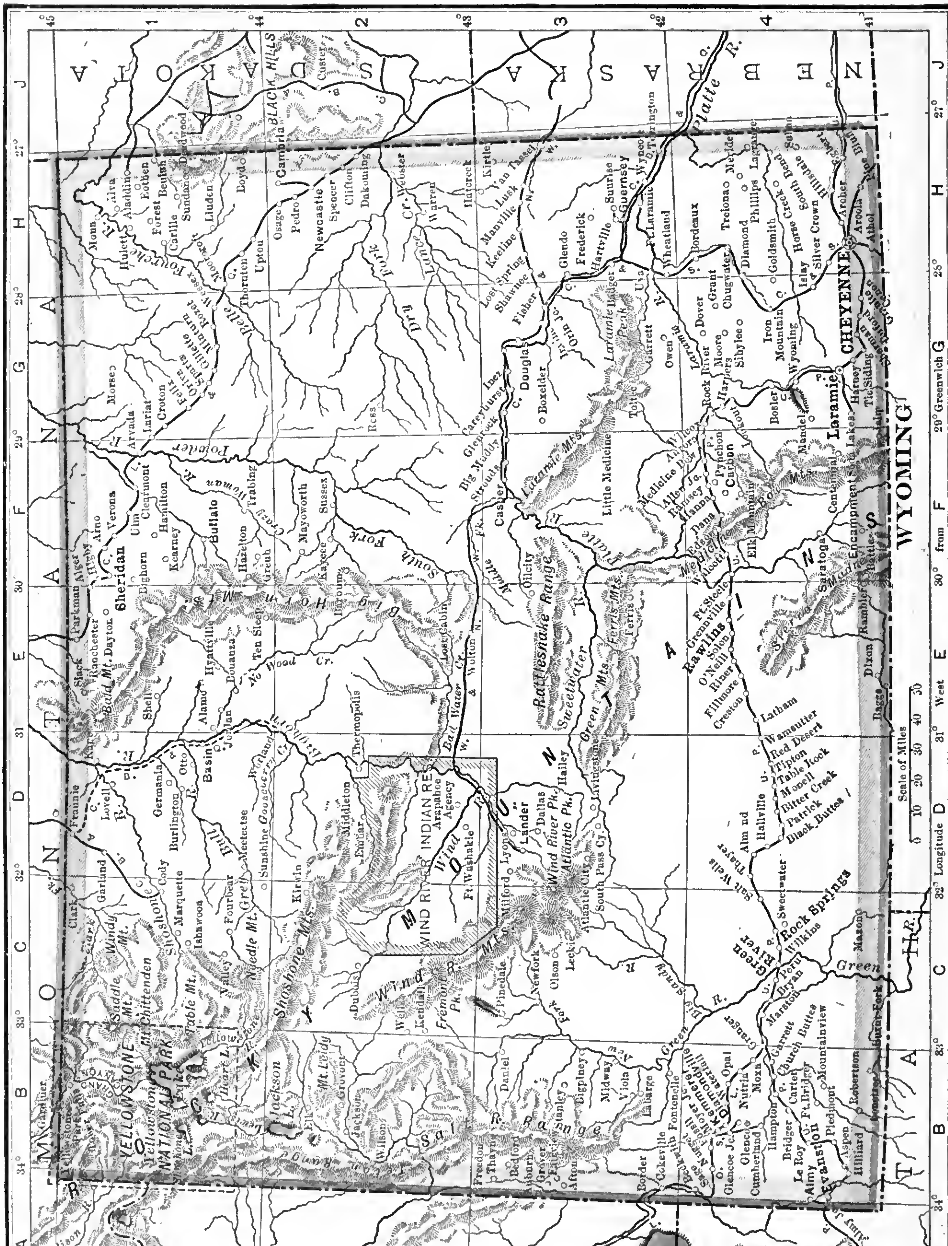

KANSAS
Scale of Miles
0 10 20 30 40 50
Longitude West 98° from Greenwich
TOPEKA
Wichita
Kansas Cy.
Leavenworth
Atchison
Lawrence
Emporia
Hutchinson
Salina
Dodge Cy.
Missouri
Arkansas
Cimarron
Republican

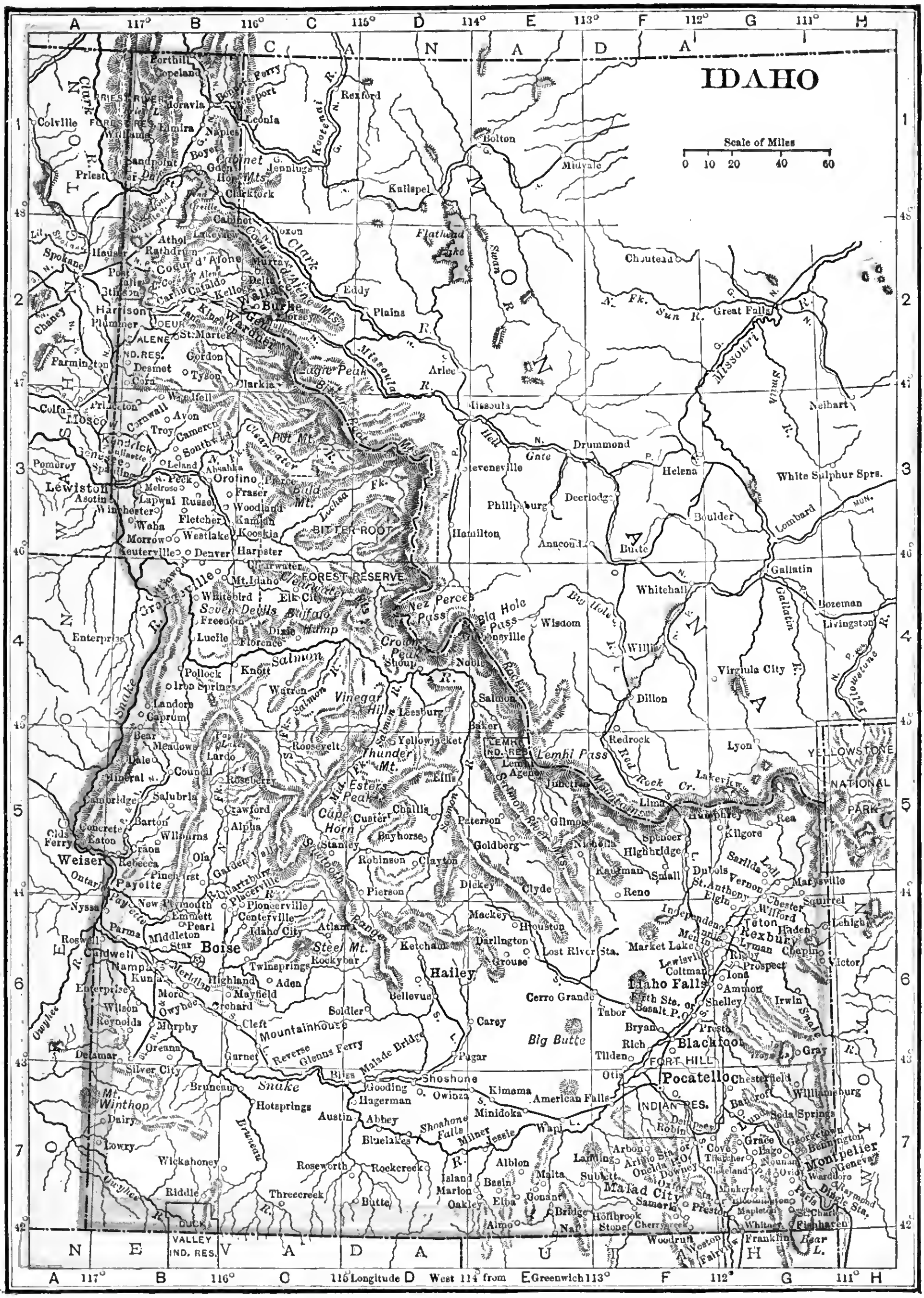

NEBRASKA
Scale of Miles
0 10 20 40 60 80
Longitude 100° West from Greenwich
SOUTH DAKOTA
IOWA
KANSAS
COLORADO
WYOMING
Omaha
Lincoln
Fremont
Nebraska City
Beatrice
Grand Island
Hastings
Kearney
North Platte
Norfolk
Columbus
McCook
Alliance
Missouri R.
Platte R.
Niobrara R.
Loup R.

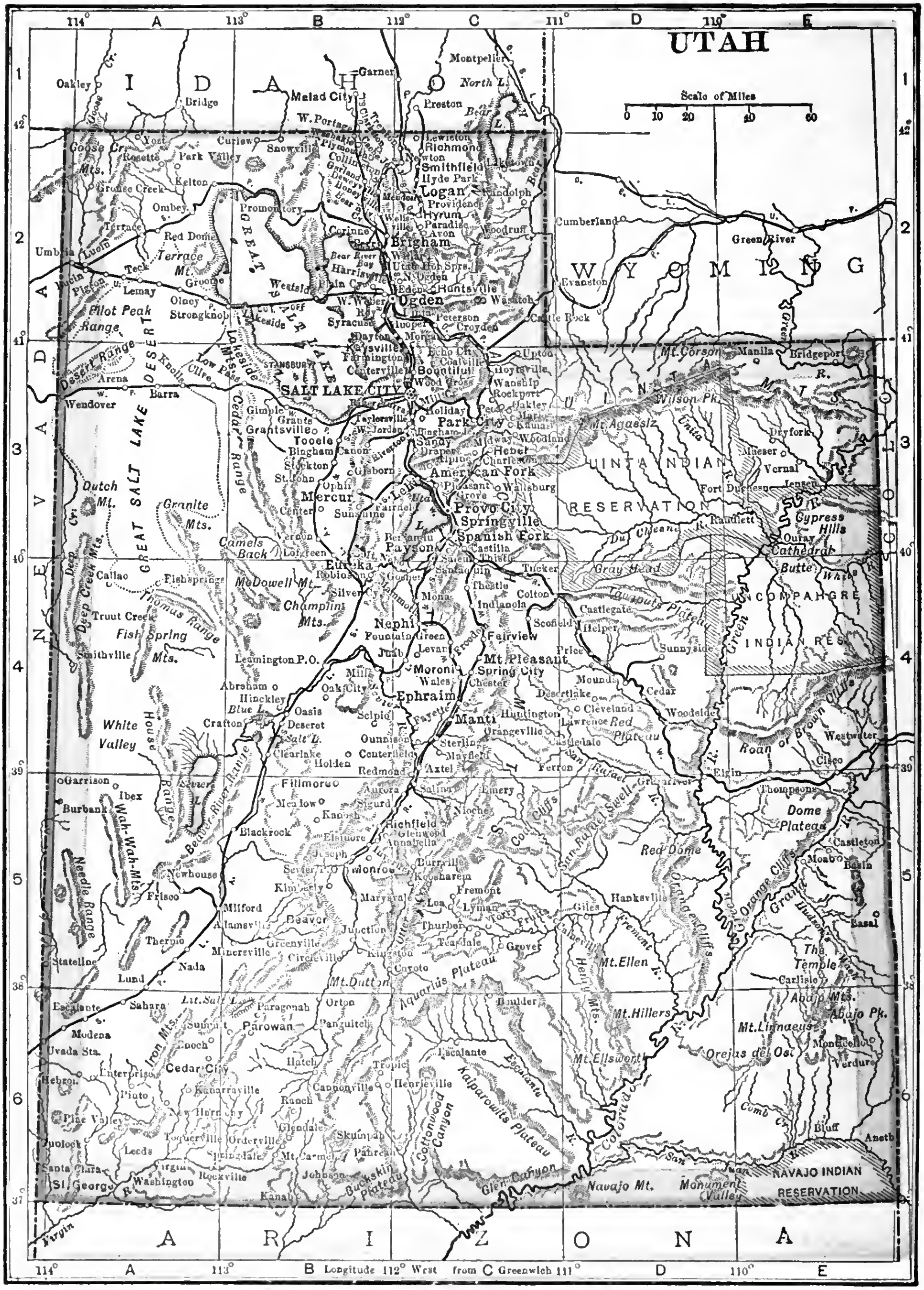

NORTH DAKOTA
Scale of Miles
0 10 20 30 40 50
C. S. HAMMOND & CO., N.Y.
Longitude 101° West from 100° Greenwich
FORT BERTHOLD INDIAN RESERVATION
STANDING ROCK INDIAN RESERVATION
DOMINION OF CANADA
MINNESOTA
SOUTH DAKOTA
MONTANA
BISMARCK
Mandan
Jamestown
Valley City
Grand Forks
Devils Lake
Minot
Dickinson
Williston
Fargo
Wahpeton
Langdon
Grafton
Larimore
Hillsboro
Mayville
Cooperstown
Carrington
Bottineau
Willow City
Cando
Lisbon
Ellendale
Missouri
Sheyenne
James
Red
Mouse
Turtle Mts.
Camels Hump
Sentinel Buttes
Red Butte
Whetstone Buttes
Cedar Cr.
Heart R.
Cannon Ball
Grand R.

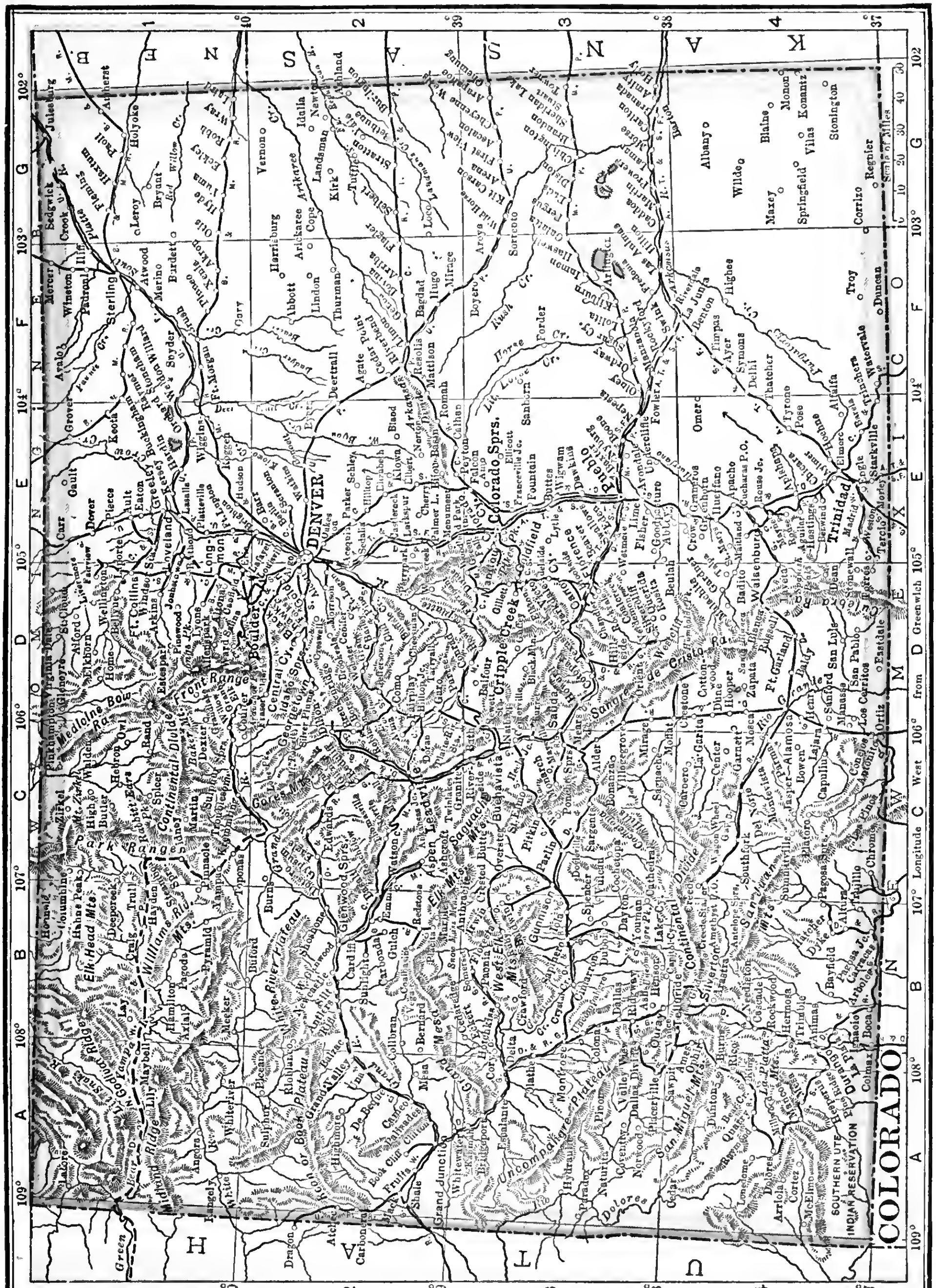

SOUTH DAKOTA
Scale of Miles
0 10 20 30 40 50 60
Size of type indicates relative importance of places.
NORTH DAKOTA
MINNESOTA
NEBRASKA
MONTANA
WYOMING
IOWA
PIERRE
Sioux Falls
Aberdeen
Watertown
Huron
Mitchell
Rapid City
Yankton
Deadwood
Lead
Hot Springs
Brookings
Madison
Redfield
Chamberlain
Webster
Milbank
Sisseton
STANDING ROCK INDIAN RESERVATION
CHEYENNE RIVER INDIAN RESERVATION
PINE RIDGE INDIAN RESERVATION
LOWER BRULE IND. RES.
CROW CREEK IND. RES.
Longitude West from Greenwich


MONTANA
Scale of Miles
Size of type indicates relative importance of places.
C. S. HAMMOND & CO., N.Y.


WYOMING
YELLOWSTONE NATIONAL PARK
WIND RIVER INDIAN RES.
CHEYENNE
Laramie
Sheridan
Buffalo
Rawlins
Rock Springs
Evanston
Lander
Casper
Douglas
Green River
Thermopolis
Newcastle
Big Horn Mts.
Laramie Mts.
Rattlesnake Range
Wind River Pk.
Fremont Pk.
Black Hills
Scale of Miles
Longitude West from Greenwich


IDAHO
Scale of Miles
0 10 20 40 60
A 117° B 116° C 115° D 114° E 113° F 112° G 111° H
C A N A D A
Longitude West from Greenwich
N E V A D A
U T A H
W A S H I N G T O N
O R E G O N
M O N T A N A
W Y O M I N G
Porthill
Copeland
Bonners Ferry
Moravia
Crossport
Leonia
Rexford
Colville
Priest River Forest Res.
Elmira
Naples
Williams
Boyer
Sandpoint
Cabinet Mts.
Priest
Oden
Jennings
Hope
Clarkfork
Kalispel
Bolton
Midvale
Cabinet
Athol
Rathdrum
Coeur d'Alene
Spokane
Hauser
Post Falls
Stinson
Cataldo
Kellogg
Murray
Wallace
Burke
Mullen
Delta
Harrison
Plummer
Coeur d'Alene Ind. Res.
St. Maries
Gordon
Desmet
Tyson
Farmington
Cora
Clarkia
Eddy
Plains
Arlee
Flathead Lake
Swan R.
Missoula
Eagle Peak
Bitter Root Mts.
Choteau
Great Falls
Sun R.
Missouri
Neihart
Colfax
Moscow
Princeton
Woodfell
Avon
Troy
Cameron
Kendrick
Genesee
Juliaetta
Leland
Pot Mt.
Clearwater R.
Hell Gate
Drummond
Helena
White Sulphur Sprs.
Pomeroy
Lewiston
Asotin
Lapwai
Melrose
Orofino
Pierce
Fraser
Woodland
Kamiah
Kooskia
Bald Mt.
Lochsa
Winchester
Waha
Fletcher
Russell
Westlake
Morrow
Reuterville
Denver
Harpster
Bitter Root
Stevensville
Philipsburg
Deerlodge
Boulder
Lombard
Hamilton
Anaconda
Butte
Gallatin
Whitehall
Bozeman
Livingston
Grangeville
Mt. Idaho
Clearwater Forest Reserve
Whitebird
Elk City
Seven Devils
Buffalo Hump
Freedom
Dixie
Lucile
Florence
Enterprise
Nez Perce Pass
Big Hole Pass
Gibbonsville
Wisdom
Crown Peak
Shoup
Noble
Salmon R.
Pollock
Knott
Iron Springs
Warren
Vinegar Hill
Leesburg
Salmon
Baker
Virginia City
Dillon
Landore
Caprum
Bear
Meadows
Payette Lakes
Lardo
Roosevelt
Yellowjacket
Thunder Mt.
Lemhi Ind. Res.
Lemhi Pass
Lemhi Agency
Junction
Red Rock Cr.
Redrock
Lyon
Lakeview
Yellowstone National Park
Dale
Council
Mineral
Salubria
Roseberry
Cambridge
Crawford
Esters Peak
Ellis
Challis
Cape Horn
Custer
Bayhorse
Paterson
Gilmore
Lima
Humphrey
Rea
Kilgore
Olds Ferry
Concrete
Eaton
Barton
Alpha
Wilburns
Craon
Weiser
Rebecca
Stanley
Robinson
Clayton
Goldberg
Nicholia
Spencer
Highbridge
Ola
Pinehurst
Garden Valley
Sawtooth
Kaufman
Small
Dubois
Vernon
Sarilda
Lodi
Marysville
Ontario
Payette
Quartzburg
Placerville
Pierson
Dickey
Clyde
Reno
St. Anthony
Elgin
Chester
Wilford
Squirrel
Nyssa
New Plymouth
Emmett
Pioneerville
Centerville
Idaho City
Atlanta
Mackey
Houston
Independence
Teton
Rexburg
Haden
Lehigh
Parma
Pearl
Middleton
Star
Roswell
Boise
Steel Mt.
Ketchum
Darlington
Grouse
Lost River Sta.
Market Lake
Menan
Lyman
Chepin
Victor
Caldwell
Nampa
Kuna
Twinsprings
Rockybar
Hailey
Lewisville
Coltman
Ririe
Prospect
Highland
Aden
Mayfield
Idaho Falls
Iona
Ammon
Enterprise
Meridian
Moro
Orchard
Owyhee
Bellevue
Cerro Grande
Tabor
Firth Sta.
Basalt P.O.
Shelley
Irwin
Wilson
Reynolds
Murphy
Soldier
Cleft
Carey
Bryan
Presto
Mountainhouse
Big Butte
Blackfoot
Rich
Oreana
Delamar
Reverse
Glenns Ferry
Malade Bridge
Garnet
Pagar
Tilden
Fort Hall
Gray
Silver City
Bruneau
Snake
Bliss
Shoshone
Otis
Pocatello
Chesterfield
Mt. Winthop
Hotsprings
Gooding
Hagerman
Owinza
Kimama
American Falls
Indian Res.
Bancroft
Williamsburg
Dairy
Austin
Abbey
Minidoka
Shoshone Falls
Wapi
Robin
Soda Springs
Georgetown
Bennington
Lowry
Bluelakes
Milner
Jessie
Arbon
Grace
Montpelier
Geneva
Wickahoney
Roseworth
Rockcreek
Albion
Lanning
Malta
Sublett
Oneida
Downey
Cove
Cleveland
Riddle
Threecreek
Island
Marion
Basin
Malad City
Oxford
Bruneau
Oakley
Elba
Conant
Samaria
Preston
Duck Valley Ind. Res.
Butte
Almo
Bridge
Holbrook
Naf
Stone
Cherrycreek
Woodruff
Weston
Fairview
Franklin
Fishhaven
Bear L.
Dingle Sta.
Paris
Raymond
Mapleton
Whitney
St. Charles
Owyhee R.
Bruneau R.
Salmon River Mts.
Lemhi River Mts.
Saw Tooth Range

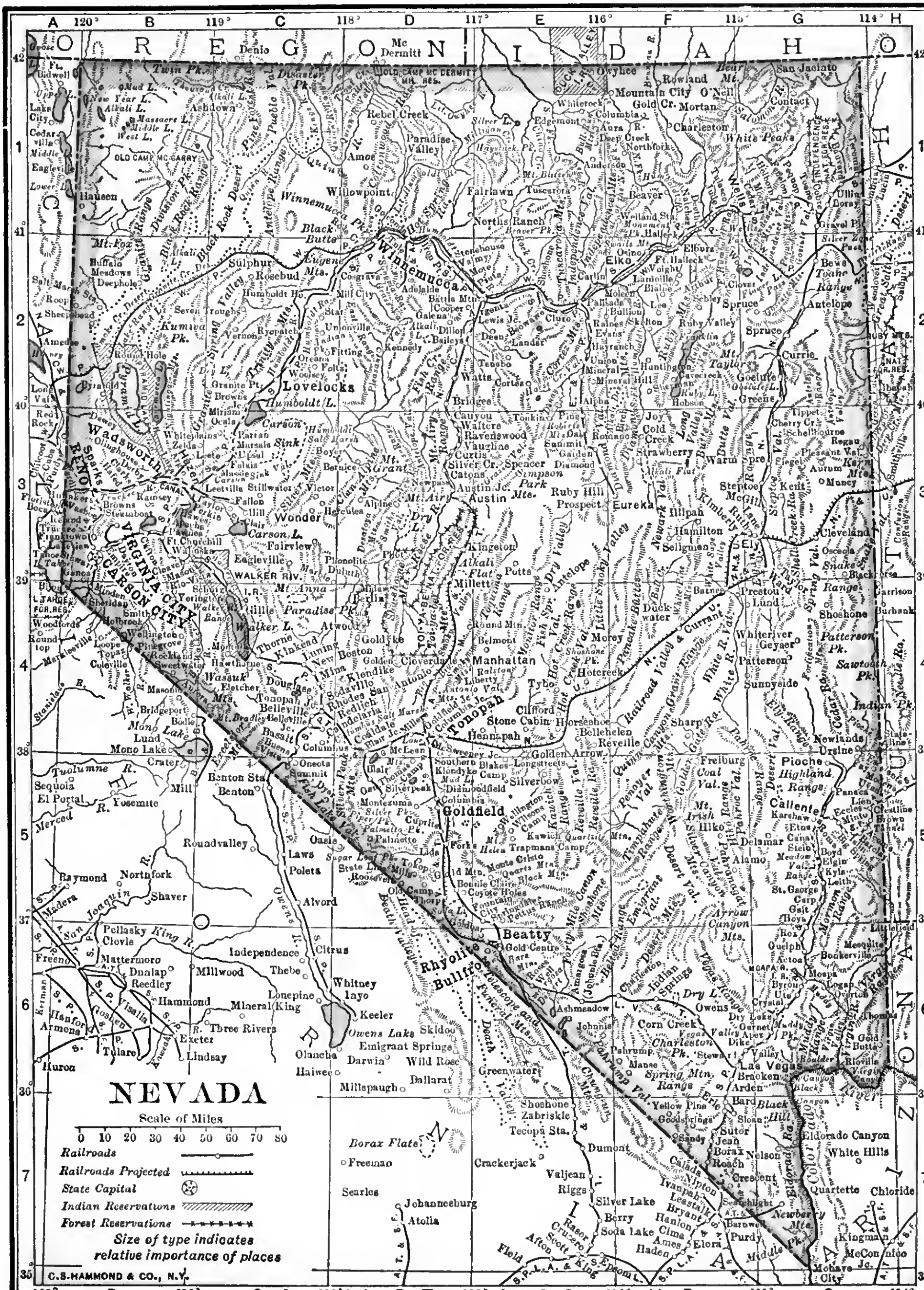

UTAH
Scale of Miles
0 10 20 40 60
IDAHO
WYOMING
NEVADA
ARIZONA
COLORADO
GREAT SALT LAKE
GREAT SALT LAKE DESERT
SALT LAKE CITY
Ogden
Logan
Brigham
Provo City
Springville
Spanish Fork
Park City
American Fork
Bountiful
Tooele
Payson
Eureka
Nephi
Manti
Ephraim
Mt. Pleasant
Richfield
Fillmore
Beaver
Parowan
Cedar City
St. George
Kanab
Green River
Price
Moab
Vernal
UINTA INDIAN RESERVATION
UNCOMPAHGRE INDIAN RES.
NAVAJO INDIAN RESERVATION
Wah-Wah Mts.
Needle Range
Aquarius Plateau
Kaiparowits Plateau
Glen Canyon
Navajo Mt.
Monument Valley
Mt. Ellen
Mt. Hillers
Mt. Ellsworth
Abajo Mts.
Roan or Brown Cliffs
Orange Cliffs
San Rafael Swell
Colorado R.
San Juan R.
Longitude 112° West from Greenwich 111°
114° 113° 112° 111° 110°
A B C D E
42° 41° 40° 39° 38° 37°
1 2 3 4 5 6

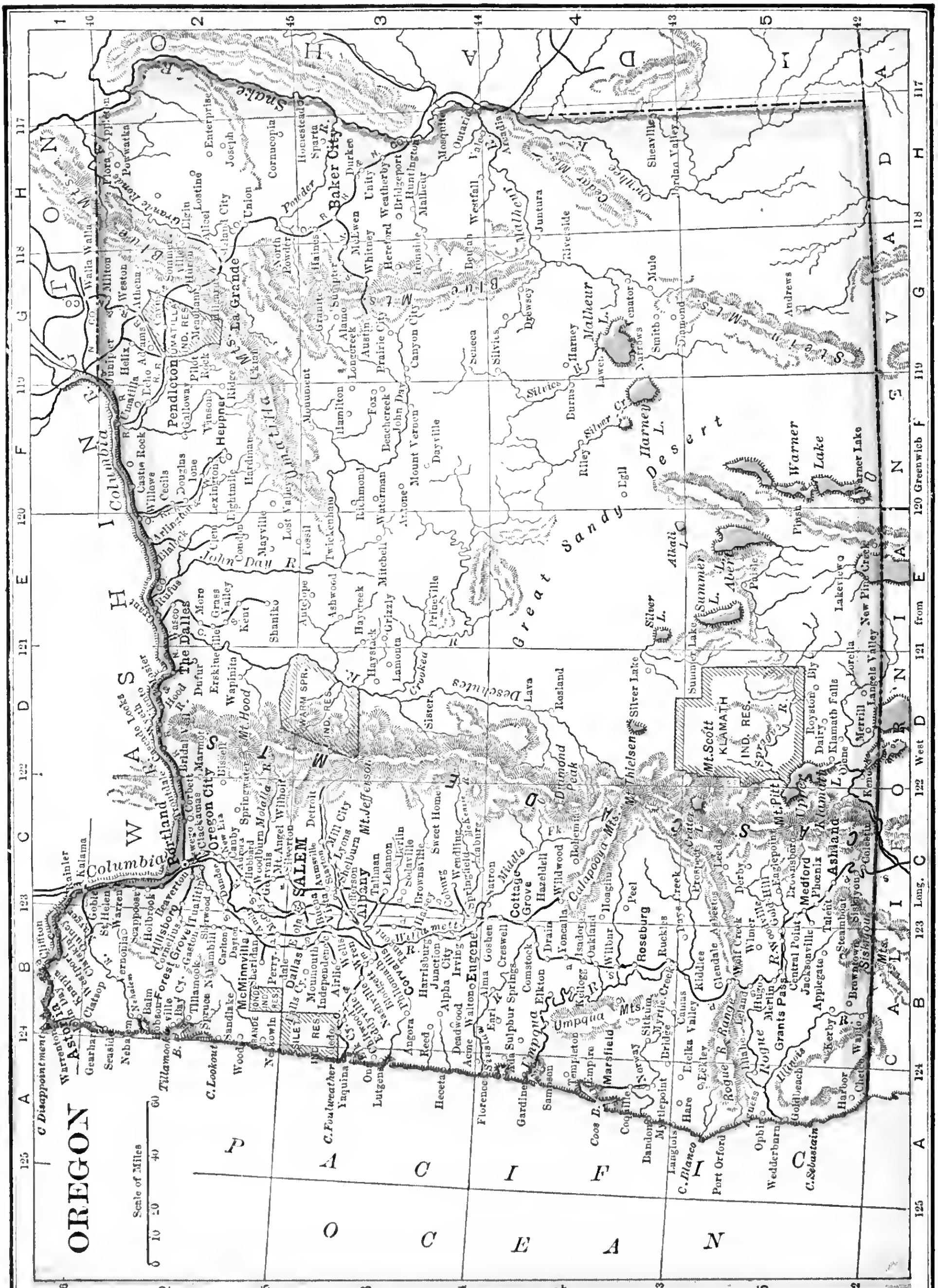

COLORADO
DENVER
Colorado Sprs.
Pueblo
Leadville
Cripple Creek
Trinidad
Boulder
Scale of Miles
Longitude West from Greenwich

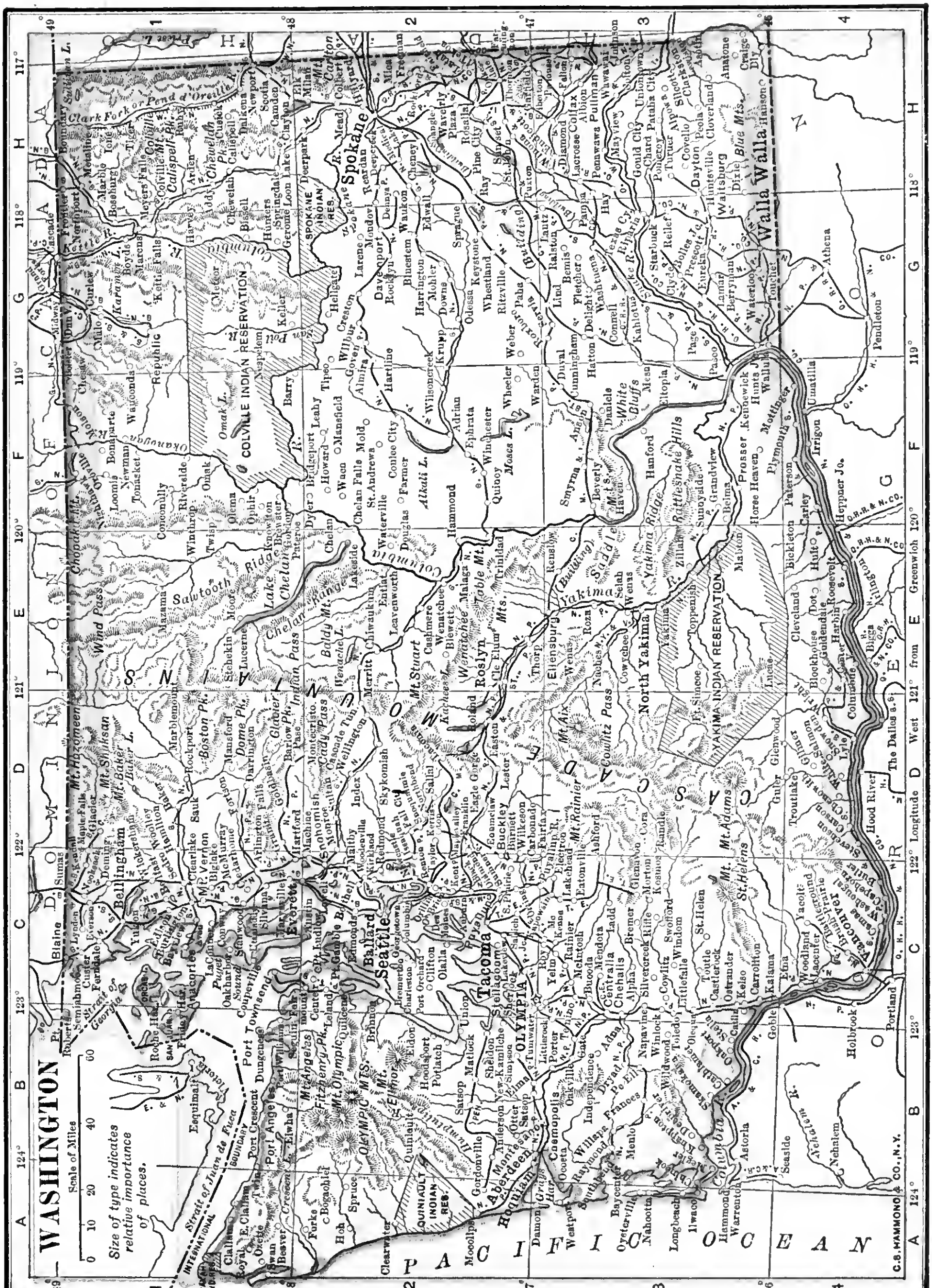

NEW MEXICO
C O L O R A D O
T E X A S
M E X I C O
U T A H
A R I Z O N A
O K L A.
SANTA FE
Albuquerque
Las Vegas
Raton
Taos
Mora
Gallup
Isleta
Belen
Socorro
Roswell
Lincoln
Alamogordo
Lascruces
Mesilla
Deming
Silver City
Carlsbad
El Paso
Alamosa
Durango
Trinidad
CONTINENTAL DIVIDE
Rio Grande
Pecos R.
Llano Estacado
Mt. Taylor
Sierra Blanca
Sacramento Mts.
Guadalupe
Fort Sumner
Tucumcari
Scale of Miles
0 10 20 30 40 50 60 70 80
Long. West from Green.
109° 108° 107° 106° 105° 104° 103°
37° 36° 35° 34° 33° 32° 31°

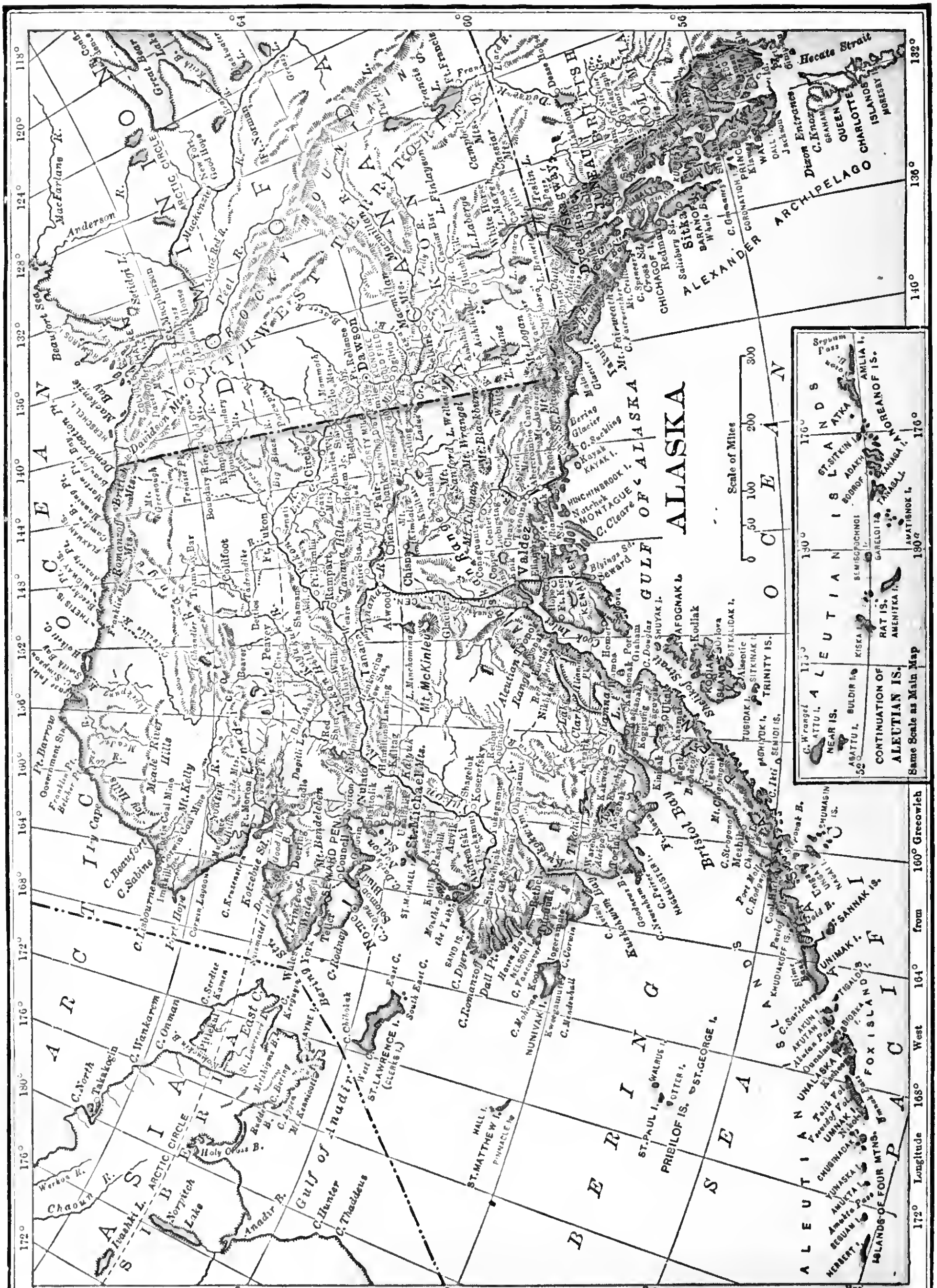

ARIZONA
Scale of Miles
0 5 10 20 30 40 50 60 70
UTAH
NEVADA
CALIFORNIA
NEW MEXICO
COLORADO
MEXICO
NAVAJO INDIAN RESERVATION
MOQUI INDIAN RESERVATION
HUALPAI INDIAN RES.
COLORADO RIV. INDIAN RES.
WHITE MOUNTAIN INDIAN RESERVATION
PHŒNIX
Tucson
Prescott
Flagstaff
Jerome
Yuma
Globe
Bisbee
Tombstone
Nogales
Florence
Winslow
Holbrook
Kingman
Williams
St. Johns
Morenci
Clifton
Douglas
Mesa
Tempe
Wickenburg
Grand Cañon
Mogollon Mesa
Colorado R.
Little Colorado R.
Gila R.
Salt R.
San Juan R.
Bill Williams Fk.
Altar R.
Longitude West from Greenwich
115° 114° 113° 112° 111° 110° 109°
37° 36° 35° 34° 33° 32° 31°

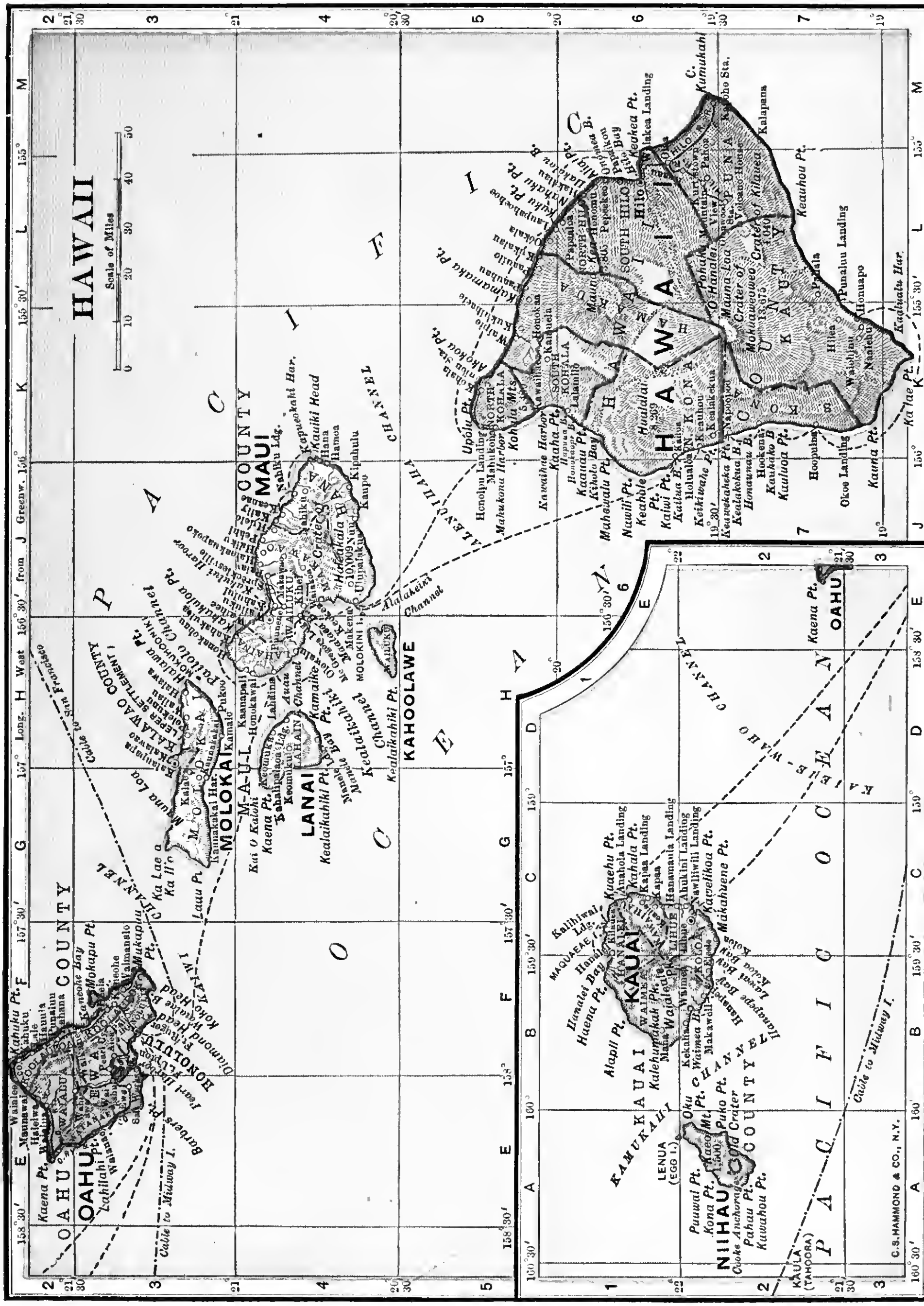

CALIFORNIA
PART OF SOUTHEASTERN CALIFORNIA
Same Scale as Main Map
Scale of Miles
0 10 20 40 60 80 100 120 140
Size of type indicates relative importance of places.
C.S.HAMMOND & CO., N.Y.
Longitude West from Greenwich
PACIFIC OCEAN
OREGON
NEVADA
ARIZONA
MEXICO
San Francisco
Oakland
SACRAMENTO
Stockton
San Jose
Fresno
Bakersfield
Los Angeles
San Diego
Santa Barbara Channel
Outer Santa Barbara Channel
Gulf of Santa Catalina

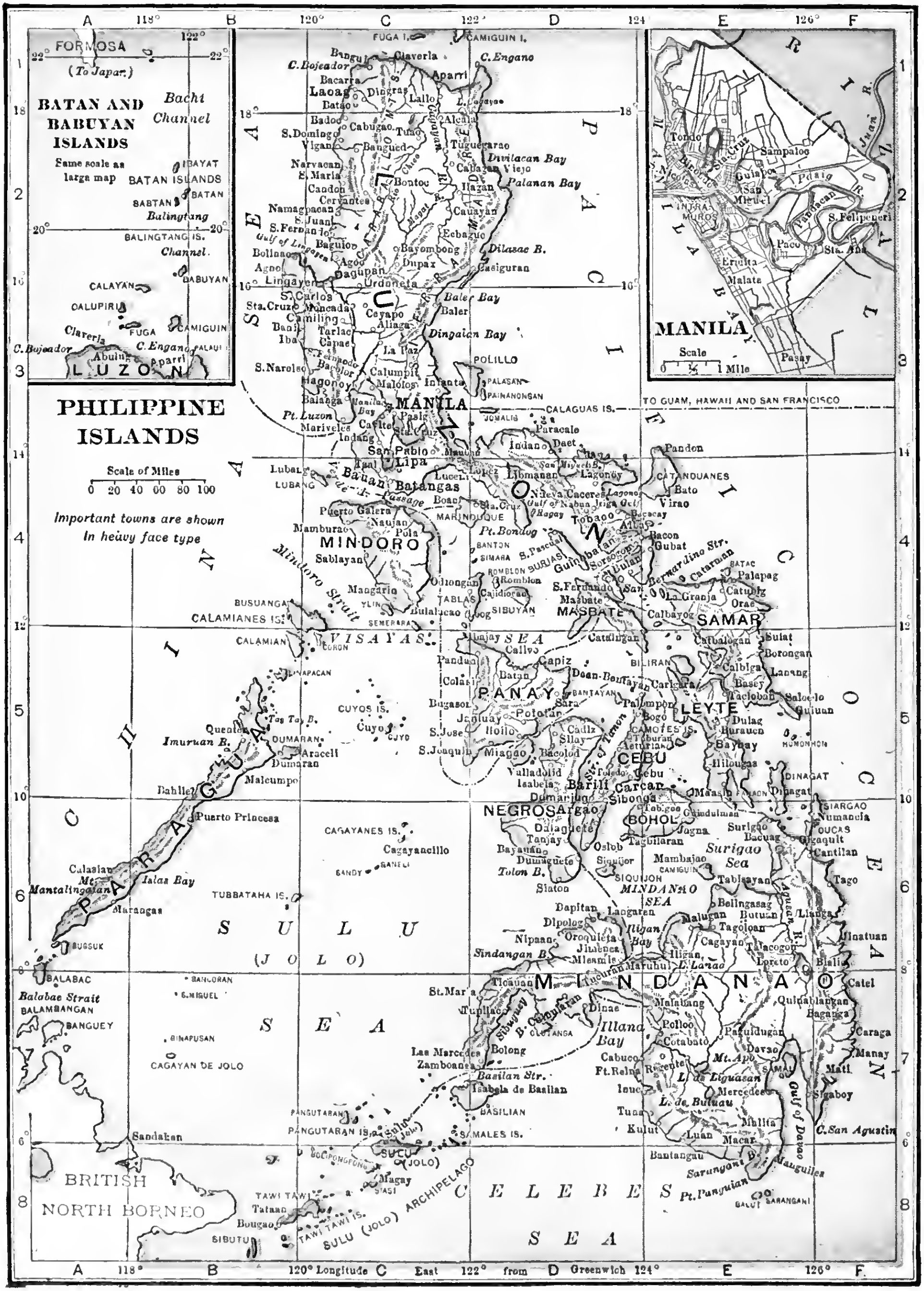

NEVADA
Scale of Miles
0 10 20 30 40 50 60 70 80
Railroads
Railroads Projected
State Capital
Indian Reservations
Forest Reservations
Size of type indicates relative importance of places
C.S.HAMMOND & CO., N.Y.
Long 118° itude West 117° from Green 116° wich

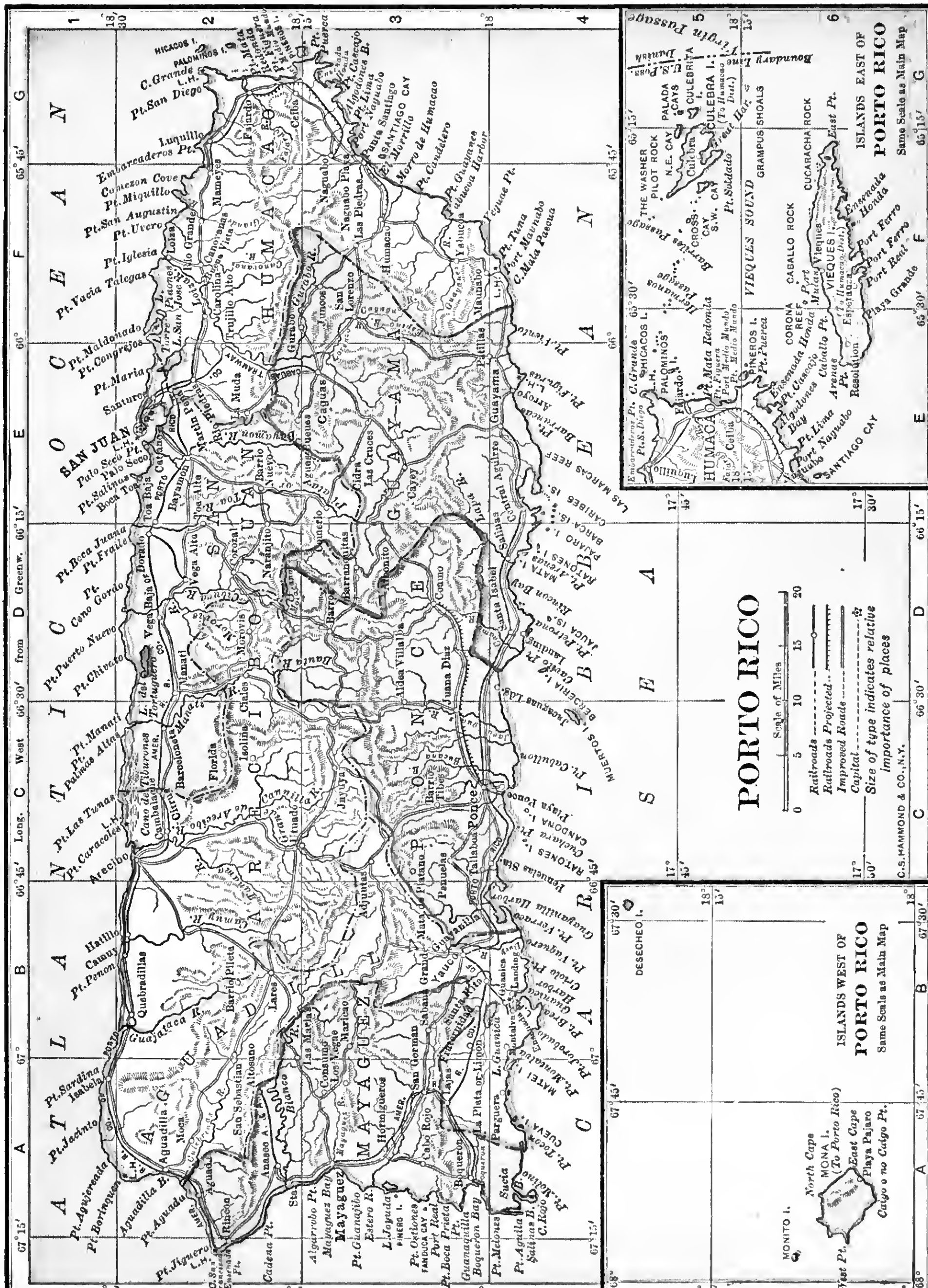

OREGON
Scale of Miles
0 10 20 40 60
P A C I F I C
O C E A N
W A S H I N G T O N
I D A H O
N E V A D A
C A L I F O R N I A
Portland
SALEM
Oregon City
Astoria
The Dalles
Pendleton
Baker City
La Grande
Heppner
Albany
Corvallis
Eugene
Roseburg
Ashland
Medford
Jacksonville
Grants Pass
Klamath Falls
Columbia R.
Snake R.
John Day R.
Willamette R.
Umpqua
Rogue R.
Deschutes
Malheur L.
Harney L.
Warner Lake
Great Sandy Desert
Mt. Hood
Mt. Jefferson
Mt. Thielsen
Mt. Scott
Mt. Pitt
Diamond Peak
Blue Mts.
Calapooya Mts.
Umpqua Mts.
Siskiyou Mts.
Steins Mts.
KLAMATH IND. RES.
WARM SPR. IND. RES.
UMATILLA IND. RES.
C. Blanco
C. Sebastain
C. Lookout
C. Foulweather
C. Disappointment
Long. 123 West 122 from 121 Greenwich 120

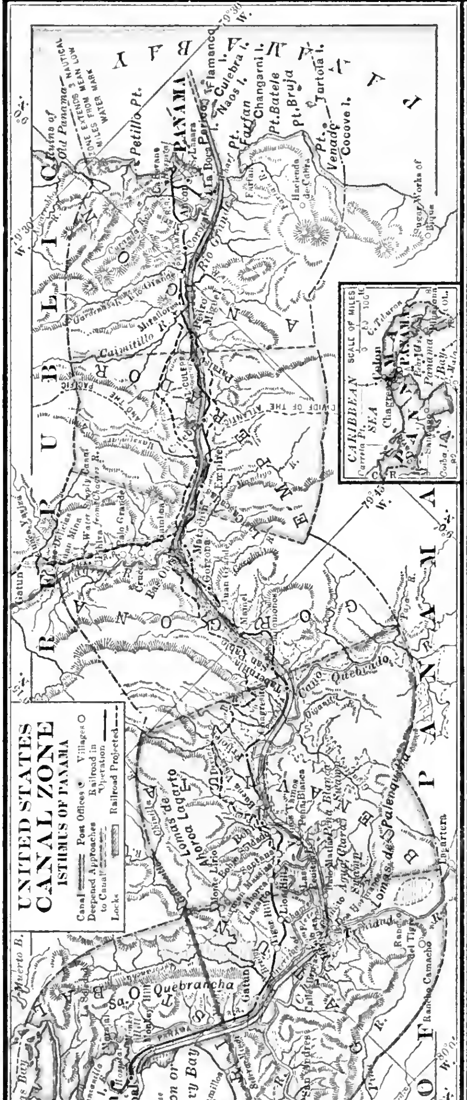

WASHINGTON
Scale of Miles
Size of type indicates relative importance of places.
PACIFIC OCEAN
C.S. HAMMOND & CO., N.Y.

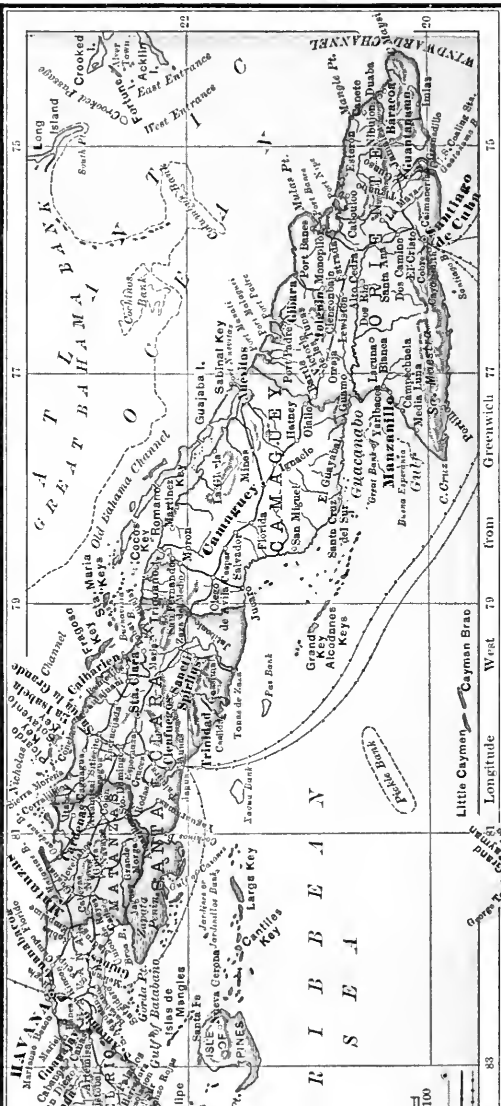

ALASKA
ARCTIC OCEAN
BERING SEA
PACIFIC OCEAN
GULF OF ALASKA
ASIA
SIBERIA
ALEXANDER ARCHIPELAGO
QUEEN CHARLOTTE ISLANDS
ALEUTIAN ISLANDS
FOX ISLANDS
PRIBILOF IS.
ST. LAWRENCE I.
NUNIVAK I.
Bristol Bay
Norton Sd.
Kotzebue Sd.
Gulf of Anadir
Hecate Strait
Mt. McKinley
Valdez
Dawson
Nome
Sitka
Juneau
Scale of Miles
CONTINUATION OF ALEUTIAN IS.
Same Scale as Main Map
Longitude West from 160° Greenwich

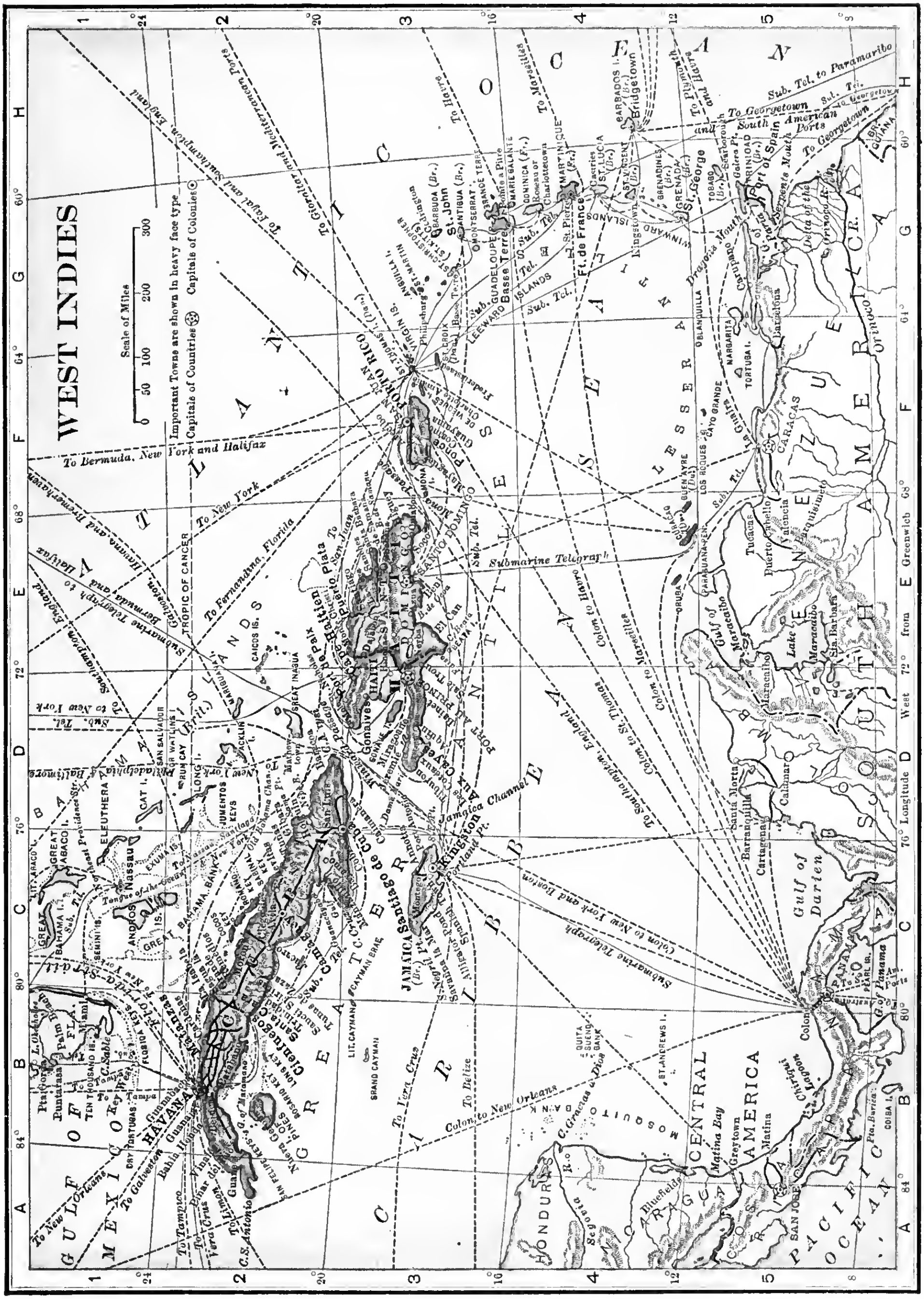

HAWAII
Scale of Miles
PACIFIC OCEAN
OAHU
MOLOKAI
LANAI
MAUI
KAHOOLAWE
HAWAII
KAUAI
NIIHAU
C.S. HAMMOND & CO., N.Y.

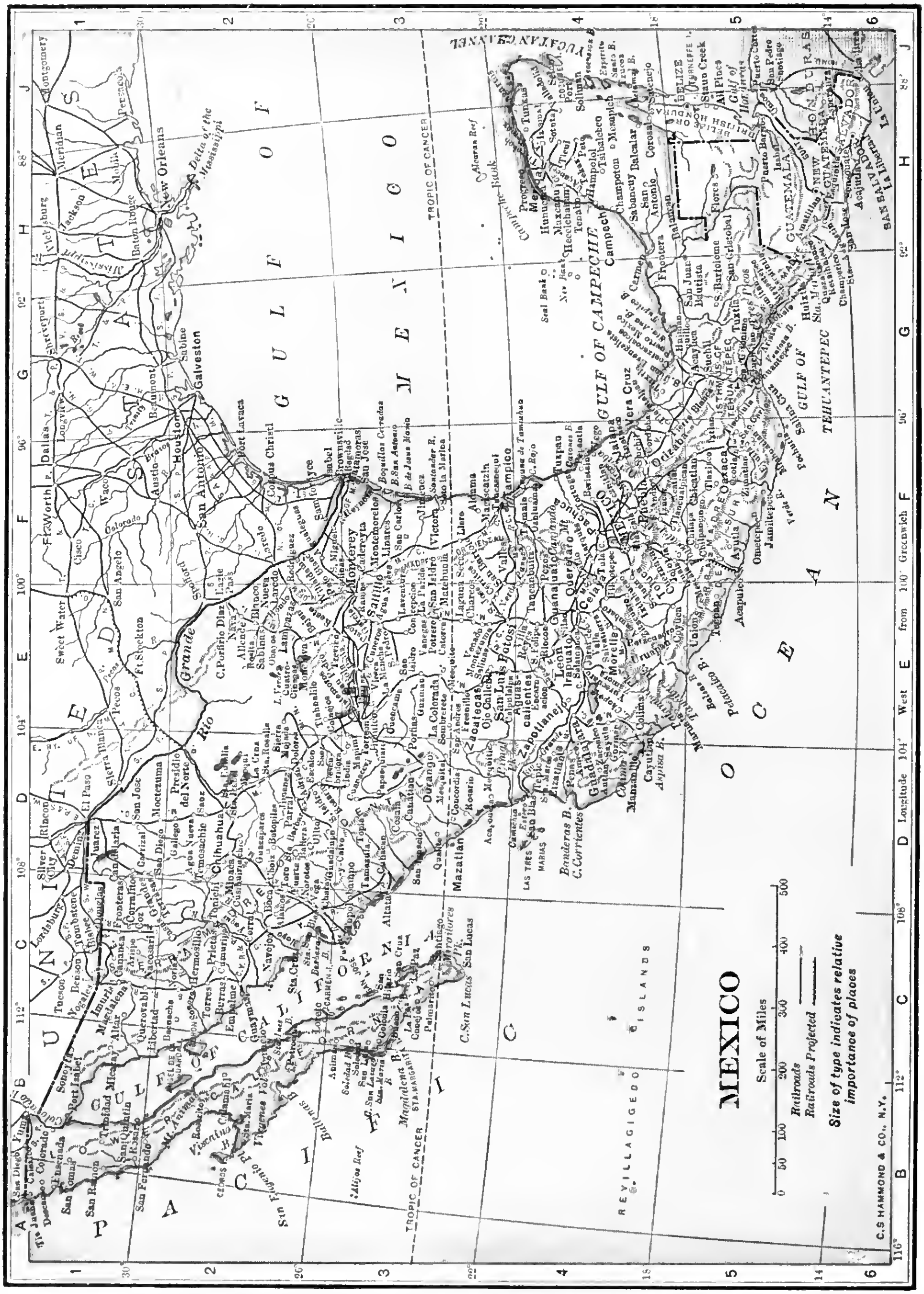

PHILIPPINE ISLANDS
Scale of Miles
0 20 40 60 80 100
Important towns are shown in heavy face type
BATAN AND BABUYAN ISLANDS
Same scale as large map
FORMOSA
(To Japan)
Bacht Channel
BATAN ISLANDS
Balingtang Channel
LUZON
MANILA
Scale
1 Mile
TO GUAM, HAWAII AND SAN FRANCISCO
MINDORO
PANAY
NEGROS
CEBU
BOHOL
LEYTE
SAMAR
MASBATE
MINDANAO
PARAGUA
VISAYAS SEA
MINDANAO SEA
SULU (JOLO) SEA
CELEBES SEA
SULU (JOLO) ARCHIPELAGO
BRITISH NORTH BORNEO
PACIFIC OCEAN
CHINA SEA
120° Longitude East 122° from Greenwich 124°

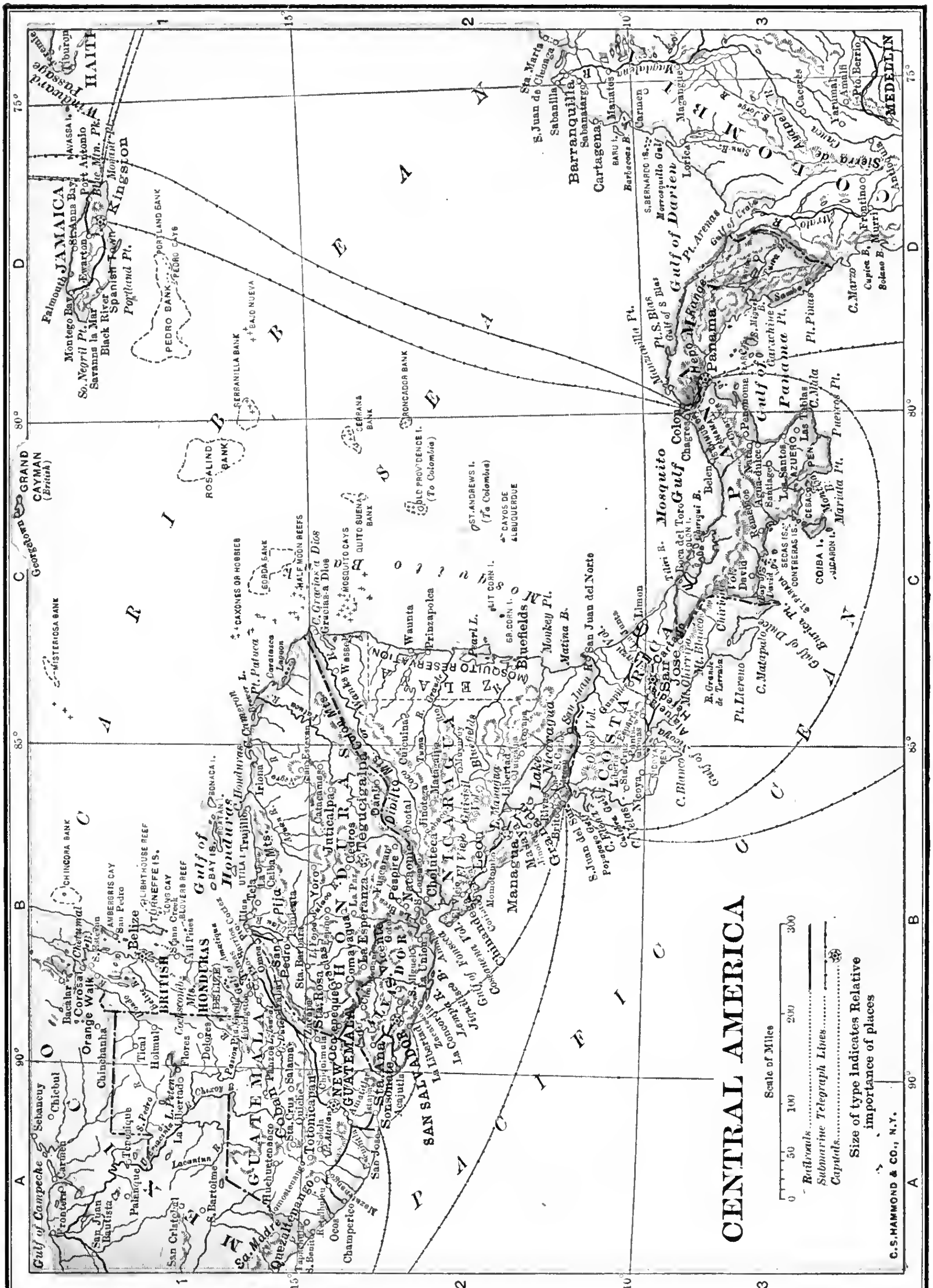

PORTO RICO
Scale of Miles
0 5 10 15 20
Railroads
Railroads Projected
Improved Roads
Capital
Size of type indicates relative importance of places
C.S. HAMMOND & CO., N.Y.
ATLANTIC OCEAN
CARIBBEAN SEA
SAN JUAN
Ponce
Mayaguez
Arecibo
Aguadilla
Guayama
Humacao
Long. West from Greenw.
ISLANDS EAST OF PORTO RICO
Same Scale as Main Map
CULEBRA I.
VIEQUES I.
VIEQUES SOUND
Virgin Passage
ISLANDS WEST OF PORTO RICO
Same Scale as Main Map
MONA I.
MONITO I.
DESECHEO I.

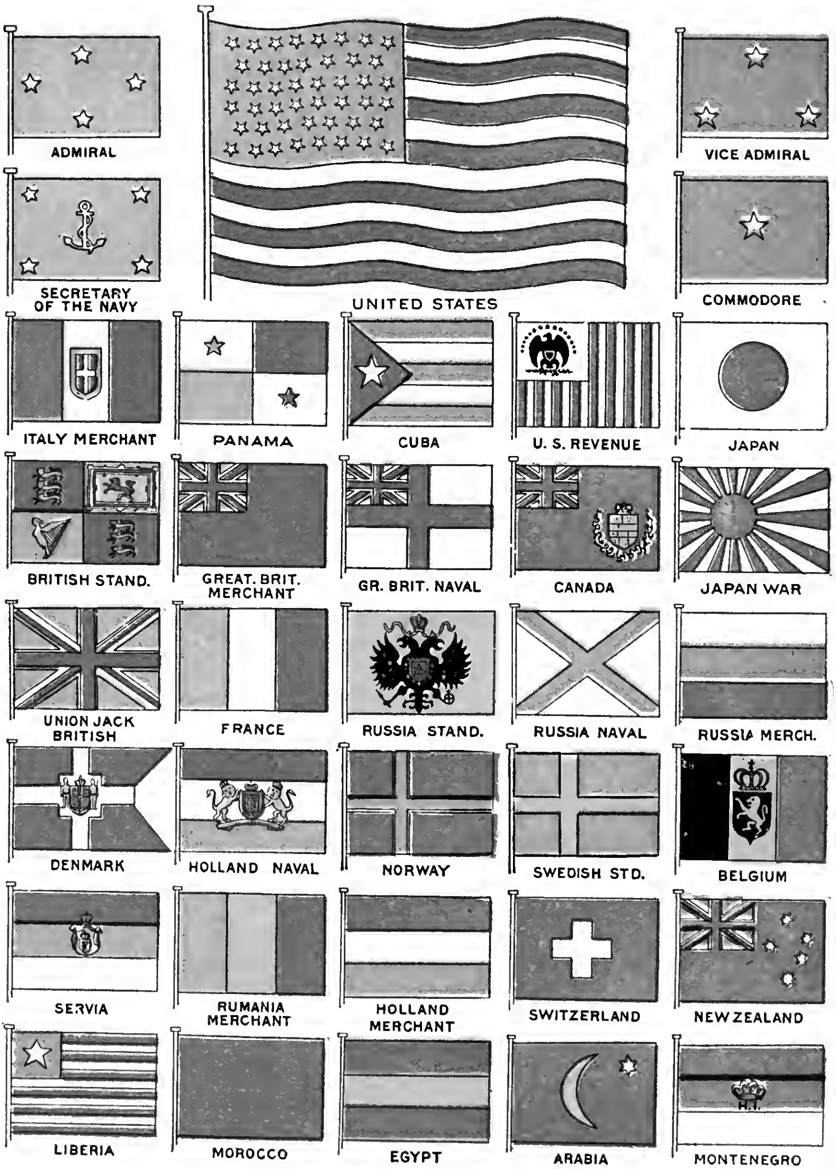

UNITED STATES
CANAL ZONE
ISTHMUS OF PANAMA
Canal
Post Offices
Villages
Deepened Approaches to Canal
Railroad in Operation
Locks
Railroad Projected
SCALE OF MILES
0 1 2 3 4 5
C.S.HAMMOND & CO., N.Y.


CUBA
SCALE OF MILES
0 50 100
Capitals of Provinces
Railroads
Submarine Telegraph Cables
C.S.HAMMOND & CO., N.Y.

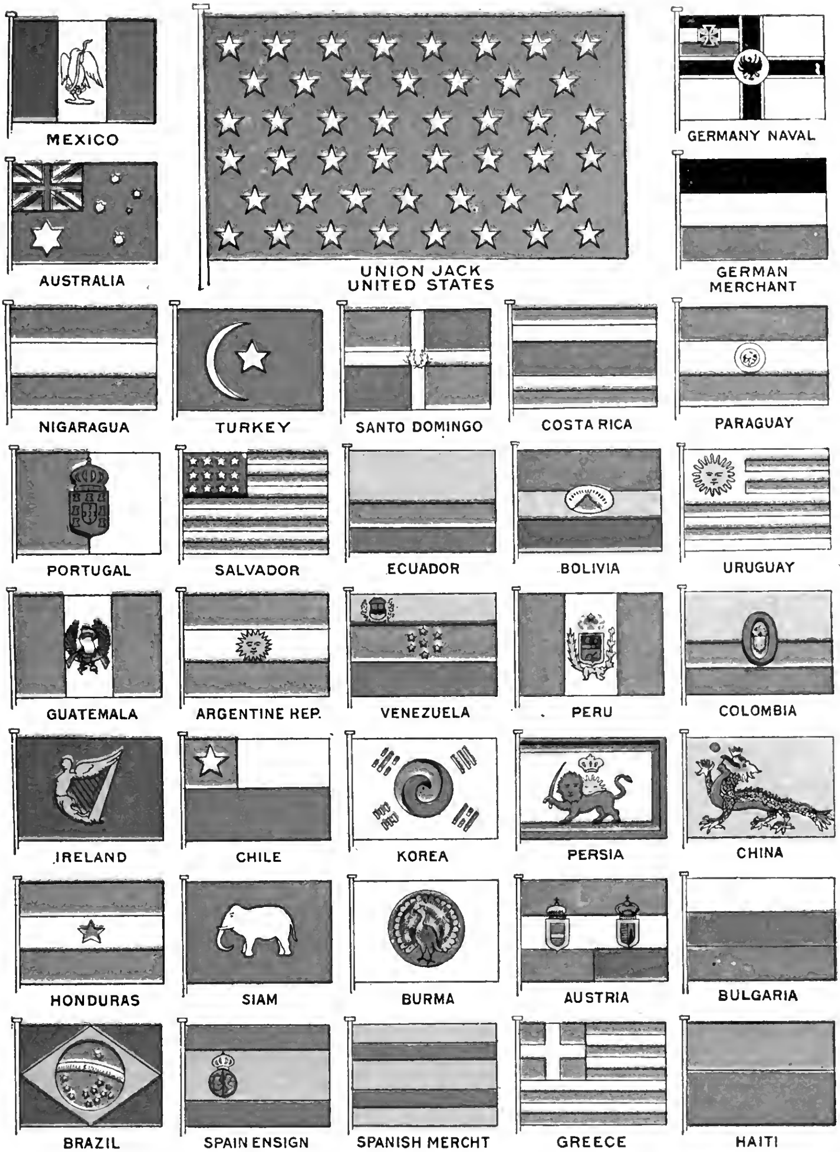

WEST INDIES
Scale of Miles
0 50 100 200 300
Important Towns are shown in heavy face type
Capitals of Colonies
Capitals of Countries
ATLANTIC OCEAN
CARIBBEAN SEA
GULF OF MEXICO
SOUTH AMERICA
CENTRAL AMERICA
PACIFIC OCEAN
Longitude West from Greenwich


MEXICO
Scale of Miles
0 50 100 200 300 400 500
Railroads
Railroads Projected
Size of type indicates relative importance of places
C.S. HAMMOND & CO., N.Y.
GULF OF MEXICO
PACIFIC OCEAN
GULF OF CAMPECHE
GULF OF TEHUANTEPEC
TROPIC OF CANCER
Longitude 104° West from 100° Greenwich
UNITED STATES


CENTRAL AMERICA
Scale of Miles
0 50 100 200 300
Railroads
Submarine Telegraph Lines
Capitals
Size of type indicates Relative importance of places
C.S.HAMMOND & CO., N.Y.
CARIBBEAN SEA
PACIFIC OCEAN
JAMAICA
Kingston
HAITI
GRAND CAYMAN (British)
Gulf of Campeche
BRITISH HONDURAS (BELIZE)
Belize
GUATEMALA
NEW GUATEMALA
Gulf of Honduras
HONDURAS
Tegucigalpa
SAN SALVADOR
NICARAGUA
Managua
Lake Nicaragua
Mosquito Gulf
COSTA RICA
San Jose
Limon
PANAMA
Colon
Panama
Gulf of Panama
Gulf of Darien
Barranquilla
Cartagena
MEDELLIN
Bluefields
Greytown
Leon
Granada

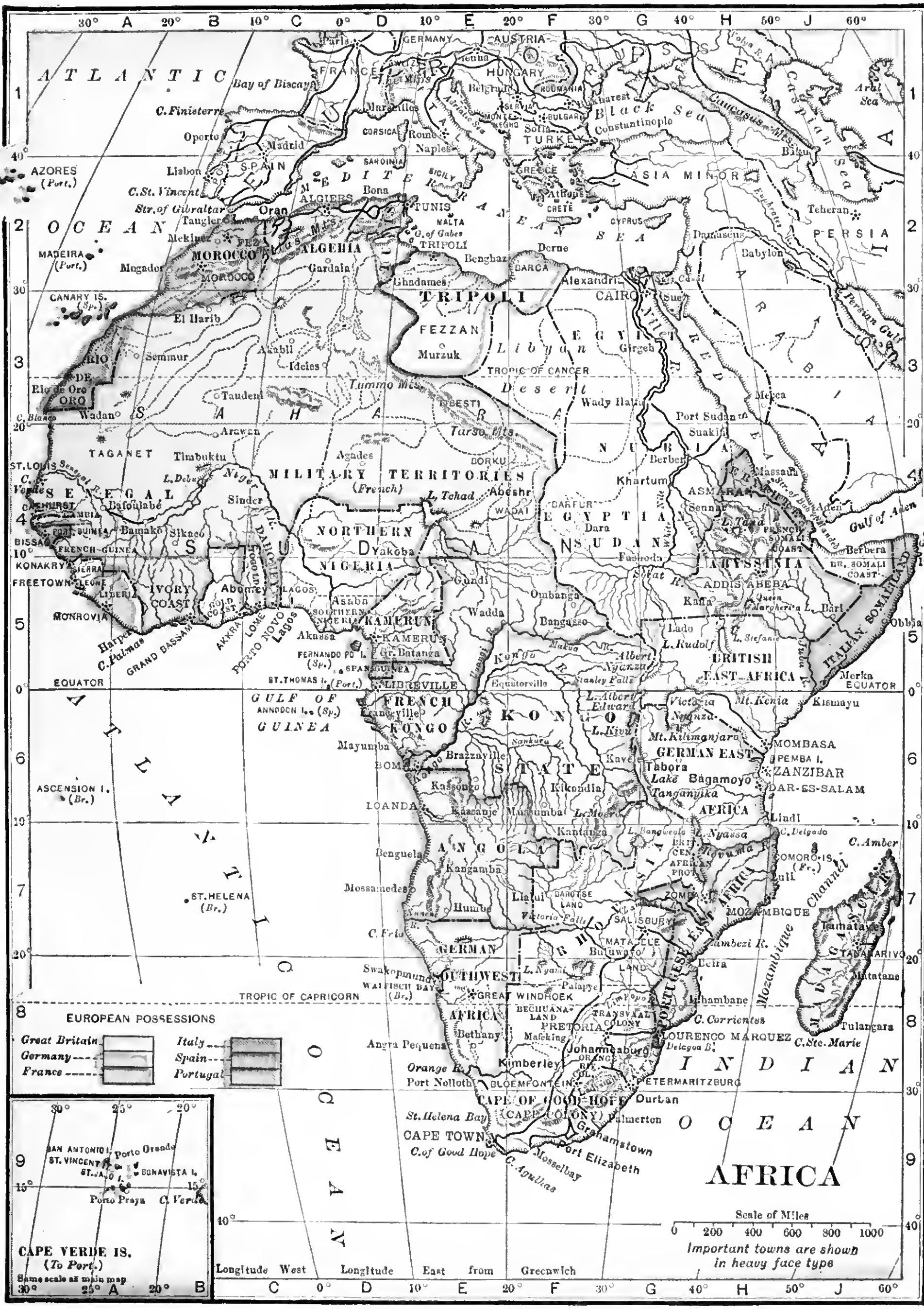


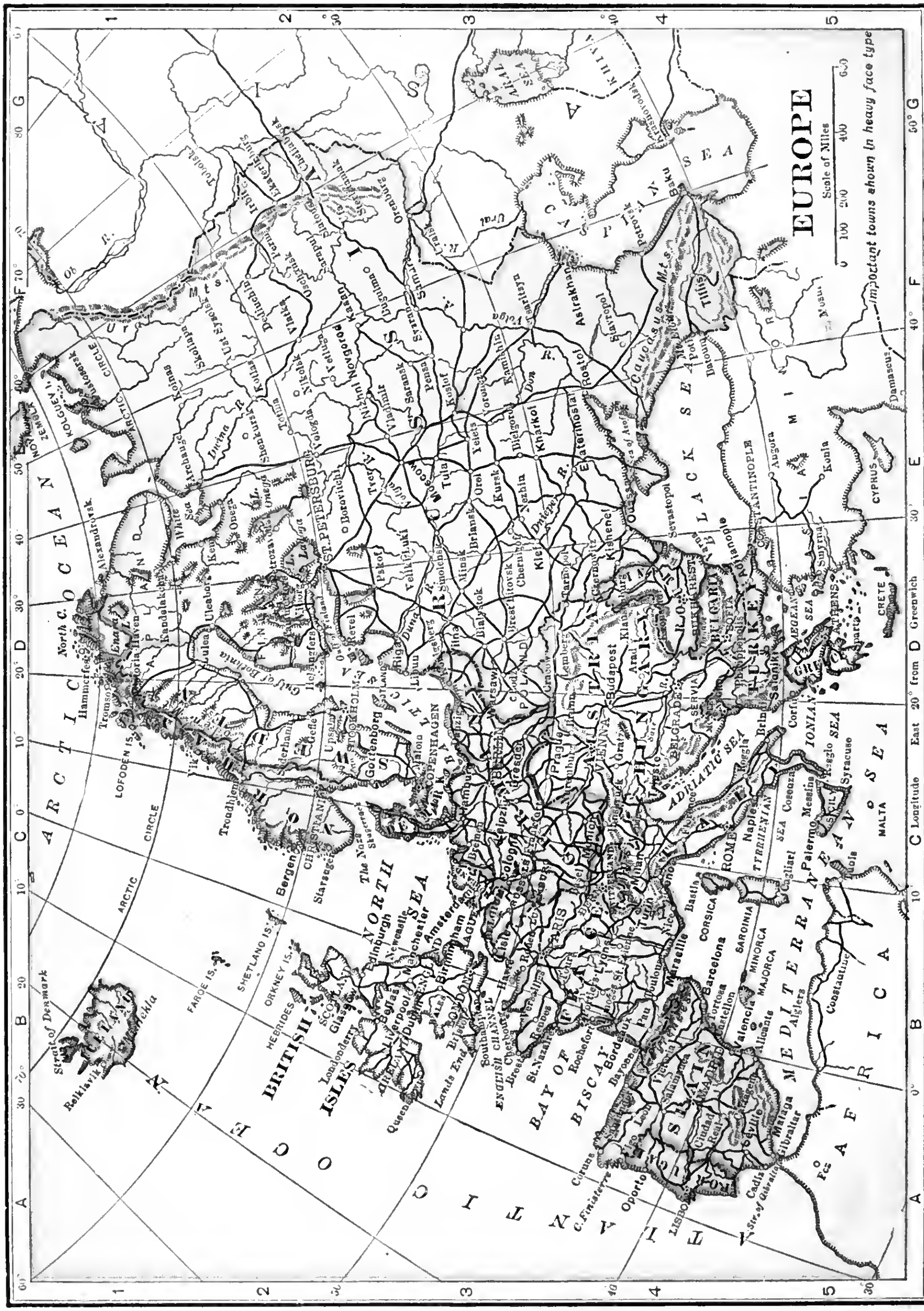
FLAGS OF ALL NATIONS



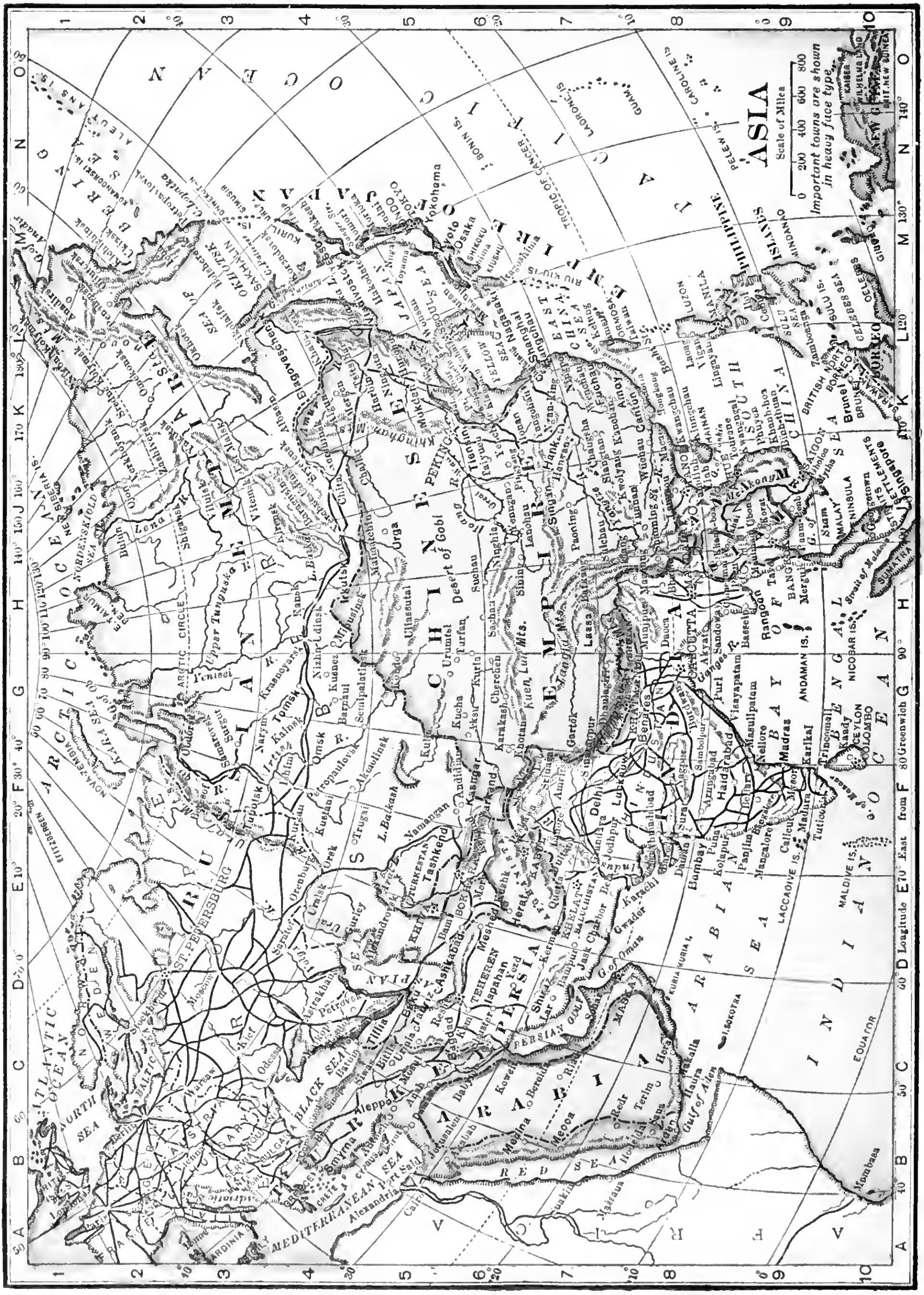
FLAGS OF ALL NATIONS


SOUTH AMERICA
Scale of Miles
0 100 200 400 600 800
Important towns are shown in heavy face type
Longitude West from Greenwich
CARIBBEAN SEA
CENTRAL AMERICA
MARTINIQUE (Fr.)
SANTA LUCIA (Br.)
BARBADOS (Br.)
ST. VINCENT (Br.)
GRENADA
TOBAGO (Br.)
TRINIDAD (Br.)
PORT OF SPAIN
Pt. Gallinas
Barranquilla
Cartagena
Mosquito
Gulf Colon
Panama
Gulf of Panama
Maracaibo
Valencia
CARACAS
Barcelona
Orinoco Delta
Merida
Ciudad Bolivar
VENEZUELA
GEORGETOWN
PARAMARIBO
CAYENNE
C Orange
Medellin
Bucaramanga
Antioquia
Honda
BOGOTA
C. Corrientes
COLOMBIA
BRITISH
GUIANA
DUTCH
FRENCH
Buenaventura
Cali
Popayan
Tumaco
C. San Francisco
QUITO
Cotopaxi
V. Chimborazo
Guayaquil
ECUADOR
Cuenca
G. of Guayaquil
Iquitos
Pt. Parina
Piura
Chiclay
Trujillo
Mouths of the Amazon R.
Para or Tocantins R.
Braganca
EQUATOR
Obidos
Manaos
Amazon
Negro
Rio
Santarem
Para
Maranhao
Parnahiba
Granja
Ceara
Aracat
C. S. Roque
Therezina
Carolina
S. Francisco
Parahiba
Pernambuco
Alagoas
Aracaju
Penedo
Bahia
Bomjardim
Cachoeira
Rio de Contas
Caravellas
Porto Alegre
Victoria
Campos
Xingu R.
Tapajos R.
Madeira R.
Purus
Jurua
Javari R.
Maranon R.
S. Antonio
Falls of the Madeira
BRAZIL
Santa Maria
Joazeiro
Araguaya
Palma
Paracatu
Diamantina
Itambe Mt.
Matto Grosso
Cuyaba
Goyaz
Geral Mts.
Huaraz
PERU
Callao
LIMA
Ayacucho
Cuzco
CINCHA IS.
Ica
Arequipa
Puno
Mollendo
Tacna
Arica
L. Titicaca
La Paz
Mt. Illimani
Oruro
Cochabamba
Santa Cruz
Trinidad
BOLIVIA
SUCRE
Potosi
Tarija
Iquique
Tocopilla
Antofagasta
TROPIC OF CAPRICORN
Puerto Pacheco
Concepcion
PARAGUAY
Jujuy
Campinas
Sao Paulo
Santos
RIO DE JANIERO
Ouro Preto
Petropolis
Villa Rica
ASUNCION
Curitiba
Paranagua
Desterro
Laguna
Cruz Alta
Rio Pardo
Porto Alegre
Pelotas
Rio Grande do Sul
Taltal
Tucuman
Villa Pilar
Corrientes
Parana
Caldera
Catamarca
Rioja
Uruguayana
Serena
Ovalle
Cordoba
Salto
Fray Bentos
URUGUAY
Chuy
MONTEVIDEO
Mt. Aconcagua
Mendoza
Valparaiso
SANTIAGO
Mercedes
Rosario
BUENOS AIRES
La Plata
Plata River
Talca
Azul
Tandil
C. Corrientes
Concepcion
General Acha
Bahia Blanca
Blanca Bay
ST. FELIX (To Chile)
ST. AMBROSE (To Chile)
MAS A FUERA I. (To Chile)
MAS A TIERRA I. (To Chile)
Temuco
General Roca
Viedma
S. Matias Gulf
Puerto Montt
Ancud
Puerto Madrin
Rawson
CHILOE I.
G. of Corcovado
CHONOS ARCH.
Gulf of St. George
Gulf of Penas
S. Valentin
C. Tres Puntas
CAMPANA I.
WELLINGTON I.
Santa Cruz
MADRE DE DIOS I.
Grande Bay
FALKLAND IS. (Br.)
Port Stanley
Str. of Magellan
Arena
Strait of Magellan
TIERRA DEL FUEGO
SANTA INES I.
Mt. Darwin
STATEN I.
WALLASTON I.
Cape Horn
SOUTH GEORGIA (Br.)
PACIFIC OCEAN
ATLANTIC OCEAN
GALAPAGOS IS.
TO ECUADOR
Same scale as large map
ABINGTON I.
CHATHAM I.
ALBEMARLE I.
INDEFATIGABLE I.

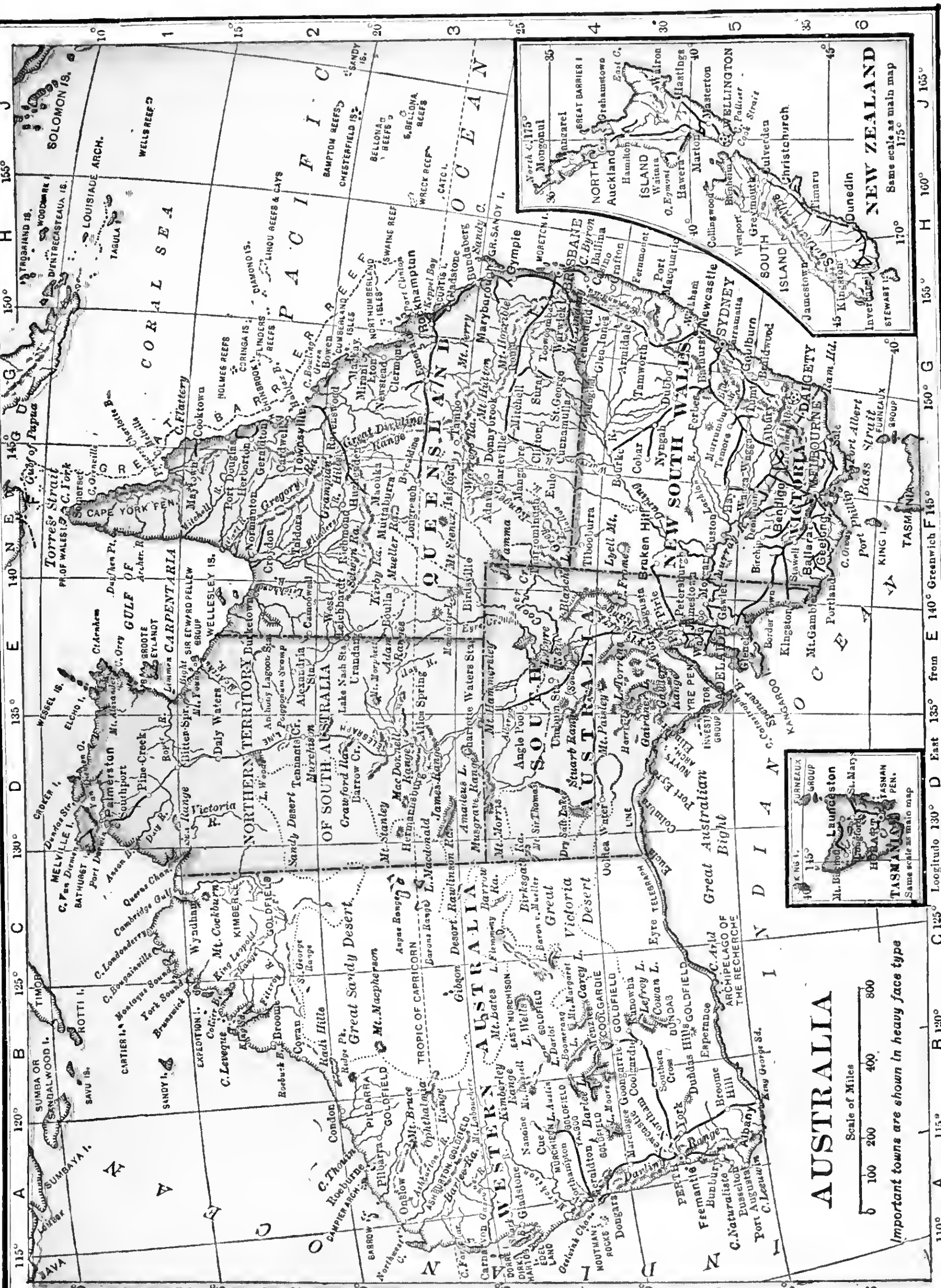

AFRICA
ATLANTIC OCEAN
INDIAN OCEAN
Bay of Biscay
C. Finisterre
Oporto
Madrid
SPAIN
Lisbon
AZORES (Port.)
C. St. Vincent
Str. of Gibraltar
Tangier
MADEIRA (Port.)
Mogador
MOROCCO
Fez
CANARY IS. (Sp.)
El Harib
RIO DE ORO
Rio de Oro
C. Blanco
Wadan
Semmur
Taudeni
Arawan
TAGANET
Timbuktu
ST. LOUIS
C. Verde
SENEGAL
BATHURST
GAMBIA
PORT. GUINEA
BISSAO
FRENCH GUINEA
KONAKRY
SIERRA LEONE
FREETOWN
LIBERIA
MONROVIA
Harper
C. Palmas
IVORY COAST
GRAND BASSAM
GOLD COAST
AKKRA
LOME
TOGO
DAHOMEY
PORTO NOVO
Lagos
Abomey
Bamako
Sikaso
Sinder
Niger R.
MILITARY TERRITORIES (French)
NORTHERN NIGERIA
Yakoba
SOUTHERN NIGERIA
Asaba
Akassa
KAMERUN
FERNANDO PO I. (Sp.)
ST. THOMAS I. (Port.)
SPAN. GUINEA
LIBREVILLE
GULF OF GUINEA
ANNOBON I. (Sp.)
FRENCH KONGO
Franceville
Mayumba
Brazzaville
BOMA
Kongo R.
LOANDA
ANGOLA
Benguela
Mossamedes
Humbe
GERMAN SOUTHWEST AFRICA
Swakopmund
WALFISCH BAY (Br.)
GREAT WINDHOEK
TROPIC OF CAPRICORN
Angra Pequena
Orange R.
Port Nolloth
St. Helena Bay
CAPE TOWN
C. of Good Hope
C. Agulhas
Mosselbay
Port Elizabeth
Grahamstown
CAPE OF GOOD HOPE (CAPE COLONY)
Kimberley
BLOEMFONTEIN
ORANGE RIV. COL.
Johannesburg
PRETORIA
TRANSVAAL COLONY
Mafeking
BECHUANALAND
Durban
PIETERMARITZBURG
NATAL
LOURENCO MARQUEZ
Delagoa B.
C. Corrientes
Inhambane
Beira
PORTUGUESE EAST AFRICA
MOZAMBIQUE
Mozambique Channel
MADAGASCAR
Tamatave
TANANARIVO
Tulangara
C. Ste. Marie
C. Amber
COMORO IS. (Fr.)
RHODESIA
Buluwayo
MATABELE LAND
SALISBURY
Victoria Falls
BAROTSE LAND
Zambezi R.
ZOMBA
L. Nyassa
BRIT. CEN. AFRICAN PROT.
GERMAN EAST AFRICA
Tabora
Bagamoyo
ZANZIBAR
PEMBA I.
DAR-ES-SALAM
MOMBASA
Lindi
C. Delgado
Lake Tanganyika
Kilimanjaro
L. Victoria Nyanza
Mt. Kenia
Kismayu
BRITISH EAST AFRICA
L. Rudolf
Lado
L. Albert Edward
L. Kivu
KONGO STATE
Equatorville
Stanley Falls
Kassongo
Kikondia
L. Moero
Kantanga
L. Bangweolo
ITALIAN SOMALILAND
Obbia
Merka
BR. SOMALI COAST
Berbera
FRENCH SOMALI COAST
C. Guardafui
SOKOTRA (Br.)
Gulf of Aden
Aden
ABYSSINIA
ADDIS ABEBA
Kaffa
L. Tana
Massaua
ASMARA
ERITREA
Suakin
Port Sudan
Mecca
RED SEA
ARABIA
EGYPTIAN SUDAN
NUBIA
Khartum
Berber
Sennar
Fashoda
Dara
DARFUR
WADAI
Abeshr
L. Tchad
Borku
Tarso Mts.
TIBESTI
Tummo Mts.
Libyan Desert
Wady Halfa
EGYPT
Girgeh
CAIRO
Alexandria
Suez Canal
Nile R.
TROPIC OF CANCER
FEZZAN
Murzuk
TRIPOLI
BARCA
Benghazi
Derne
Ghadames
ALGERIA
ALGIERS
Oran
Bona
TUNIS
MALTA
Gardaia
Akabli
Ideles
SAHARA
Agades
MEDITERRANEAN SEA
SARDINIA
CORSICA
SICILY
Rome
Naples
ITALY
FRANCE
Paris
Marseilles
GERMANY
AUSTRIA
HUNGARY
Vienna
Belgrade
ROUMANIA
SERVIA
MONTENEGRO
BULGARIA
Sofia
Bukharest
TURKEY
Constantinople
Black Sea
GREECE
Athens
CRETE
CYPRUS
ASIA MINOR
Damascus
Babylon
Teheran
PERSIA
Persian Gulf
Caspian Sea
Aral Sea
Baku
Caucasus Mts.
Euphrates
ST. HELENA (Br.)
ASCENSION I. (Br.)
EQUATOR
EUROPEAN POSSESSIONS
Great Britain
Germany
France
Italy
Spain
Portugal
CAPE VERDE IS. (To Port.)
Same scale as main map
SAN ANTONIO I.
ST. VINCENT
ST. JAGO I.
Porto Grande
BONAVISTA I.
Porto Praya
C. Verde
Scale of Miles
0 200 400 600 800 1000
Important towns are shown in heavy face type
Longitude West
Longitude East from Greenwich

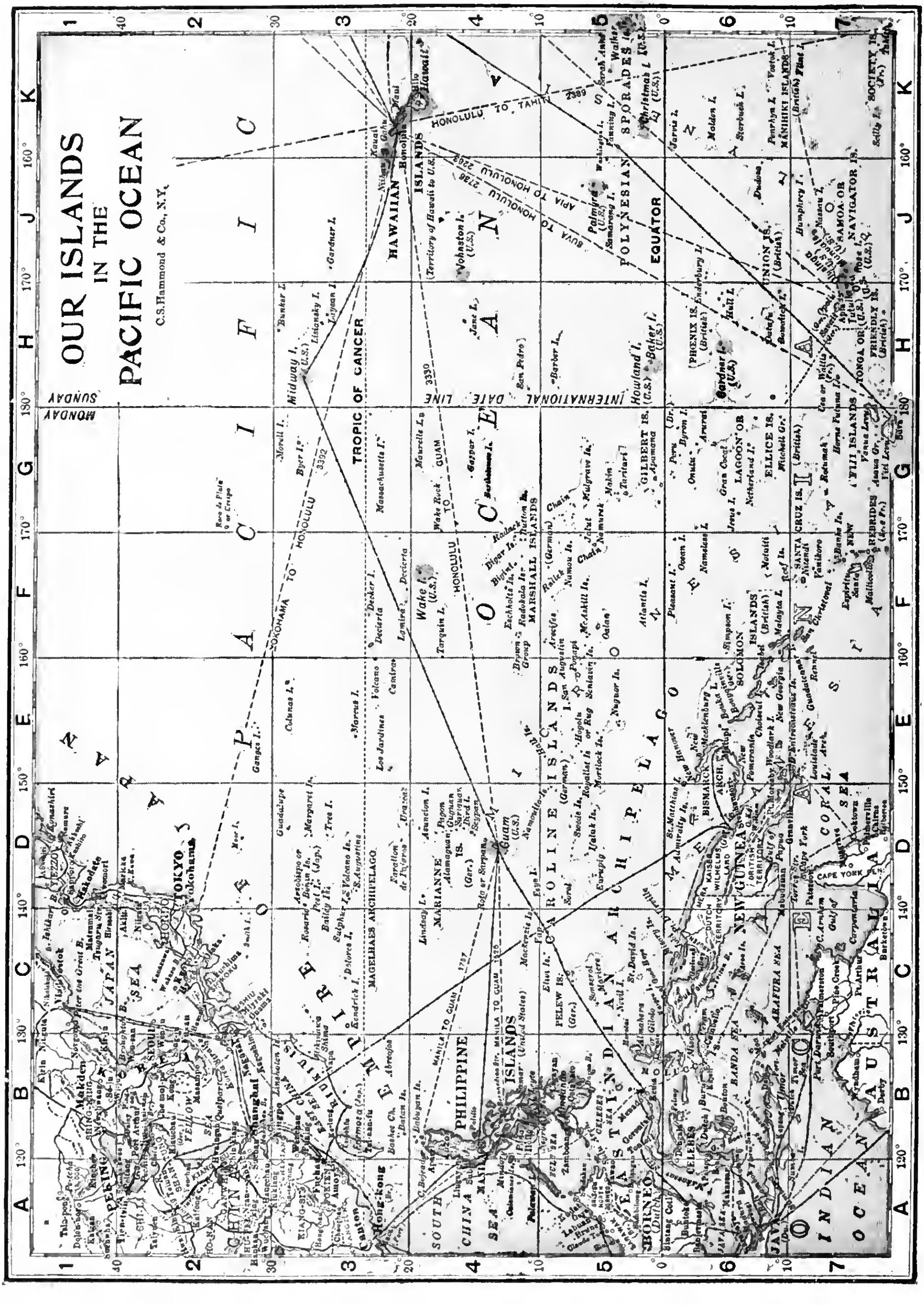

EUROPE
Scale of Miles
0 100 200 400 600
Important towns shown in heavy face type
ARCTIC OCEAN
ATLANTIC OCEAN
NORTH SEA
BAY OF BISCAY
MEDITERRANEAN SEA
BLACK SEA
CASPIAN SEA
ADRIATIC SEA
AFRICA
BRITISH ISLES
FRANCE
SPAIN
RUSSIA
TURKEY
GREECE
ITALY

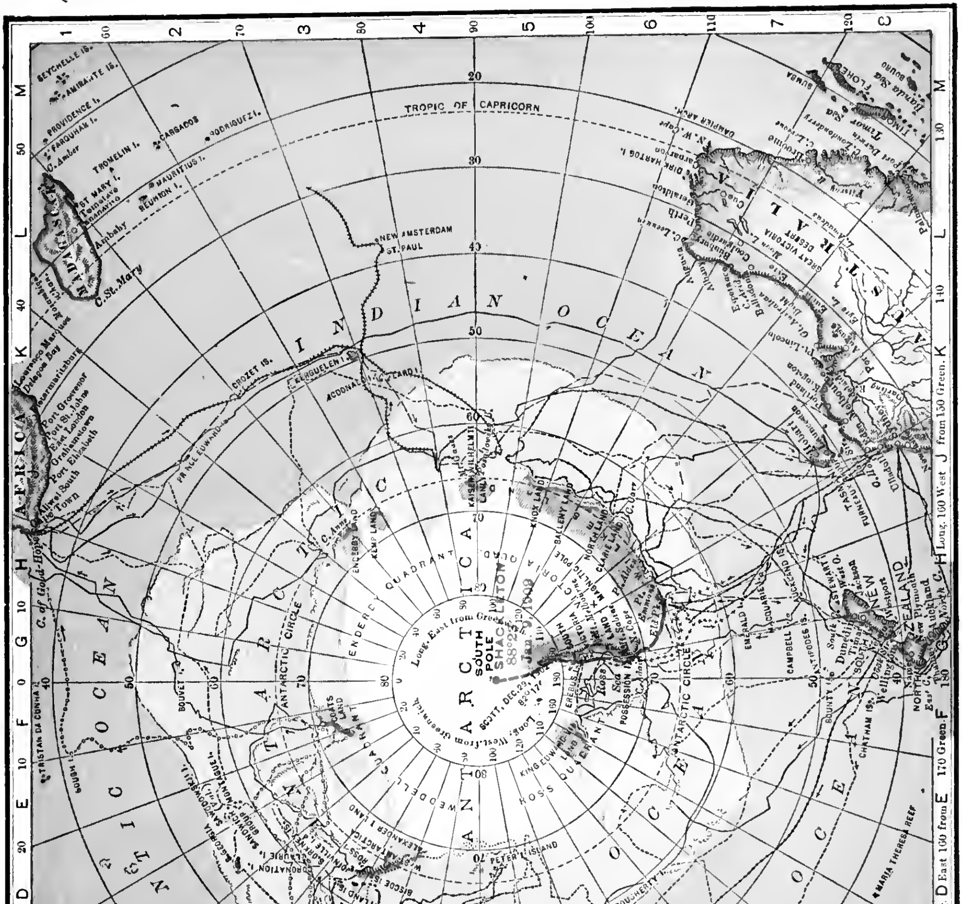

BRITISH ISLES
Scale of Miles
0 25 50 100
Through Railroads
Other Railroads
Submarine Cables
Important towns are shown in heavy face type
C.S. HAMMOND & CO., N.Y.
6 Longitude D West 4 from E Greenwich 2
0 Long. G East
ATLANTIC OCEAN
NORTH SEA
IRISH SEA
ST. GEORGE'S CHANNEL
ENGLISH CHANNEL
North Channel
Bristol Channel
SHETLAND ISLANDS
UNST
FETLAR
YELL
Yell Sd.
St. Magnus B.
PAPA STOUR
WHALSEY
MAINLAND
BRESSAY
FOULA
Lerwick
Sumburgh Hd.
FAIR I.
SANDAY
ORKNEY IS.
STRONSAY
PAPA WESTRAY
N. RONALDSHAY
WESTRAY
ROUSAY
MAINLAND
HOY
Kirkwall
S. RONALDSHAY
Pentland Firth
Duncansbay Hd
Noss Hd.
Wick
Cape Wrath
Strathy Pt.
Thurso
Butt of Lewis
LEWIS
Stornoway
HARRIS
N. UIST
BENBECULA
S. UIST
BARRA IS.
Barra Hd.
The Minch
Little Minch
CANNA
RUM I.
Gulf of Hebrides
COLL
TIREE
MULL
Passage of Coll
Firth of Lorne
COLONSAY
HEBRIDES
Helmsdale
L. Shin
Dornoch
Dornoch Firth
Tarbat Ness
Moray Firth
Tain
Cromarty
Dingwall
Gairloch
Inverness
Strome Ferry
Mallaig
Oban
Elgin
Forres
Nairn
Banff
Fraserburgh
Peterhead
Buchan Ness
Aberdeen
Stonehaven
Montrose
Forfar
Arbroath
Dundee
Perth
Kinross
Cupar
Clackmannan
Kirkcaldy
Leith
Firth of Forth
Haddington
Stirling
Dumbarton
Greenock
Paisley
Glasgow
Hamilton
Lanark
Kilmarnock
ARRAN
KINTYRE
Firth of Clyde
Ayr
Edinburgh
Dunse
Peebles
Selkirk
Jedburgh
Hawick
Cheviot Hills
Berwick-upon-Tweed
GRAMPIAN MTS.
SCOTLAND
Dumfries
Kirkcudbright
Wigtown
Port Patrick
Solway Firth
Tynemouth
South Shields
Sunderland
Newcastle
Gateshead
Carlisle
Workington
Durham
Stockton
W. Hartlepool
Middlesbrough
Whitby
Scarborough
Flamborough Hd.
Bridlington
Appleby
Whitehaven
Darlington
Kendal
Lancaster
ISLE OF MAN
Douglas
Barrow
Morecambe B.
Fleetwood
Blackburn
Preston
Halifax
Burnley
Leeds
York
Hull
Bradford
Huddersfield
Great Grimsby
Spurn Hd.
Humber Mouth
Bolton
Manchester
Oldham
Liverpool
Birkenhead
Doncaster
Sheffield
Lincoln
Stockport
Chester
Macclesfield
Mansfield
Nottingham
Grantham
Boston
The Wash
Cromer
Kings Lynn
Yarmouth
Norwich
Lowestoft
Burslem
Hanley
Crewe
Longton
Derby
Burton-on-Trent
Loughborough
Leicester
Peterborough
Stafford
Walsall
Birmingham
Wolverhampton
Dudley
Kidderminster
Huntingdon
Ely
Bury St. Edmunds
Coventry
Northampton
Cambridge
Ipswich
Harwich
Warwick
Worcester
Bedford
Colchester
Banbury
Stratford
Luton
Hertford
Chelmsford
Hereford
Cheltenham
Oxford
Aylesbury
LONDON
Gloucester
Monmouth
Thames
Gravesend
Chatham
Ramsgate
Canterbury
Dover
Swindon
Reading
Windsor
Bristol
Bath
Newport
Cardiff
Greenwich
Croydon
Guildford
Tunbridge Wells
Folkestone
Lewes
Hastings
Salisbury
Winchester
Southampton
Brighton
Worthing
Chichester
Portsmouth
I. OF WIGHT
Newhaven
Str. of Dover
Boulogne
Dorchester
Weymouth
Bournemouth
Poole Bay
St. Albans Hd.
Severn R.
Bridgewater
Barnstaple
Barnstaple Bay
LUNDY I.
Hartland Pt.
Taunton
Exeter
Lyme Bay
Torquay
Dartmouth
Plymouth
Devonport
Bodmin
Truro
Falmouth
Penzance
St. Austell B.
Plymouth Sd.
EDDYSTONE
Lizard Hd.
Mounts B.
Lands End
SCILLY IS.
CASQUETS
ALDERNEY
CHANNEL
GUERNSEY
HERM
SARK
ISLAND
JERSEY
Cherbourg
Havre
Mouth of Seine
Rouen
Seine
Fecamp
Dieppe
Caen
FRANCE
ANGLESEY
Holyhead
HOLY I.
Carnarvon
Carnarvon Bay
Bangor
Mold
Ruabon
Shrewsbury
Montgomery
Tremadoc B.
Dolgelly
Cardigan Bay
Aberystwyth
Cardigan
Carmarthen
Haverfordwest
St. Brides B.
Milford Haven
Pembroke
Carmarthen B.
Worms Hd.
Swansea
Merthyr Tydfil
Brecon
Cambrian Mts.
WALES
ENGLAND
Giants Causeway
Malin Head
Lough Swilly
Portrush
Moville
TORY I.
Bloody Foreland
ARAN I.
Londonderry
Lifford
Foyle
Ballyshannon
Teelin Hd.
Donegal Bay
Omagh
Lough Neagh
Belfast
Lisburn
Lurgan
Downpatrick
Sligo B.
Killala B.
The Mullet
Enniskillen
Monaghan
Armagh
Sligo
Upper L. Erne
Newry
Dundalk
Dundrum Bay
Ballina
Achill Hd.
ACHILL I.
Castlebar
Carrick on-Shannon
Cavan
Westport
Longford
Drogheda
Dundalk B.
Roscommon
Lough Ree
Mullingar
Trim
L. Corrib
Athlone
Slyne Hd.
Galway
Galway B.
Tullamore
Dublin
Dublin B.
Kingstown
ARAN IS.
Maryborough
Kildare
Liscanor B.
Dunbeg B.
Lough Derg
Ennis
Wicklow
Carlow
Loop Hd.
Limerick
Kilkenny
R. Shannon
Ballyheige
Tipperary
Clonmel
Tralee
Suir
Waterford
Wexford
Carnsore Pt.
Killarney
Blackwater
Waterford Har.
Dingle B.
Cork
Queenstown
Kenmare R.
Bantry B.
Cork Harbor
Kinsale Har.
Courtmacsherry B.
Clonakilty B.
Skibbereen
C. Clear
Mizzen Hd.
IRELAND

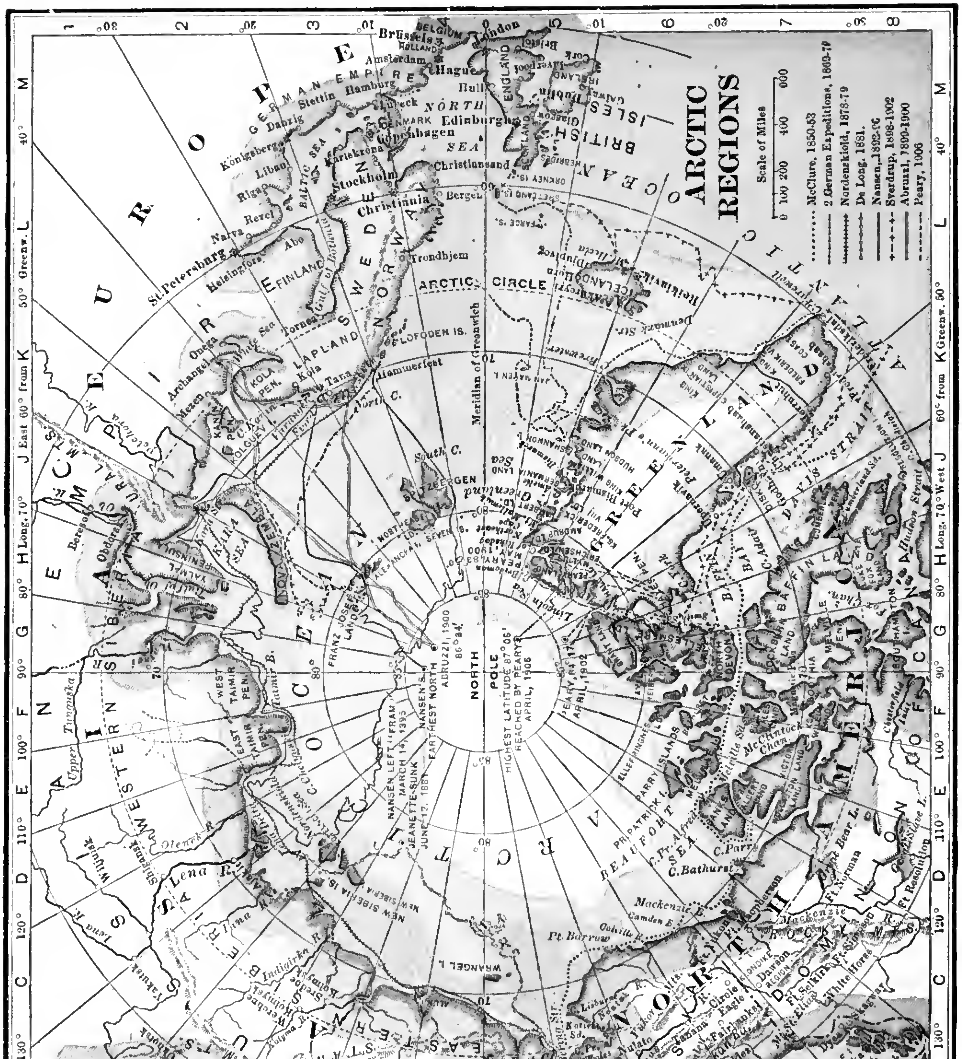


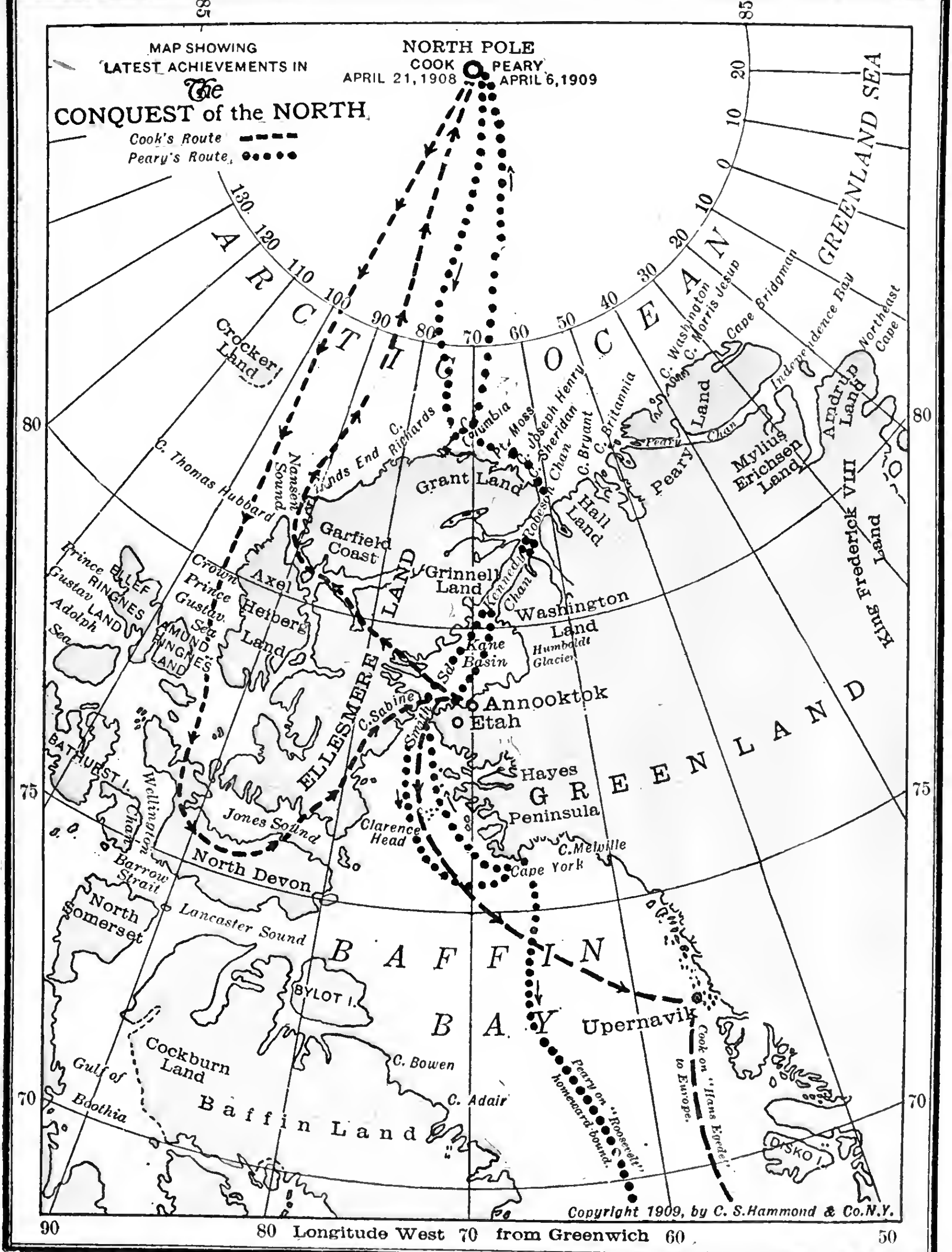
ASIA
Scale of Miles
0 200 400 600 800
Important towns are shown in heavy face type
ARCTIC OCEAN
PACIFIC OCEAN
INDIAN OCEAN
ARABIAN SEA
BAY OF BENGAL
SOUTH CHINA SEA
EAST CHINA SEA
YELLOW SEA
SEA OF JAPAN
SEA OF OKHOTSK
BERING SEA
RED SEA
MEDITERRANEAN SEA
BLACK SEA
CASPIAN SEA
PERSIAN GULF
RUSSIAN EMPIRE
CHINESE EMPIRE
JAPANESE EMPIRE
PERSIA
ARABIA
INDIA
PEKING
CALCUTTA
BOMBAY
MADRAS
ST. PETERSBURG
TROPIC OF CANCER
ARCTIC CIRCLE
EQUATOR
Longitude East from Greenwich

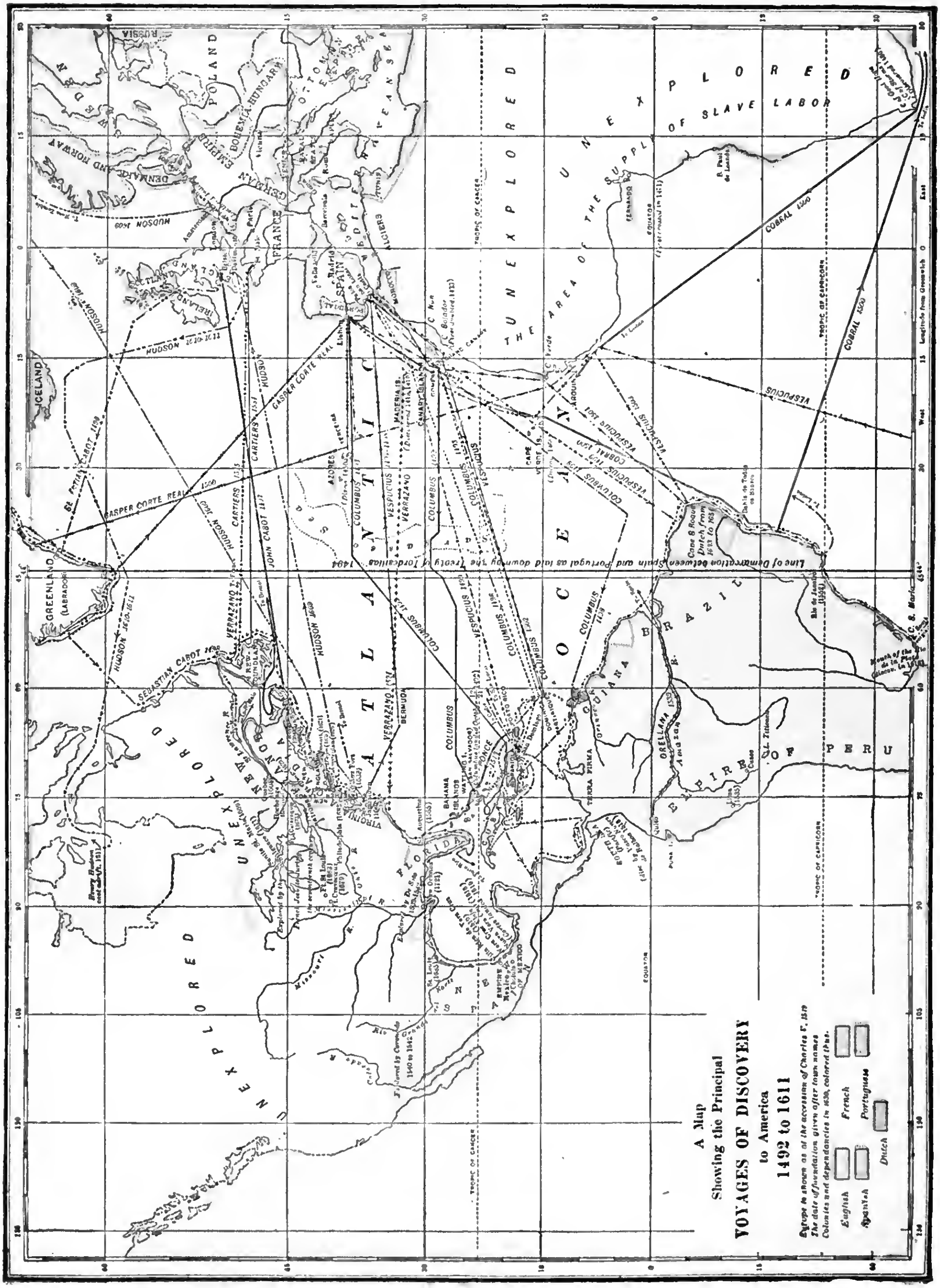

AUSTRALIA
Scale of Miles
Important towns are shown in heavy face type
NEW ZEALAND
Same scale as main map
TASMANIA
Same scale as main map


OUR ISLANDS
IN THE
PACIFIC OCEAN
C.S.Hammond & Co., N.Y.
PACIFIC
OCEAN
TROPIC OF CANCER
EQUATOR
INTERNATIONAL DATE LINE
HAWAIIAN ISLANDS
PHILIPPINE ISLANDS
MARSHALL ISLANDS
CAROLINE ISLANDS
NEW GUINEA
AUSTRALIA
INDIAN OCEAN
SOUTH CHINA SEA
CORAL SEA
SOLOMON ISLANDS
POLYNESIAN SPORADES
JAPAN
CHINA
KOREA
HONOLULU TO TAHITI
YOKOHAMA TO HONOLULU
MANILA TO GUAM

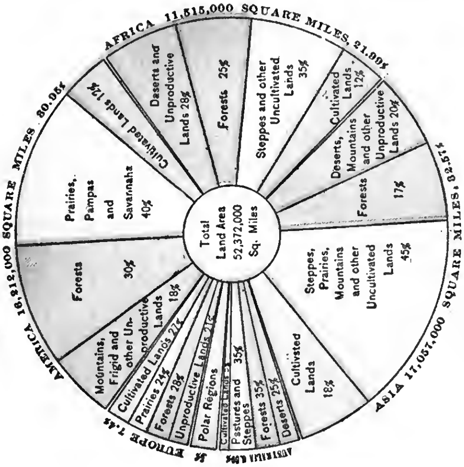

ANTARCTIC REGIONS
SHOWING THE ROUTES OF THE MOST IMPORTANT EXPLORATIONS
Scale of Miles
0 250 500 1000 1500
SHACKLETON'S ROUTE
Cook's Route 1772-1775
D'Urville's Route 1838-1840
Wilke's Route 1839-1840
Ross' Route 1839-1843
Route of "Challenger" 1872-1876
Route of "Belgica" 1898
Borchgrevink's Route 1898-1900
Drygalski's Route 1901-1903
Scott's Route 1901-1904
Bruce's Route 1902-1904
Limits of Pack Ice
INDIAN OCEAN
ATLANTIC OCEAN
PACIFIC OCEAN
ANTARCTICA
ANTARCTIC CIRCLE
TROPIC OF CAPRICORN
SOUTH POLE
AFRICA
SOUTH AMERICA
AUSTRALIA
NEW ZEALAND
MADAGASCAR
ENDERBY QUADRANT
VICTORIA QUADRANT
ROSS QUADRANT
WEDDELL QUADRANT
Long. East from Greenwich
Long. West from Greenwich


ARCTIC REGIONS
Scale of Miles
0 100 200 400 600
McClure, 1850-53
2 German Expeditions, 1869-70
Nordenskiold, 1878-79
De Long, 1881.
Sverdrup, 1898-1902
Peary, 1906
NORTH POLE
HIGHEST LATITUDE 87° 06' REACHED BY PEARY APRIL, 1906
ARCTIC CIRCLE
Meridian of Greenwich

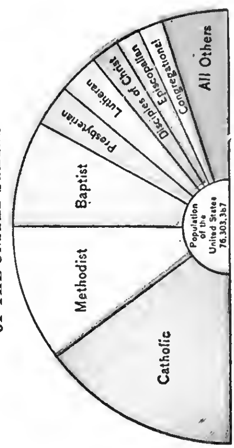

MAP SHOWING
LATEST ACHIEVEMENTS IN
The
CONQUEST of the NORTH
Cook's Route
Peary's Route
NORTH POLE
COOK PEARY
APRIL 21, 1908 APRIL 6, 1909
ARCTIC OCEAN
GREENLAND SEA
Crocker Land
C. Thomas Hubbard
Nansen Sound
Grant Land
Garfield Coast
Grinnell Land
Axel Heiberg Land
ELLESMERE LAND
Kane Basin
Annooktok
Etah
Hayes Peninsula
GREENLAND
Washington Land
Humboldt Glacier
Hall Land
Peary Land
Mylius Erichsen Land
Amdrup Land
King Frederick VIII Land
Northeast Cape
Independence Bay
Cape Bridgman
C. Morris Jesup
C. Washington
C. Britannia
C. Bryant
Robeson Chan
Kennedy Chan
Smith Sd
C. Sabine
Jones Sound
North Devon
Lancaster Sound
Barrow Strait
Wellington Chan
North Somerset
BATHURST I.
ELLEF RINGNES LAND
AMUND RINGNES LAND
Prince Gustav Adolph Sea
Crown Prince Gustav Sea
Clarence Head
Cape York
C. Melville
BAFFIN BAY
Upernavik
BYLOT I.
Cockburn Land
Gulf of Boothia
Baffin Land
C. Bowen
C. Adair
DISKO I.
Peary on "Roosevelt" homeward bound.
Cook on "Hans Egede" to Europe.
Copyright 1909, by C. S. Hammond & Co. N.Y.
Longitude West from Greenwich


A Map
Showing the Principal
VOYAGES OF DISCOVERY
to America
1492 to 1611
Europe is shown as at the accession of Charles V, 1519
The date of foundation given after town names
Colonies and dependencies in 1630, colored thus
English
French
Portuguese
Spanish
Dutch

CHARACTER OF LAND OF THE EARTH

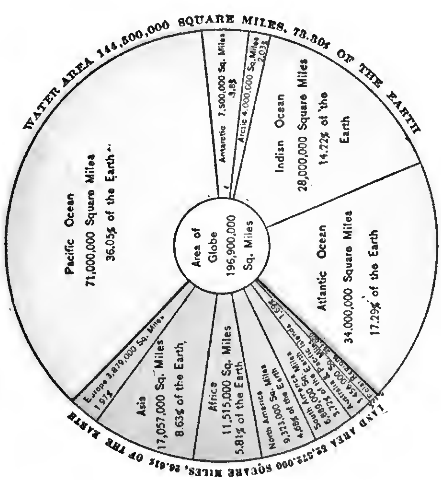


PRINCIPAL RELIGIOUS SECTS OF THE UNITED STATES

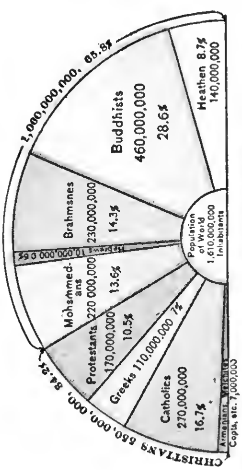


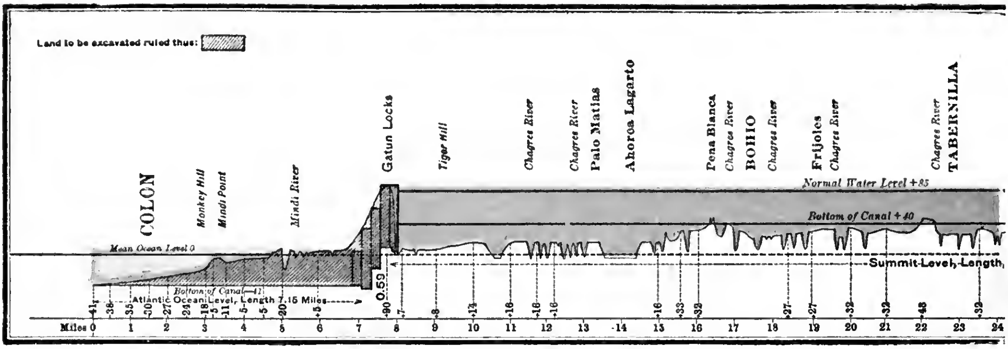
C. S. HAMMOND & CO., N. Y.

AREAS OF THE EARTH

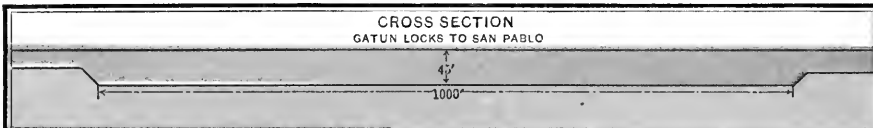


PRINCIPAL RELIGIONS OF THE WORLD

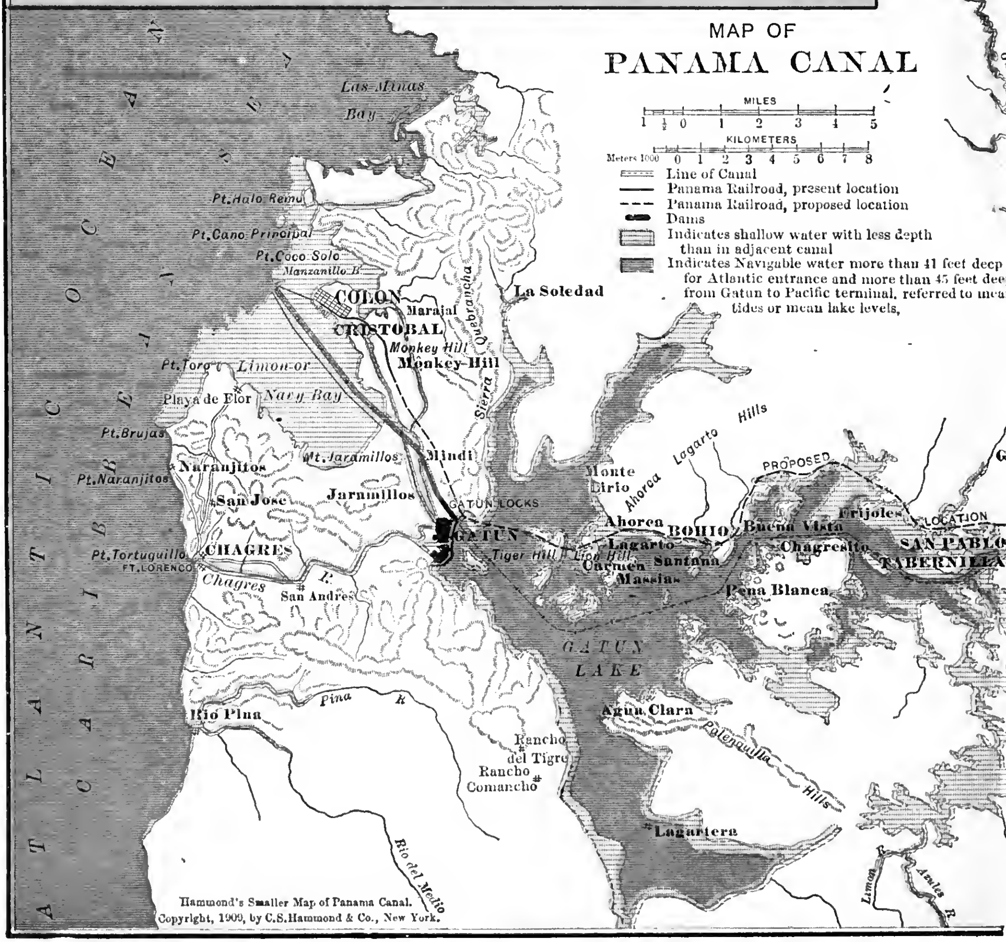




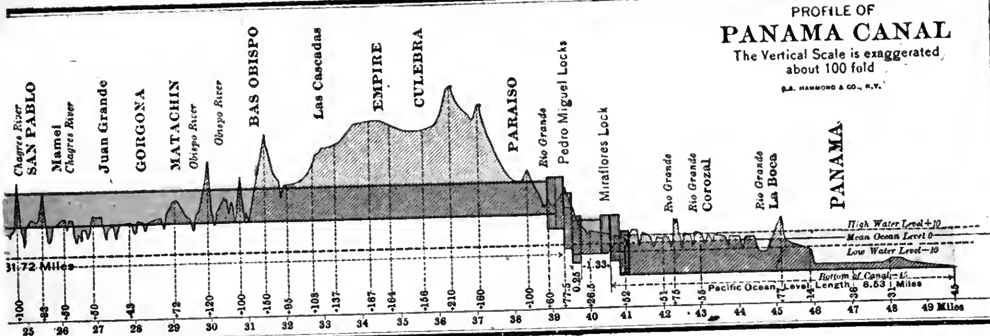
Land to be excavated ruled thus:
COLON
Monkey Hill
Mindi Point
Mindi River
Gatun Locks
Tiger Hill
Chagres River
Chagres River
Palo Matias
Ahorca Lagarto
Pena Blanca
Chagres River
BOHIO
Chagres River
Frijoles
Chagres River
Chagres River
TABERNILLA
Normal Water Level +85
Bottom of Canal +40
Mean Ocean Level 0
Summit-Level, Length
Bottom of Canal—41
Atlantic Ocean Level, Length 7.15 Miles
Miles 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

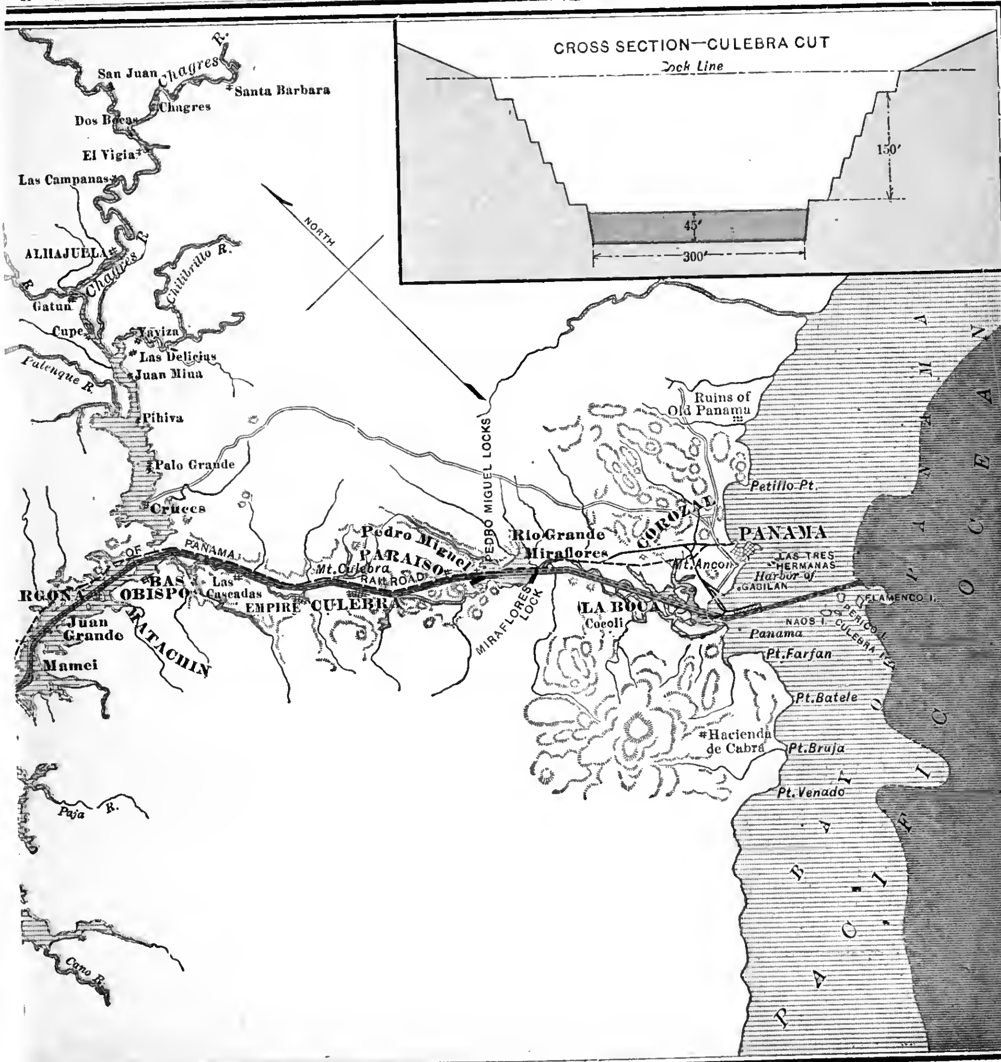


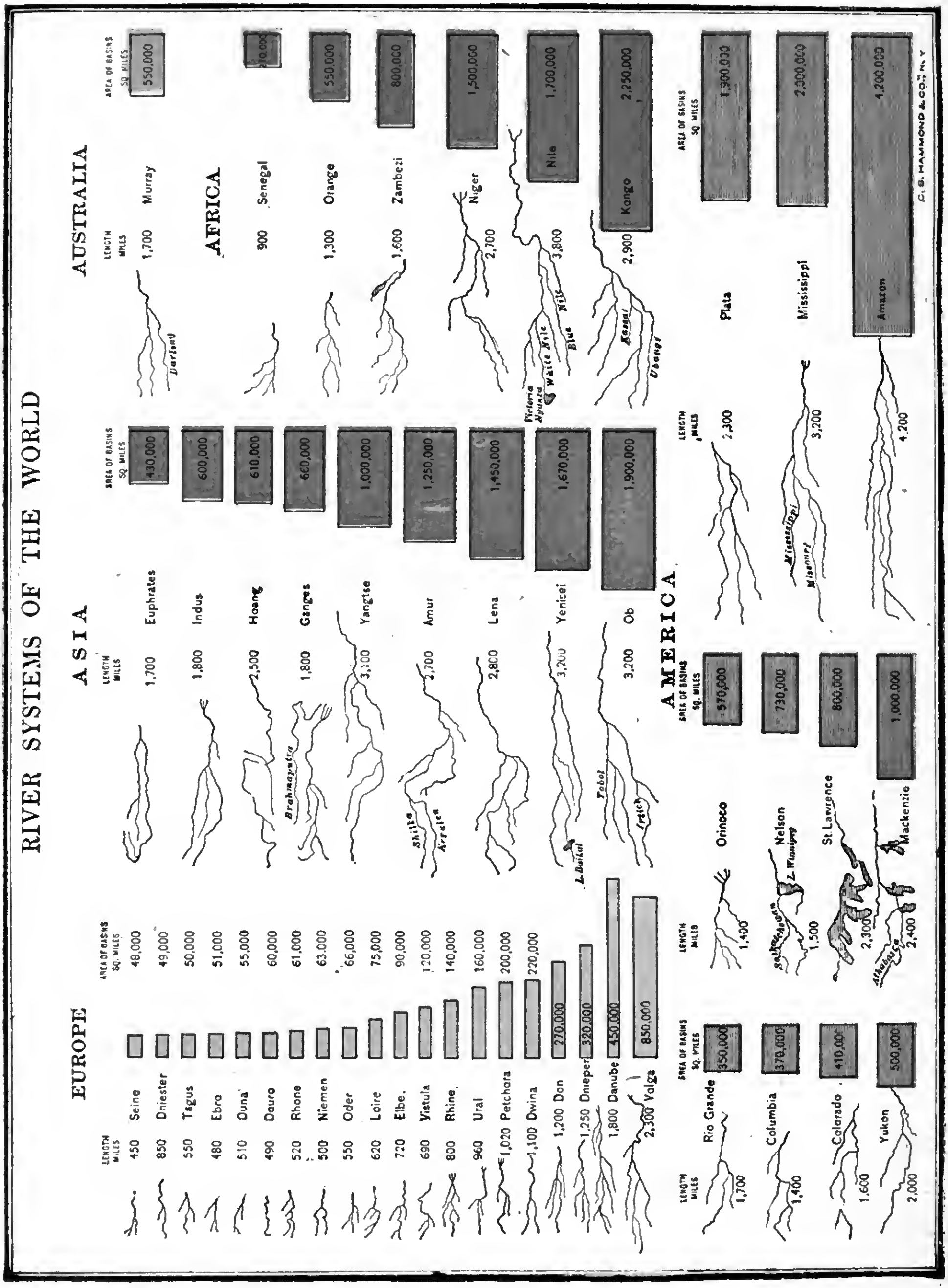
CROSS SECTION
GATUN LOCKS TO SAN PABLO
45'
1000'



MAP OF
PANAMA CANAL
MILES
1 ½ 0 1 2 3 4 5
KILOMETERS
Meters 1000 0 1 2 3 4 5 6 7 8
Line of Canal
Panama Railroad, present location
Panama Railroad, proposed location
Dams
Indicates shallow water with less depth than in adjacent canal
Indicates Navigable water more than 41 feet deep for Atlantic entrance and more than 45 feet deep from Gatun to Pacific terminal, referred to mean tides or mean lake levels,
ATLANTIC OCEAN
CARIBBEAN SEA
Las Minas Bay
Pt. Halo Remu
Pt. Cano Principal
Pt. Coco Solo
Manzanillo B.
COLON
CRISTOBAL
Marajal
Monkey Hill
Monkey Hill
Sierra Quebrancha
La Soledad
Pt. Toro
Limon or Navy Bay
Playa de Flor
Pt. Brujas
Pt. Naranjitos
Naranjitos
Mt. Jaramillos
Mindi
San Jose
Jaramillos
Pt. Tortuguillo
FT. LORENCO
CHAGRES
Chagres R.
San Andres
GATUN LOCKS
GATUN
Tiger Hill
Lion Hill
Monte Lirio
Ahorca Lagarto Hills
Ahorca
Lagarto
BOHIO
Carmen
Santana
Massias
Buena Vista
PROPOSED LOCATION
Frijoles
Chagresito
SAN PABLO
TABERNILLA
Pena Blanca
GATUN LAKE
Agua Clara
Palenquilla Hills
Rio Pina
Pina R.
Rancho del Tigre
Rancho Comancho
Lagartera
Rio del Medio
Limon R.
Aguas R.
Gatuncillo
Hammond's Smaller Map of Panama Canal.
Copyright, 1909, by C.S. Hammond & Co., New York.


PROFILE OF
PANAMA CANAL
The Vertical Scale is exaggerated about 100 fold
Chagres River
SAN PABLO
Mamei
Chagres River
Juan Grande
GORGONA
MATACHIN
Obispo River
Obispo River
BAS OBISPO
Las Cascadas
EMPIRE
CULEBRA
PARAISO
Rio Grande
Pedro Miguel Locks
Miraflores Lock
Rio Grande
Rio Grande
Corozal
Rio Grande
La Boca
PANAMA
High Water Level +10
Mean Ocean Level 0
Low Water Level −10
Bottom of Canal −45
Pacific Ocean Level Length 8.53 Miles
31.72 Miles
49 Miles


CROSS SECTION—CULEBRA CUT
150′
45′
300′
Chagres R.
San Juan
Santa Barbara
Chagres
Dos Bocas
El Vigia
Las Campanas
ALHAJUELA
Chilibrillo R.
Gatun
Cupe
Yaviza
Las Delicias
Palenque R.
Juan Mina
Pihiva
Palo Grande
Cruces
NORTH
PEDRO MIGUEL LOCKS
Ruins of Old Panama
Petillo Pt.
COROZAL
PANAMA
Pedro Miguel
PARAISO
Rio Grande
Miraflores
Mt. Culebra
RAILROAD
Mt. Ancon
LAS TRES HERMANAS
Harbor of
GABILAN
BAS OBISPO
Las Cascadas
EMPIRE
CULEBRA
MIRAFLORES LOCK
LA BOCA
Cocoli
FLAMENCO I.
PERICO I.
NAOS I.
CULEBRA I.
Panama
Pt. Farfan
Juan Grande
MATACHIN
Mamei
Pt. Batele
Hacienda de Cabra
Pt. Bruja
Pt. Venado
Paja R.
Cano R.
PACIFIC OCEAN


RIVER SYSTEMS OF THE WORLD
EUROPE
LENGTH MILES
AREA OF BASINS SQ. MILES
450 Seine 48,000
850 Dniester 49,000
550 Tagus 50,000
480 Ebro 51,000
510 Duna 55,000
490 Douro 60,000
520 Rhone 61,000
500 Niemen 63,000
550 Oder 66,000
620 Loire 75,000
720 Elbe 90,000
690 Vistula 120,000
800 Rhine 140,000
960 Ural 160,000
1,020 Petchora 200,000
1,100 Dwina 220,000
1,200 Don 270,000
1,250 Dnieper 320,000
1,800 Danube 450,000
2,300 Volga 850,000
ASIA
LENGTH MILES
AREA OF BASINS SQ. MILES
1,700 Euphrates 430,000
1,800 Indus 600,000
2,500 Hoang 610,000
Brahmaputra
1,800 Ganges 660,000
3,100 Yangtse 1,000,000
Shilka
Kerulen
2,700 Amur 1,250,000
2,800 Lena 1,450,000
L. Baikal
3,200 Yenisei 1,670,000
Tobol
Irtish
3,200 Ob 1,900,000
AUSTRALIA
LENGTH MILES
AREA OF BASINS SQ. MILES
Darling
1,700 Murray 550,000
AFRICA
900 Senegal 10,000
1,300 Orange 550,000
1,600 Zambezi 800,000
2,700 Niger 1,500,000
Victoria Nyanza
White Nile
Blue Nile
3,800 Nile 1,700,000
Kasai
Ubangi
2,900 Kongo 2,250,000
AMERICA
LENGTH MILES
AREA OF BASINS SQ. MILES
1,700 Rio Grande 350,000
1,400 Columbia 370,000
1,600 Colorado 410,000
2,000 Yukon 500,000
1,400 Orinoco 570,000
Saskatchewan
L. Winnipeg
1,500 Nelson 730,000
2,300 St. Lawrence 800,000
Athabasca
2,400 Mackenzie 1,000,000
2,300 Plata 1,900,000
Missouri
Mississippi
3,200 Mississippi 2,300,000
4,200 Amazon 4,200,000
C. S. HAMMOND & CO., N.Y.

PRINCIPAL CITIES OF THE WORLD

The following list contains the principal towns of the world in all countries except the United States. In it will be found approximately all places of more than thirty thousand inhabitants and most of those of from twenty to thirty thousand. The date of the latest census enumerations and official estimates of the following countries is given as indicating the respective value of the figures used in the compilation: Algeria, 1901; Australia, 1901; Austria Hungary, 1900; British South African States, 1904; England and Wales, 1901, with government estimates of all towns of over 50,000 for 1905; Germany, 1901, with government estimates of Berlin, Hamburg and Essen for 1905; Japan, 1903; Philippine Islands, 1903; Sweden, 1905.

Aachen, Germany	135,245
Aalborg, Denmark	31,457
Aarhus, Denmark	51,814
Abbeokuta, Yoruba	150,000
Aberdare, Wales	43,357
Aberdeen, Scotland	167,537
Abo, Russia	38,235
Accrington, England	48,890
Acireale, Italy	35,418
Acton, England	37,744
Adama, Turkey in Asia	45,000
Adelaide, Australia	170,729
Aden, Arabia	42,758
Adis Abeba, Abyssinia	35,000
Adrianople, Turkey in Europe	81,000
Agra, India	180,022
Ahmadabad, India	185,889
Aidin, Turkey in Asia	38,000
Aix, France	24,861
Ajmer, India	73,839
Akerman, Russia	32,470
Akita, Japan	34,350
Alcano, Italy	51,809
Alcoy, Spain	32,053
Aldershot, England	30,974
Aleppo, Turkey in Asia	127,150
Alessandria, Italy	71,298
Alexandria, Egypt	319,766
Alexandropol, Russia	32,018
Alexandrovsk, Russia	40,807
Algiers, Algeria	96,542
Alicante, Spain	50,142
Aligarh, India	70,434
Allahabad, India	172,032
Allenstein, Germany	24,287
Almeria, Spain	47,326
Alost, Belgium	31,655
Altenburg, Germany	37,110
Altendorf, Germany	63,238
Altona, Germany	161,501
Alwar, India	56,771
Ambala, India	78,638
Amiens, France	90,758
Amoy, China	114,000
Amritsar, India	162,429
Amsterdam, Netherlands	551,415
Ancona, Italy	56,835
Anderlecht, Belgium	51,921
Andijan, Russia in Asia	46,682
Andria, Italy	49,569
Angers, France	82,398
Angouleme, France	37,650
Antequera, Spain	31,609
Antwerp, Belgium	291,149
Apeldoorn, Netherlands	30,892
Aquila, Italy	21,188
Arad, Hungary	56,220
Arequipa, Peru	35,000
Arezzo, Italy	44,316
Argao, P. I.	35,448
Arles, France	29,000
Armentieres, France	29,000
Arnhem, Netherlands	60,528
Aschersleben, Germany	27,315
Ascoli, Italy	28,882
Ashkabad, Russia	26,835
Ashton-under-Lyne, England	43,890
Asnieres, France	31,330
Asti, Italy	38,045
Aston Manor, England	77,310
Astrakhan, Russia	121,580
Asuncion, Paraguay	60,000
Athens, Greece	128,735
Aubervilliers, France	31,215
Auckland, New Zealand	67,226
Augsburg, Germany	89,170
Aussig, Austria	37,265
Avellino, Italy	23,760
Avignon, France	46,896
Ayr, Scotland	28,624
Ayuthia, Siam	50,000
Azof, Russia	25,124
Badjos, Spain	30,899
Bagdad, Turkey in Asia	145,000
Bahia, Brazil	174,412
Bahour, India	56,595
Baireuth, Germany	29,397
Baku, Russia	179,133
Ballarat, Australia	49,202
Bamberg, Germany	41,823
Bangalore, India	159,046
Bangkok, Siam	600,000
Banjermassin, Borneo	51,880
Barcelona, Spain	533,000
Bareilly, India	131,208
Barfrush, Persia	50,000
Bari, Italy	77,478
Barile, P. I.	31,617
Barletta, Italy	42,022
Barmen, Germany	141,944
Barnaul, Russia in Asia	29,850
Barnsley, England	41,083
Baroda, India	103,790
Barquisimeto, Venezuela	31,476
Barranquilla, Colombia	55,000
Barrow-in-Furness, England	69,306
Basel, Switzerland	124,392
Basra, Turkey in Asia	50,000
Batangas, P. I	33,131
Batavia, Java	115,887
Bath, England	49,817
Batley, England	30,321
Batum, Russia	28,512
Bauan, P. I	39,049
Bautzen, Germany	26,125
Bayonne, France	25,075
Bedford, England	35,144
Beirut, Turkey in Asia	118,800
Bekes, Hungary	37,547
Belfast, Ireland	349,180
Belfort, France	32,567
Belgrade, Servia	69,790
Bellary, India	58,247
Benares, India	209,331
Bender, Russia	35,741
Bendigo, Australia	42,660
Benevento, Italy	24,447
Berbera, Br. Somaliland	30,000
Berdiansk, Russia	29,168
Berditchef, Russia	53,728
Bergamo, Italy	47,772
Bergen, Norway	72,251
Berlat, Roumania	24,000
Berlin, Germany	2,033,900
Bern, Switzerland	70,339
Bernburg, Germany	34,175
Besancon, France	55,404
Beuthen, Germany	51,362
Beziers, France	52,510
Bhagalpur, India	75,560
Bhaunagar, India	56,442
Bhopal, India	77,023
Bialystok, Russia	63,040
Biel, Switzerland	29,394
Bielefeld, Germany	63,046
Bikanor, India	53,078
Bilbao, Spain	83,306
Birkenhead, England	116,035
Birmingham, England	542,959
Bitlis, Turkey in Asia	38,800
Blackburn, England	133,067
Blackpool, England	47,346
Blagoveschensk, Russia in Asia	37,368
Bloemfontein, Orange R. Col.	33,890
Blois, France	20,434

PRINCIPAL CITIES OF THE WORLD—CONTINUED

Blumenau, Brazil	40,000
Bobrinsk, Russia	35,177
Bochum, Germany	65,551
Bogota, Colombia	130,000
Bologna, Italy	152,009
Bolton, England	178,111
Bombay, India	776,006
Bona, Algeria	36,993
Bonn, Germany	50,736
Bootle, England	62,758
Bordeaux, France	257,638
Borgerhout, Belgium	41,075
Botuchany, Roumania	32,000
Boulogne-sur-Mer, France	49,949
Boulogne-sur-Seine, France	44,416
Bourges, France	46,551
Bournemouth, England	66,168
Bradford, England	286,799
Braga, Portugal	24,202
Bralia, Roumania	58,392
Brandenburg, Germany	49,250
Breda, Netherlands	26,949
Bremen, Germany	163,297
Brescia, Italy	70,614
Breslau, Germany	422,709
Brest, France	84,284
Brest-Litovsk, Russia	42,812
Bridgetown, Barbados	35,000
Brieg, Germany	24,224
Brighton, England	127,183
Brisbane, Australia	122,815
Bristol, England	358,515
Broken Hill, Australia	27,500
Bromberg, Germany	52,204
Bruges, Belgium	53,728
Brunn, Austria	109,346
Brunswick, Germany	128,226
Brusa, Turkey in Asia	76,303
Brussels, Belgium	598,599
Budapest, Hungary	732,322
Budweis, Austria	39,328
Buenos Aires, Argentina	979,235
Bukharest, Roumania	282,071
Burgos, Spain	30,167
Burnley, England	101,682
Burslem, England	38,766
Burton-upon-Trent, England	52,424
Bury, England	58,954
Cadiz, Spain	69,382
Caen, France	44,794
Cagliari, Italy	53,747
Cairo, Egypt	570,062
Calais, France	59,743
Calcutta, India	1,026,987
Calicut, India	76,981
Callao, Peru	31,000
Caltagirone, Italy	44,879
Caltanisetta, Italy	43,303
Camaguey, Cuba	25,102
Cambridge, England	38,393
Canea, Crete	24,537
Cannes, France	30,420
Cannstadt, Germany	26,575
Canterbury, England	24,899
Canton, China	900,000
Cape Coast Castle, Gold Coast, Africa	28,948
Cape Haitien, Haiti	29,000
Cape Town, Cape of Good Hope	87,483
Caracas, Venezuela	72,429
Carcassonne, France	30,720
Cardenas, Cuba	26,448
Cardiff, Wales	180,054
Carear, P. I.	31,895
Carlisle, England	45,478
Carrara, Italy	42,097
Cartagena, Spain	99,871
Caserta, Italy	32,709
Cassel, Germany	106,034
Castellon, Spain	29,904
Castres, France	24,135
Catania, Italy	149,295
Catanzaro, Italy	31,824
Cawnpur, India	197,170
Ceara, Brazil	40,902
Cebu, P. I.	31,079
Celaya, Mexico	25,565
Cette, France	33,246
Chalon-sur-Saone, France	26,462
Changsha, China	230,000
Charleroi, Belgium	26,528
Charlottenburg, Germany	189,305
Chatham, England	40,753
Chaux de Fonds, Switzerland	38,784
Chefu, China	75,000
Cheltenham, England	49,439
Chemnitz, Germany	214,030
Cherbourg, France	42,938
Chernigof, Russia	27,006
Chester, England	38,309
Chieta, Italy	26,368
Chihuahua, Mexico	30,405
Chillan, Chile	36,681
Chinandega, Nicaragua	20,000
Chingtu, China	1,000,000
Chinkiang, China	167,000
Cholan, China	129,721
Christchurch, New Zealand	57,041
Christiania, Norway	227,626
Chungking, China	600,000
Cienfuegos, Cuba	59,428
Clermont, France	52,933
Clichy, France	39,521
Coatbridge, Scotland	36,981
Coban, Guatemala	30,770
Coblenz, Germany	47,526
Cochabamba, Bolivia	21,886
Coimbatore, India	53,080
Colchester, England	38,351
Colmar, Germany	36,844
Cologne, Germany	372,529
Colombo, Ceylon	158,228
Combaconum, India	59,673
Como, Italy	38,895
Concepcion, Chile	55,458
Constantine, Algeria	48,243
Constantinople, Turkey	1,125,000
Copenhagen, Denmark	500,479
Cordoba, Argentina	60,000
Cordova, Spain	58,275
Cork, Ireland	76,122
Coruna, Spain	43,971
Courbevoie, France	23,796
Coutrai, Belgium	34,564
Coventry, England	75,134
Crajova, Roumania	45,438
Crefeld, Germany	107,968
Cremona, Italy	37,693
Crewe, England	42,075
Cronstadt, Russia	59,539
Croydon, England	147,704
Cuddalore, India	52,216
Cuenca, Ecuador	30,000
Cuneo, Italy	27,065
Cuttack, India	51,364
Czegled, Hungary	30,106
Czenstochowa, Russia	53,650
Czernowitz, Austria	67,622
Dacca, India	90,542
Daman, India	41,671
Damanhur, Egypt	27,263
Damascus, Turkey in Asia	225,000
Danzig, Germany	147,301
Darbhangah, India	66,246
Darlington, England	44,496
Darmstadt, Germany	72,381
Darwen, England	38,211
Debreczin, Hungary	75,006
Delft, Netherlands	32,950
Delhi, India	208,575
Derby, England	122,207
Dessau, Germany	50,849
Deventer, Netherlands	27,411
Devonport, England	78,864
Diarbekr, Turkey	34,000
Dijon, France	71,326
Dordrecht, Netherlands	43,482
Dorpat, Russia	42,421
Dortmund, Germany	142,733
Douai, France	33,649
Dover, England	41,782
Drammen, Norway	23,093
Dresden, Germany	480,658
Dublin, Ireland	373,179
Dudley, England	48,809
Duisburg, Germany	94,185
Dumbarton, Scotland	115,176
Dunaburg, Russia	65,906
Dundee, Scotland	164,269
Dunedin, New Zealand	62,390
Dunkirk, France	38,925
Durango, Mexico	31,092
Durban, Natal	79,000
Düren, Germany	27,185
Düsseldorf, Germany	213,711
Dvinsk, Russia	69,675
Ealing, England	83,040
Eastbourne, England	43,337
East Ham, England	95,989
East London, C. of Good Hope	25,220
Eccles, England	34,369
Ecija, Spain	24,395
Edinburgh, Scotland	336,577
Edmonton, England	46,899
Eger, Austria	23,675
Eisenach, Germany	31,457
Ekaterinburg, Russia	55,448
Ekaterinodar, Russia	65,697
Ekaterinoslaf, Russia	135,552
Elberfeld, Germany	156,968
Elbing, Germany	52,518
Elche, Spain	27,380
Elizavetgrad, Russia	66,182
Elizavetpol, Russia	33,090
Enfield, England	42,738
Enschede, Netherlands	29,510
Erfurt, Germany	85,202
Erivan, Russia	29,033
Erzerum, Turkey in Asia	38,900
Essen, Germany	229,270
Esslingen, Germany	27,260
Exeter, England	47,185
Faizabad, India	75,085
Falkirk, Scotland	29,271
Farakhabad, India	67,338
Felegyhaza, Hungary	33,406
Ferrara, Italy	87,648
Ferrol, Spain	25,281
Fez, Morocco	140,000
Fiume, Hungary	38,955
Flensburg, Germany	48,922
Florence, Italy	205,589
Foggia, Italy	53,151
Folkstone, England	30,694
Forli, Italy	43,708
Forst, Germany	32,150
Fort de France, Martinique	22,164
Frankfort-on-Main, Germany	288,989
Frankfort-on-Oder, Germany	61,852

PRINCIPAL CITIES OF THE WORLD—Continued

Freetown, Sierra Leone	34,463
Freiberg, Germany	31,000
Freiburg, Germany	61,504
Fremantle, Australia	23,008
Fuchau, China	624,000
Fukui, Japan	50,155
Fukuoka, Japan	71,047
Funchal, Madeira	20,844
Fünfkirchen, Hungary	43,982
Fürth, Germany	54,142
Gäfle, Sweden	30,776
Galatz, Roumania	62,678
Gallipoli, Turkey	30,000
Gateshead, England	120,620
Gaya, India	71,288
Geisenkirchen, Germany	36,935
Geneva, Switzerland	112,736
Genoa, Italy	234,710
Georgetown, Br. Guiana	53,176
Gera, Germany	45,634
Ghent, Belgium	162,925
Gibraltar, Spain	27,460
Giessen, Germany	25,491
Gifu, Japan	40,168
Gijon, Spain	47,544
Gillingham, England	42,530
Girgenti, Italy	25,024
Gladbach, Germany	58,023
Glasgow, Scotland	809,986
Glauchau, Germany	25,776
Gleiwitz, Germany	52,862
Gloucester, England	47,955
Gomel, Russia	45,081
Gorakhpur, India	64,148
Gorlitz, Germany	80,931
Gotha, Germany	34,185
Gottenborg, Sweden	138,030
Göttingen, Germany	39,359
Govan, Scotland	76,351
Granada, Nicaragua	25,000
Granada, Spain	75,900
Gratz, Austria	138,080
Graudenz, Germany	32,786
Great Grimsby, England	68,153
Greenock, Scotland	70,253
Grenoble, France	68,615
Grodno, Russia	41,756
Groningen, Netherlands	71,490
Grosswardein, Hungary	50,177
Guadalajara, Mexico	101,208
Guanajuato, Mexico	41,486
Guayaquil, Ecuador	51,000
Guben, Germany	33,135
Gwalior, India	119,433
Haarlem, Netherlands	68,518
Hagen, Germany	50,612
Hague, Netherlands	234,459
Haidarabad, India	448,446
Hakodate, Japan	85,313
Halberstadt, Germany	42,810
Halifax, England	108,419
Halifax, Nova Scotia	40,832
Halle, Germany	156,609
Hälsingborg, Sweden	27,253
Hama, Turkey in Asia	44,000
Hamadan, Persia	40,000
Hamburg, Germany	872,028
Hamilton, Ontario, Canada	52,634
Hamilton, Scotland	32,775
Hamm, Germany	31,390
Handsworth, England	52,921
Hangchau, China	300,000
Hankau, China	870,000
Hanley, England	64,667
Hanoi, Anam	103,238
Hanover, Germany	235,649
Harar, Abyssinia	40,000
Harbin, China	60,000
Harburg, Germany	49,153
Hastings, England	66,820
Havana, Cuba	262,395
Havre, France	130,196
Heidelberg, Germany	40,121
Heilbronn, Germany	37,891
Helder, Netherlands	26,681
Helsingfors, Finland	93,576
Herat, Afghanistan	45,000
Hildesheim, Germany	42,973
Himeji, Japan	36,443
Hirosaki, Japan	36,509
Hiroshima, Japan	121,196
Hobart, Australia	34,809
Hodmezo-Vasarhely, Hungary	60,883
Hof, Germany	32,805
Hongkong, China	136,900
Honolulu, Hawaii	39,306
Hornsey, England	72,056
Hove, England	36,542
Howrah, India	157,594
Hubli, India	60,214
Huddersfield, England	96,008
Hue, Anam	50,000
Hull, England	258,127
Hyde, England	32,708
Ibadan, Yoruba	200,000
Ichang, China	45,000
Igtau, Austria	24,423
Ilford England	41,240
Imoschi, Austria	36,789
Indore, India	97,804
Innsbruck, Austria	27,056
Inowraclaw, Germany	26,152
Insterburg, Germany	27,280
Ipswich, England	70,802
Iquique, Chile	43,005
Irkutsk, Russia in Asia	49,106
Iserlohn, Germany	27,275
Ismail, Russia	33,607
Ispahan, Persia	80,000
Ivanovo-Voznesensk, Russia	56,628
Ivry-sur-Seine, France	25,575
Ixelles, Belgium	62,979
Jabalpur, India	90,316
Jaipur, India	160,167
Jalandhar, India	67,735
Janina, Turkey	25,000
Jaroslaw, Austria	22,641
Jarrow, England	34,294
Jassy, Roumania	78,069
Jerez, Spain	63,473
Jerusalem, Turkey in Asia	48,000
Jhansi, India	55,724
Jodhpur, India	60,437
Johannesburg, Transvaal	158,580
Jokjokarta, Java	58,229
Jönköping, Sweden	23,240
Jumet, Belgium	25,950
Kabul, Afghanistan	70,000
Kagoshima, Japan	59,001
Kaiserieh, Turkey in Asia	72,000
Kaiserslautern, Germany	48,310
Kaluga, Russia	49,728
Kamenetz, Russia	39,113
Kanazawa, Japan	99,657
Kandahar, Afghanistan	60,000
Karachi, India	116,663
Karlskrona, Sweden	26,074
Karlsruhe, Germany	97,185
Kaschau, Hungary	40,102
Kashan, Persia	40,000
Kashgar, Turkestan	75,000
Kasiof, Russia	40,347
Kattowitz, Germany	31,749
Kazan, Russia	143,707
Kazvin, Persia	40,000
Kecskemet, Hungary	57,812
Keighley, England	41,565
Kerbela, Turkey in Asia	65,000
Kerman, Persia	60,000
Kermanshah, Persia	30,000
Kertch, Russia	30,342
Kharkof, Russia	197,405
Khatmandu, Nepal	50,000
Kherson, Russia	73,185
Khojent, Russia in Asia	31,881
Khotin, Russia	30,424
Kiauchau, China	80,000
Kief, Russia	319,000
Kiel, Germany	121,824
Kilmarnock, Scotland	34t161
Kimberly, Cape of Good Hope	34,331
King's Norton, England	57,120
Kingston, Jamaica	46,542
Kingston-upon-Thames, Eng.	34,373
Kioto, Japan	380,568
Kirin, China	250,000
Kirkcaldy, Scotland	34,064
Kishenef, Russia	125,787
Kiukiang, China	36,000
Kiungchau, China	30,000
Klausenburg, Hungary	49,295
Kobe, Japan	285,002
Kofu, Japan	44,188
Kokand, Russia in Asia	86,704
Kokura, Japan	36,825
Kolhapur, India	51,373
Kolomea, Austria	34,188
Kom, Persia	40,000
Koniah, Turkey in Asia	44,000
Königsberg, Germany	57,919
Kostroma, Russia	41,268
Kotchi, Japan	35,815
Kottbus, Germany	39,322
Kovno, Russia	73,743
Krakow, Austria	91,323
Krasnoyarsk, Russia in Asia	33,337
Krementchug, Russia	58,648
Kronstadt, Hungary	36,046
Kuching, Borneo	25,000
Kumamoto, Japan	59,717
Kure, Japan	66,006
Kursk, Russia	52,896
Kutais, Russia	32,492
Kwala Kangsa, Straits Settlements	77,234
Lagos, Nigeria	42,000
Lahore, India	202,964
Laibach, Austria	36,547
Lancaster, England	40,329
Lanchau, China	500,000
Landsberg Germany	33,600
Laoag, P. I.	34,454
La Paz, Bolivia	62,000
La Plata, Argentina	75,023
La Rochelle, France	31,559
Lassa, Tibet	45,000
Lausanne, Switzerland	51,936
Laval, France	30,356
Le Creuzot, France	30,584
Leece, Italy	32,687
Leeds, England	456,787
Leeuwarden Netherlands	34,098
Leghorn, Italy	98,321
Leicester, England	228,132
Leiden, Netherlands	56,044
Leigh, England	40,001
Leipzig, Germany	456,124
Leith, Scotland	81,477

PRINCIPAL CITIES OF THE WORLD—Continued

City	Population
Le Mans, France	63,272
Lemberg, Austria	159,877
Lens, France	24,353
Lenz, Austria	58,791
Leon, Mexico	63,263
Leon, Nicaragua	45,000
Leyton, England	98,899
Libau, Russia	64,505
Lichtenberg, Germany	43,371
Lieben, Austria	21,375
Liege, Belgium	168,532
Liegnitz, Germany	54,882
Lima, Peru	130,000
Limerick, Ireland	45,806
Limoges, France	84,121
Linares, Chile	33,000
Linares, Spain	38,245
Lincoln, England	48,784
Linden, Germany	50,628
Lipa, P. I	37,924
Lisbon, Portugal	356,009
Lisle, France	210,696
Liverpool, England	730,143
Lodz, Russia	351,570
London, England	6,580,616
London, Ont., Canada	37,983
Londonderry, Ireland	39,892
Longton, England	35,825
Lorca, Spain	69,836
Lorient, France	44,640
Louvain, Belgium	42,194
Lübeck, Germany	82,098
Lublin, Russia	50,152
Lucca, Italy	74,971
Lucerne, Switzerland	32,801
Lucknow, India	264,049
Ludwigshafen, Germany	61,914
Lüneburg, Germany	24,715
Luton, England	36,404
Luxemburg, Luxemburg	20,928
Lyon, France	459,099
Maastricht, Netherlands	36,146
Macao, China	63,991
Macclesfield, England	34,635
Madras, Ind a	509,346
Madrid, Spain	539,835
Madura, India	105,984
Magdeburg, Germany	229,667
Maidstone, England	33,516
Maikop, Russia in Asia	34,191
Mainz, Germany	84,251
Mako, Hungary	33,722
Malaga, Spain	130,109
Malines, Belgium	58,101
Malmo, Sweden	70,797
Managua, Nicaragua	30,000
Manchester, England	631,185
Mandalay, India	183,816
Manila, P. I	219,928
Manipur, India	67,093
Manissa, Turkey in Asia	50,000
Mannheim, Germany	141,131
Mantua, Italy	29,142
Maracaibo, Venezuela	34,284
Maranhao, Brazil	29,308
Maria Theresiopol, Hungary	82,122
Mariapol, Russia	52,770
Marsala, Italy	57,567
Marseille, France	491,161
Maskat, Arabia	60,000
Massa, Italy	26,413
Matanzas, Cuba	45,282
Matsuyama, Japan	37,841
Matsuye, Japan	35,081
Maulman, India	58,446
Mayebeshi, Japan	41,721
Mecca, Turkey in Asia	60,000

City	Population
Mechlin, Belgium	58,101
Medellin, Colombia	40,000
Medina, Turkey in Asia	48,000
Medinet-el-Fayoum, Egypt	40,350
Meerut, India	118,129
Mehallet-el Kebir, Egypt	31,535
Mekinez, Morocco	56,000
Melbourne, Australia	508,450
Mendoza, Argentina	29,100
Merida, Mexico	43,630
Merthyr Tydfil, Wales	69,227
Meshed, Persia	60,000
Messina, Italy	149,778
Metz, Germany	58,462
Mexico, Mexico	368,777
Middlesborough, England	98,369
Milan, Italy	491,460
Minsk, Russia	91,494
Mirzapur, India	79,862
Miskolcz, Hungary	43,096
Mitau, Russia	35,011
Mito, Japan	36,928
Modena, Italy	64,843
Modica, Italy	48,962
Mohilef, Russia	45,000
Molenbeek, Belgium	61,122
Molfetta, Italy	40,135
Mombasa, Br. E. Africa	27,000
Monastir, Turkey	45,000
Mons, Belgium	27,072
Monterey, Mexico	62,266
Montevideo, Uruguay	276,000
Montlucon, France	35,062
Montpelier, France	75,950
Montreal, Canada	267,730
Montreuil, France	31,773
Monza, Italy	33,685
Morad bad, India	75,128
Morelia, Mexico	37,278
Morocco, Morocco	60,000
Morshansk, Russia	25,913
Moscow, Russia	1,092,360
Mosul, Turkey	61,000
Motherwell, Scotland	30,423
Mountain Ash, Wales	31,093
Mukden, China	160,000
Mülhausen, Germany	89,118
Mülheim-on-Rhine, Germany	45,062
Mülheim-on-Ruhr, Germany	80,609
Multan, India	87,394
Munich, Germany	499,959
Münster, Germany	63,776
Murcia, Spain	111,539
Mustapha, Algeria	38,327
Muttra, India	60,042
Mysore, India	68,111
Nafa, Japan	43,132
Nagano, Japan	37,202
Nagasaki, Japan	153,293
Nagoya, Japan	288,639
Nagpur, India	127,734
Nagy-Koros, Hungary	26,535
Nakichevan, Russia	40,384
Namangan, Russia in Asia	61,906
Namur, Belgium	31,940
Nanchang, China	300,000
Nancy, France	102,559
Nankin, China	270,000
Nantes, France	132,990
Naples, Italy	563,540
Nara, Japan	33,735
Narbonne, France	24,670
Nawangar, India	53,844
Negapatam, India	57,190
Neisset, Germany	24,367
Nelson, England	32,816
Neuilly, France	37,493

City	Population
Neumünster, Germany	37,400
Neustadt, Austria	28,700
Nevers, France	27,673
Newcastle, Australia	58,620
Newcastle, England	264,511
New Guatemala, Guatemala	96,560
Newport, England	72,880
Nice, France	105,109
Niigata, Japan	59,576
Nijmegen, Netherlands	49,342
Nikolaief, Russia	92,060
Nimes, France	80,605
Ningpo, China	260,000
Nissa, Servia	24,000
Niuchwang, China	56,000
Nizhni Novgorod, Russia	95,124
Nordhausen, Germany	28,516
Norköping, Sweden	44,378
Northampton, England	92,441
Norwich, England	116,741
Nottingham, England	251,671
Novara, Italy	45,248
Novgorod, Russia	26,972
Novo Cherkask, Russia	52,005
Nuka, Russia	24,811
Nuremberg, Germany	261,081
Ny-reghyhaza, Hungary	33,088
Oaxaca Mexico	35,049
Oberhausen, Germany	42,148
Odenburg, Hungary	33,478
Odense, Denmark	40,138
Odessa, Russia	449,673
Offenbach, Germany	50,468
Okayama, Japan	81,025
Oldenburg, Germany	26,656
Oldham, England	140,225
Olmütz, Austria	22,106
Omdurman, Egypt	69,000
Omsk, Russia in Asia	53,050
Oporto, Portugal	172,421
Oppeln, Germany	30,175
Oran, Algeria	88,235
Örebro, Sweden	25,288
Orel, Russia	70,075
Orizaba, Mexico	32,894
Orleans, France	67,311
Osaka, Japan	995,945
Osh, Russia	37,397
Osnabrück, Germany	51,573
Ostend, Belgium	41,181
Otaru, Japan	79,361
Otsu, Japan	39,595
Ottawa, Canada	59,928
Oulgaret, India	54,965
Ouro Preto, Brazil	59,249
Oviedo, Spain	48,103
Oxford, England	49,336
Pachuca, Mexico	37,487
Padua, Italy	82,281
Paisley, Scotland	85,604
Pakhoi, China	30,000
Palembang, Sumatra	53,788
Palermo, Italy	309,694
Palma, Spain	63,937
Palmas, Canary Islands	44,517
Panama, Panama	30,000
Para, Brazil	100,000
Paramaribo, Dutch Guiana	32,585
Parana, Argentina	25,000
Paris, France	2,714,068
Parma, Italy	49,340
Partick, Scotland	64,274
Patiala, India	53,545
Patna, India	134,785
Patras, Greece	50,158
Pau, France	34,268

PRINCIPAL CITIES OF THE WORLD—Continued

Pavia, Italy	35,447
Peking, China	1,600,000
Pelotas, Brazil	41,591
Penang, Straits Settlements	94,086
Pensa, Russia	61,851
Perigueux, France	31,976
Perm, Russia	45,403
Pernambuco, Brazil	111,556
Perpignan, France	36,157
Perth, Australia	42,474
Perth, Scotland	34,214
Perugia, Italy	61,385
Pesaro, Italy	25,103
Peshawar, India	95,147
Peterborough, England	30,870
Pforzheim, Germany	43,351
Philippopolis, East. Roumelia	42,849
Piacenza, Italy	36,064
Pietra, Roumania	25,000
Pietermaritzburg, Natal	34,676
Pilsen, Austria	68,079
Pingyang, Korea	74,213
Pinsk, Russia	27,938
Piotrkof, Russia	33,173
Piraeus, Greece	51,020
Pirmasens, Germany	30,200
Pisa, Italy	61,321
Pistoza, Italy	62,606
Plauen, Germany	73,891
Ployesti, Roumania	42,687
Plymouth, England	116,000
Pnum Penh, Cambodia	50,000
Point de Galle, Ceylon	48,500
Poitiers, France	39,886
Pola, Austria	45,205
Poltava, Russia	53,060
Ponce, Porto Rico	27,952
Pondichery, India	47,843
Poona, India	153,320
Pont-y-Pridd, Wales	32,319
Port au Prince, Haiti	70,000
Port Arthur, China	
Port Elizabeth, Cape of Good Hope	32,959
Port Louis, Mauritius	52,740
Porto Alegre, Brazil	100,000
Port of Spain, Trinidad	54,100
Porto Novo, Dahomey	50,000
Port Said, Egypt	50,179
Portsmouth, England	201,975
Posen, Germany	117,033
Potosi, Bolivia	20,910
Potsdam, Germany	59,796
Prague, Austria	201,589
Prato, Italy	51,453
Praya, Cape Verde Islands	20,000
Presburg, Hungary	65,867
Preston, England	115,721
Pretoria, Transvaal	36,700
Prisrend, Turkey	50,000
Prossnitz, Austria	24,343
Przemysl, Austria	46,295
Pskof, Russia	30,683
Pueblo, Mexico	93,521
Quebec, Canada	68,840
Queretaro, Mexico	33,152
Quito, Ecuador	80,000
Radom, Russia	30,128
Ragusa, Italy	31,950
Rampur, India	78,758
Rangoon, India	234,881
Rathmines, Ireland	32,472
Ratisbon, Germany	45,435
Ravenna, Italy	64,031
Rawalpindi, India	87,688
Rawtenstall England	31,052

Reading, England	77,674
Reggia, Emilia, Italy	58,490
Reggio, Calabria, Italy	44,415
Reichenberg, Austria	34,099
Remscheid, Germany	58,103
Rennes, France	74,676
Resht, Persia	40,000
Reus, Spain	26,235
Revel, Russia	66,292
Rheims, France	108,385
Rheydt, Germany	34,036
Rhondda, Wales	113,735
Riazan, Russia	44,552
Richmond, England	31,677
Riga, Russia	282,943
Rimini, Italy	43,203
Rio de Janeiro, Brazil	750,000
Rixdorf, Germany	90,422
Roanne, France	34,901
Rochdale, England	86,390
Rochefort, France	36,458
Rochester, England	30,622
Rome, Italy	462,783
Rosario, Argentina	140,000
Rostock, Germany	54,735
Rostof, Russia	119,889
Rotherham, England	54,348
Rotterdam, Netherlands	370,390
Roubaix, France	124,365
Rouen, France	116,316
Roulers, Belgium	23,245
Rowley Regis, England	34,669
Rustchuk, Bulgaria	32,661
Ryazan, Russia	25,223
Saga, Japan	35,083
Saharanpur, India	66,254
Saigon, Anam	50,870
St. Denis, France	60,808
St. Denis, Reunion Island	27,392
St. Etienne, France	146,559
St. Gallen, Switzerland	50,625
St. Gilles, Belgium	56,750
St. Helens, England	89,843
St. John, New Brunswick	40,711
St. Johns, Newfoundland	29,594
St. Louis, Senegal	24,070
St. Nazaire, France	35,813
St. Nicolas, Belgium	32,767
St. Ouen, France	35,436
St. Petersburg, Russia	1,313,300
St. Quentin, France	50,278
Sakai, Japan	54,040
Salem, India	70,621
Salerno, Italy	42,727
Salford, England	231,514
Salonika, Turkey	105,000
Saltillo, Mexico	23,996
Salzburg, Austria	33,067
Samarang, Java	89,286
Samara, Russia	91,672
Samarkand, Russia in Asia	58,194
San Jose, Costa Rica	24,500
San Juan, Porto Rico	32,048
San Louis Potosi, Mexico	61,019
San Miguel, Salvador	24,768
San Salvador, Salvador	59,540
San Sebastian, Spain	37,812
Santa Ana, Salvador	48,120
Santa Cruz, Canary Island	38,419
Santa Fe, Argentina	25,000
Santander, Spain	54,694
Santiago, Chile	334,528
Santiago de Cuba, Cuba	45,478
Santiago, Spain	24,927
Santo Domingo, S. Domingo	20,000
Santos, Brazil	35,000
Sao Paulo, Brazil	150,934

Sapporo, Japan	55,304
Saragossa, Spain	99,118
Saratof, Russia	143,431
Sasebo, Japan	68,344
Sassari, Italy	38,268
Savona, Italy	38,355
Scarborough, England	38,160
Schaerbeck, Belgium	66,617
Schiedam, Netherlands	28,290
Schoneberg, Germany	95,998
Schweidnitz, Germany	28,448
Schwerin, Germany	38,672
Semipalatinsk, Russia	26,350
Sendai, Japan	100,231
Seoul, Korea	196,646
Seraing, Belgium	39,377
Serajevo, Austria-Hungary	41,174
Seres, Turkey	31,000
Sergievsk, Russia	31,413
Seville, Spain	148,315
Shahjahanpur, India	76,458
Shanghai, China	651,000
Shasi, China	80,000
Sheffield, England	440,415
Shimonoseki, Japan	46,280
Shiraz, Persia	50,004
Shizwoka, Japan	46,744
Sholapur, India	75,288
Shusha, Russia	25,656
Sialkot, India	57,956
Siangtan, China	850,000
Siena, Italy	28,355
Simbirsk, Russia	44,111
Simferopol, Russia	60,676
Singan, China	875,000
Singapore, Straits Settlements	193,089
Siwas, Turkey in Asia	43,100
Skutari, Turkey in Asia	80,000
Slivno, Eastern Roumelia	24,542
Smethwick, England	54,560
Smichow, Austria	47,135
Smolensk, Russia	57,405
Smyrna, Turkey in Asia	201,000
Sofia, Bulgaria	67,920
Solingen, Germany	45,260
Southampton, England	114,897
Southport, England	48,087
South Shields, England	109,360
Spandau, Germany	65,014
Spezia, Italy	65,612
Srinagar, India	122,608
Stanislaw, Austria	29,956
Stargard, Germany	26,875
Stavanger, Norway	30,613
Stavropol, Russia in Asia	46,965
Stettin, Germany	210,702
Stockholm, Sweden	317,964
Stockport, England	98,320
Stockton-on-Tees, England	51,476
Stoke-upon-Trent, England	30,476
Stolp, Germany	27,304
Stralsund, Germany	31,178
Strasburg, Germany	151,041
Stratford, England	43,000
Stretford, England	30,346
Stryj, Austria	23,300
Stuttgart, Germany	176,699
Suchau, China	500,001
Sucre, Bolivia	20,900
Suez, Egypt	24,970
Suit, Egypt	42,078
Sumy, Russia	28,511
Sunderland, England	152,964
Surabaya, Java	146,940
Surakarta, Java	125,006
Surat, India	119,300
Swansea, Wales	96,384
Swatow, China	48,000

PRINCIPAL CITIES OF THE WORLD—Continued

Swindon, England	45,906
Sydney, Australia	508,501
Syracuse, Italy	32,687
Syzran, Russia	33,046
Szegedin, Hungary	102,991
Szekesfejervar, Hungary	32,167
Szentes, Hungary	31,308
Tabriz, Persia	200,000
Taganrog, Russia	58,298
Taiwan, Formosa	48,097
Takamatsu, Japan	37,430
Takasaki, Japan	35,226
Talca, Chile	43,331
Tambof, Russia	49,203
Tammerfors, Finland	36,344
Tamsui, Formosa	100,000
Tananarivo, Madagascar	55,579
Tangier, Morocco	30,056
Tanjore, India	57,870
Tanta, Egypt	57,289
Taranto, Italy	60,733
Tarbes, France	20,845
Tarnopol, Austria	30,415
Tarragona, Spain	26,285
Tashkend, Turkestan	156,414
Tegucigalpa, Honduras	34,692
Teheran, Persia	280,000
Temesvar, Hungary	53,033
Teplitz, Austria	24,560
Terama, Italy	24,563
Theodosia, Russia	27,236
Thorn, Germany	29,470
Tientsin, China	750,000
Tiflis, Russia	160,645
Tilburg, Netherlands	45,625
Tilsit, Germany	34,539
Tipton, England	30,543
Tiraspol, Russia	29,323
Tiumen, Russia in Asia	35,000
Tlemcen, Algeria	35,468
Tobolsk, Russia in Asia	21,401
Tojama, Japan	56,275
Tokat, Turkey in Asia	60,000
Tokyo, Japan	1,818,655
Tokushima, Japan	63,710
Toledo, Spain	23,393
Toluca, Mexico	29,904
Tomsk, Russia in Asia	65,530
Toronto, Canada	208,040
Torquay, England	33,625
Tortosa, Spain	25,368
Totonicapam, Guatemala	28,310
Tottenham, England	102,519
Toulon, France	101,602
Toulouse, France	149,841
Tour, France	64,695
Tourcoing, France	79,243
Tournay, Belgium	39,940
Trapani, Italy	59,452
Trebizond, Turkey in Asia	35,000
Treves, Germany	43,506
Treviso, Italy	33,987
Trichinopoli, India	104,721
Trient, Austria	24,868
Trieste, Austria	178,599
Trikhala, Greece	21,149
Tripoli, Tripoli	35,000
Trivandrum, India	57,882
Trondhjem, Norway	38,180
Troyes, France	53,146
Tsaritsyn, Russia	67,650
Tsu, Japan	36,108
Tucuman, Argentina	50,000
Tula, Russia	109,352
Tunbridge Wells, England	33,388
Tunis, Tunis	176,500
Turin, Italy	335,656
Tver, Russia	45,644
Tynemouth, England	51,514
Udine, Italy	37,942
Ufa, Russia	49,961
Ujpest, Hungary	41,858
Ulm, Germany	42,982
Uman, Russia	28,628
Upsala, Sweden	24,150
Uralsk, Russia	38,919
Uskup, Turkey	20,000
Utrecht, Netherlands	112,796
Utsunomiya, Japan	35,953
Valence, France	26,964
Valencia, Spain	213,530
Valencia, Venezuela	38,654
Valenciennes, France	30,946
Valetta, Malta	61,268
Valladolid, Spain	68,789
Valparaiso, Chile	143,769
Vancouver, Br. Columbia	26,133
Varna, Bulgaria	33,443
Venice, Italy	151,840
Versailles, France	54,982
Verviers, Belgium	49,243
Viborg, Russia	32,312
Victoria, Br. Columbia	20,816
Vicuna (Verona), Italy	74,271
Vienna, Austria	1,674,957
Villanova, India	41,913
Villa Rica, Paraguay	25,000
Vilna, Russia	162,633
Vincennes, France	31,405
Vinnitsa, Russia	34,060
Vitebsk, Russia	66,143
Vitoria, Spain	30,701
Vladikavkas, Russia	49,924
Vladimir, Russia	32,029
Vladivostok, Russia in Asia	38,000
Volgoda, Russia	27,822
Volsk, Russia	27,572
Voronezh, Russia	84,146
Wakayama, Japan	68,527
Wakefield, England	41,554
Wallasey, England	53,586
Walsall, England	92,998
Walthamstow, England	95,125
Warrington, England	68,301
Warsaw, Russia	756,426
Waterford, Ireland	27,947
Weimar, Germany	28,498
Weissenfels, Germany	28,296
Wellington, New Zealand	52,590
Wenchau, China	80,000
West Bromwich, England	67,823
West Ham, England	294,907
West Hartlepool, England	62,61[illegible]
Wiesbaden, Germany	86,111
Wigan, England	86,581
Willesden, England	114,815
Wimbledon, England	41,604
Winnipeg, Manitoba	90,204
Winterthur, Switzerland	25,066
Withington, England	36,201
Witten, Germany	33,535
Wolverhampton, England	99,456
Wood Green, England	34,183
Worcester, England	46,623
Worms, Germany	40,705
Wuchang, China	800,000
Wuchau, China	53,000
Wuhu, China	122,000
Würzburg, Germany	75,499
Yamagata, Japan	40,248
Yarkand, China	100,000
Yarmouth, England	52,353
Yaroslaf, Russia	70,610
Yeisk, Russia in Asia	35,446
Yekaterinburg, Russia	55,488
Yekaterinoslaf, Russia	135,552
Yelets, Russia	38,239
Yelizavethgrad, Russia	66,182
Yezd, Persia	45,000
Yochau, China	20,000
Yokohama, Japan	326,035
York, England	82,362
Yurief, Russia	42,812
Zaandam, Netherlands	23,517
Zagazig, Egypt	35,715
Zanzibar, Zanzibar	50,000
Zhitomer, Russia	80,787
Zittau, Germany	30,975
Zurich, Switzerland	175,033
Zwickau, Germany	62,567
Zwolle, Netherlands	32,280

PRINCIPAL CITIES OF THE UNITED STATES

Latest Official Estimates of Population

This alphabetical list of cities of the United States having 10,000 inhabitants or more gives population of cities in States of Florida, Iowa, Kansas, Massachusetts, Minnesota, New Jersey, New York, North Dakota, Rhode Island, South Dakota and Wisconsin in accordance with the State enumerations of 1905, cities of Michigan in accordance with the State enumeration of 1904 and the other cities are estimated as of 1909, under the method adopted by the United States Census Bureau and known as the "arithmetical method." This method rests on the assumption that the annual increase of each year since the last census would be one-tenth of the decennial increase between the last two censuses. The country as a whole and most of the states and cities are growing with a steadily decreasing per cent. of increase. As this condition has obtained in the United States for the last twenty years it is likely to hold good in the immediate future. Under such conditions the "arithmetical method" has been proved more accurate than any alternative method available. Population of places marked thus * are estimated from reliable local sources.

City and State.	Pop.	City and State.	Pop.	City and State.	Pop.	City and State.	Pop.
Adams, Mass	12,486	Berkeley, Calif.*	35,000	Coffeyville, Kan.	13,182	El Paso, Texas	20,930
Adrian, Mich	10,680	Beverly, Mass.	15,223	Cohoes, N. Y.	24,183	Elwood, Ind.	22,553
Akron, Ohio	56.342	Biddeford, Me.	17,677	Colorado Spgs, Col.	30,085	Erie, Pa.	63,622
Alameda, Calif.*	30,000	Binghamton, N. Y.	42,036	Columbia, Pa.	13,761	Escanaba, Mich.	11,098
Albany, N. Y.	98,374	Birmingham, Ala.	49,428	Columbia, S. C.	26,288	Evanston, Ill.	23,557
Alexandria, Va.	14,800	Bloomfield, N. J.	11,668	Columbus, Ga.	17,831	Evansville, Ind.	66,432
Allegheny, Pa.	152,044	Bloomington, Ill.	25,806	Columbus, Ohio.	159,229	Everett, Mass.	29,111
Allentown, Pa.	44,585	Boston, Mass.*	624,921	Concord, N. H.	21,997	Fall River, Mass.	105,762
Alpena, Mich.	12,400	Braddock, Pa.	22,938	Corning, N. Y.	13,515	Fargo, N. D.	12,512
Alton, Ill.	17,810	Bradford, Pa.	19,093	Cortland, N. Y.	11,272	Findlay, Ohio.	17,500
Altoona, Pa.	46,755	Bridgeport, Conn.	90,913	Council Bluffs, Ia.	25,231	Fitchburg, Mass.	33,021
Amsterdam, N. Y.	23,943	Bridgeton, N. J.	13,624	Covington, Ky.	47,948	Flint, Mich.	14,884
Anderson, Ind.	28,671	Brockton, Mass.	47,794	Cranston, R. I.	17,570	Fond du Lac, Wis.	17,284
Ann Arbor, Mich.	14,599	Brookline, Mass.	23,436	Cripple Creek, Col.	15,000	Fort Dodge, Ia.	14,369
Ansonia, Conn.	14,312	Buffalo, N. Y.	439,457	Cumberland, Md.	21,988	Fort Scott, Kan.	12,202
Appleton, Wis.	17,000	Bullfrog, Nev.*	12,000	Dallas, Texas.*	100,000	Fort Smith, Ark.	13,876
Asheville, N. C.	18,707	Burlington, Ia.	25,318	Danbury, Conn.	16,522	Fort Wayne, Ind.	53,865
Ashland, Wis.	14,519	Burlington, Vt.	22,285	Danville, Ill.	19,602	Fort Worth, Texas*.	68,100
Ashtabula, Ohio.	17,099	Butler, Pa.	12,760	Danville, Va.	22,114	Framingham, Mass.	11,548
Atchison, Kan.	18,257	Butte, Mont.*	60,000	Davenport, Ia.	39,797	Freeport, Ill.	16,030
Athens, Ga.	11,685	Cairo, Ill.	14,546	Dayton, Ohio.	107,035	Fresno, Calif.*	35,000
Atlanta, Ga.	112,787	Cambridge, Mass.	97,434	Decatur, Ill.	24,264	Galesburg, Ill.	20,945
Atlantic City, N. J.	37,593	Camden, N. J.	83,363	Denison, Texas.	12,700	Galveston, Texas*.	38,000
Attleboro, Mass.	12,702	Canton, Ohio.	34,697	Denver, Col.*	180,000	Gardner, Mass.	12,012
Auburn, Me.	14,482	Carbondale, Pa.	15,969	Des Moines, Ia.	75,629	Gary, Ind.*	20,000
Auburn, N. Y.	31,422	Cedar Rapids, Ia.	28,759	Detroit, Mich.	317,591	Geneva, N. Y.	12,249
Augusta, Ga.	45,174	Central Falls, R. I.	19,446	Dover, N. H.	13,494	Glens Falls, N. Y.	14,650
Augusta, Me.	12,723	Charleston, S. C.	56,573	Dubuque, Ia.	41,941	Gloucester, Mass.	26,011
Aurora, Ill.	28,197	Charleston, W. Va.	15,220	Duluth, Minn.	64,942	Gloversville, N. Y.	18,672
Austin, Texas.	29,173	Charlotte, N. C.*	30,000	Dunkirk, N. Y.	15,250	Goldfield, Nev.*	15,000
Baltimore, Md.	591,755	Chattanooga, Tenn.*	50,000	Dunmore, Pa.	16,424	Grand Forks, N. D.	10,127
Bangor, Me.	24,322	Chelsea, Mass.	37,289	E. Liverpool, Ohio.	21,462	Grand Rapids, Mich.	95,718
Batavia, N. Y.	10,089	Chester, Pa.	46,394	E. Orange, N. J.	25,175	Great Falls, Mont.*	35,000
Bath, Me.	12,056	Cheyenne, Wyo.*	22,000	E. Providence, R. I.	13,750	Green Bay, Wis.	22,854
Baton Rouge, La.*	25,000	Chicago, Ill.	2,364,075	Easton, Pa.	34,909	Greensboro, N. C.*	20,000
Battle Creek, Mich.	22,213	Chicopee, Mass.	20,191	E. St. Louis, Ill.	42,682	Greenville, S. C.	14,788
Bay City, Mich.	27,644	Chillicothe, Ohio.	14,506	Eau Claire, Wis.	18,737	Guthrie, Okla.*	18,000
Bayonne, N. J.	42,262	Cincinnati, Ohio*	400 000	Elgin, Ill.	26,222	Hackensack, N. J.	11,098
Beaver Falls, Pa.	10,500	Cleveland, Ohio.	515,563	Elizabeth, N. J.	60,509	Hagerstown, Md.	16,717
Belleville, Ill.	19,395	Clinton, Ia.	22,756	Elkhart, Ind.	18,178	Hamilton, Ohio.	29,628
Beloit, Wis.	12,855	Clinton, Mass.	13,105	Elmira, N. Y.	34,687	Hammond, Ind.	18,629

PRINCIPAL CITIES OF THE UNITED STATES

City and State.	Pop.	City and State.	Pop.	City and State.	Pop.	City and State.	Pop.
Hannibal, Mo.	13,000	Malden, Mass.	38,037	Orange, N. J.	26,101	Shamokin, Pa.	21,621
Harrisburg, Pa.	59,870	Manchester, Conn.	12,260	Oshkosh, Wis.	30,575	Sheboygan, Wis.	24,026
Harrison, N. J.	12,823	Manchester, N. H.	68,561	Oskaloosa, Ia.	10,203	Shenandoah, Pa.	24,299
Hartford, Conn.	103,808	Manistee, Mich.	12,708	Oswego, N. Y.	22,572	Sherman, Texas.	12,500
Haverhill, Mass.	37,830	Manitowoc, Wis.	12,733	Ottawa, Ill.	11,008	Shreveport, La.*	30,000
Hazelton Pa.	16,352	Mankato, Minn.	10,996	Ottumwa, Ia.	20,101	Sioux City, Ia.	40,952
Helena, Mont.*	15,000	Mansfield, Ohio	21,380	Owensboro, Ky.	16,197	Sioux Falls, S. D.	12,283
Henderson, Ky.	11,565	Marietta, Ohio	17,916	Paducah, Ky.	26,524	Somerville, Mass.	69,272
Hoboken, N. J.	65,468	Marinette, Wis.	15,354	Parkersburg, W. Va.	14,006	South Bend, Ind.	48,761
Holyoke, Mass.	49,934	Marion, Ind	25,045	Parsons, Kan.	12,034	S. Bethlehem, Pa.	15,886
Homestead, Pa.	16,723	Marion, Ohio	14,333	Passaic, N. J.	37,837	Southbridge, Mass.	11,000
Hornell N. Y.	13,259	Marlboro, Mass.	14,073	Paterson, N. J.	111,529	South Omaha, Neb.	38,552
Houston, Texas,*	80,000	Marquette, Mich.	10,665	Pawtucket, R. I.	49,669	Spartanburg, S. C.*	16,671
Hudson, N. Y.	10,290	Marshalltown, Ia.	12,045	Peabody, Mass.	13,098	Spokane, Wash.*	125,000
Huntington, W. Va.	15,220	Massillon, Ohio	13,611	Peekskill, N. Y.	13,200	Springfield, Ill.	46,435
Hutchinson, Kan.	11,214	Meadville, Pa.	10,830	Pensacola, Fla.	15,940	Springfield, Mass.	73,540
Hyde Park, Mass.	14,510	Medford, Mass.	19,686	Peoria, Ill.	69,668	Springfield, Mo.	24,541
Independence, Kan.	11,190	Melrose, Mass.	14,295	Perth Amboy, N. J.	25,895	Springfield, Ohio	43,975
Indianapolis, Ind.	226,519	Memphis, Tenn.	136,420	Petersburg, Va.	21,810	Stamford, Conn.	17,859
Ironton, Ohio.	12,800	Menominee, Mich.	11,096	Philadelphia, Pa.	1,567,845	Steelton, Pa.	14,638
Ironwood, Mich.	10,019	Meriden, Conn.	26,636	Phillipsburg, N. J.	13,352	Steubenville, Ohio.	15,014
Ishpeming, Mich.	11,623	Meridian, Miss.	17,133	Pine Bluff, Ark.	12,886	Stillwater, Minn.	12,435
Ithaca, N. Y.	14,615	Michigan City, Ind.	18,517	Piqua, Ohio	14,946	Stockton, Calif.*	25,000
Jackson, Mich.	25,300	Middletown, N. Y.	14,516	Pittsburg, Kan.	15,111	Streator, Ill.	16,478
Jackson, Tenn.	18,536	Milford, Mass.	12,105	Pittsburg, Pa.*	500,000	Superior, Wis.	36,551
Jacksonville, Fla.	35,301	Millville, N. J.	11,884	Pittsfield, Mass.	25,001	Syracuse, N. Y.	117,503
Jacksonville, Ill.	16,916	Milwaukee, Wis.	312,948	Pittston, Pa.	14,585	Tacoma, Wash.*	100,000
Jamestown, N. Y.	26,160	Minneapolis, Minn.	261,974	Plainfield, N. J.	18,468	Tampa, Fla.	22,823
Janesville, Wis.	13,770	Missoula, Mont.*	20,000	Plattsburg, N. Y.	10,184	Taunton, Mass.	30,967
Jeffersonville, Ind.	11,000	Mobile, Ala.	45,123	Plymouth, Mass.	11,119	Terre Haute, Ind.	42,483
Jersey City, N. J.	232,699	Moline, Ill.	21,971	Plymouth, Pa.	17,524	Tiffin, Ohio.	11,115
Johnstown, N. Y.	9,845	Montclair, N. J.	16,370	Pontiac, Mich	10,884	Toledo, Ohio	177,171
Johnstown, Pa.	48,654	Montgomery, Ala.	37,963	Port Huron, Mich.	20,028	Tonopah, Nev.*	15,000
Joliet, Ill.*	50,000	Morristown, N. J.	12,146	Portland, Me.	62,493	Topeka, Kan.	37,817
Joplin, Mo.*	20,000	Mt. Carmel, Pa.	16,623	Portland, Ore.*	175,000	Traverse City, Mich.	11,237
Kalamazoo, Mich.	29,782	Mt. Vernon, N. Y.	25,006	Portsmouth, N. H.	11,204	Trenton, N. J.	84,180
Kankakee, Ill.	17,708	Muncie, Ind.	29,579	Portsmouth, Ohio.	22,627	Troy, N. Y.	76,910
Kansas City, Kan.	67,613	Muscatine, Ia.	15,087	Portsmouth, Va.	21,207	Union, N. J.	17,005
Kansas City, Mo.*	250,000	Muskegon, Mich.	20,897	Pottstown, Pa.	14,100	Utica, N. Y.	62,934
Kearny, N. J.	13,601	Nanticoke, Pa.	13,981	Pottsville, Pa.	17,150	Vicksburg, Miss.	16,149
Kenosha, Wis.	16,235	Nashau, N. H.	28,028	Poughkeepsie, N. Y.	25,379	Vincennes, Ind.	11,509
Keokuk, Ia.	14,604	Nashville, Tenn.*	95,000	Providence, R. I.	214,703	Waco, Texas*	26,303
Key West, Fla.	20,498	Natchez, Miss.	14,108	Pueblo, Col.	31,395	Wakefield, Mass.	10,268
Kingston, N. Y.	25,556	Naugatuck, Conn.	13,565	Quincy, Ill.	40,534	Walla Walla, Wash.	15,450
Knoxville, Tenn.*	52,000	New Albany, Ind.	21,000	Quincy, Mass.	28,076	Waltham, Mass.	26,282
Kokomo, Ind.	12,822	New Bedford, Mass.	74,362	Racine, Wis.	32,290	Warwick, R. I.	24,773
La Crosse, Wis.	29,078	New Britain, Conn.	34,529	Raleigh, N. C.	14,315	Washington, D. C.	321,212
Lafayette, Ind.	19,802	New Brunswick, N.J.	23,133	Reading, Pa.	97,231	Waterbury, Conn.	62,351
Lancaster, Pa.	49,962	New Haven, Conn.	131,083	Rensselaer, N. Y.	10,715	Waterloo, Ia.	18,071
Lansing, Mich.	20,276	New London, Conn	20,201	Revere, Mass.	12,650	Watertown, Mass.	11,258
Laredo, Texas.	15,328	New Orleans, La.*	350,000	Richmond, Ind.	19,682	Watertown, N. Y.	25,447
La Salle, Ill.	10,859	New Rochelle, N. Y.	20,480	Richmond, Va.	88,345	Watervliet, N. Y.	14,600
Lawrence, Kan.	11,597	Newark, N. J.	283,289	Roanoke, Va.	25,226	Wausau, Wis.	14,458
Lawrence, Mass.	70,050	Newark, Ohio	21,745	Rochester, N. Y.	181,666	Webster, Mass.	10,018
Leadville, Col.	14,345	Newburg, N. Y.	26,498	Rockford, Ill.	36,273	W. Bay City, Mich.	12,997
Leavenworth, Kan.	20,924	Newburyport, Mass.	14,675	Rock Island, Ill.	24,766	Westfield, Mass.	13,611
Lebanon, Pa.	20,296	Newcastle, Pa.	43,404	Rome, N. Y.	15,562	W. Hoboken, N. J.	29,082
Leominster, Mass.	14,297	Newport, Ky.	31,346	Rutland, Vt.	12,038	Weymouth, Mass.	11,585
Lewiston, Me.	25,615	Newport News, Va.	34,100	Sacramento, Calif.*	50,000	Wheeling, W. Va.	42,798
Lexington, Ky.	30,591	Newport, R. I.	25,039	Saginaw, Mich.	46,610	White Plains, N. Y.	31,078
Lima, Ohio.	26,981	Newton, Mass.	36,827	St. Joseph, Mo.	148,569	Wichita, Kan.	11,579
Lincoln, Neb.	53,656	New York, N. Y.	4,013,781	St. Louis, Mo.	712,425	Wichita Falls, Tex.*	8,000
Little Falls, N. Y.	11,122	Niagara Falls, N. Y.	26,560	St. Paul, Minn.	197,023	Wilkes-Barre, Pa.	64,324
Little Rock, Ark.	49,497	Norfolk, Va.	56,902	Salem, Mass.	36,627	Wilkinsburg, Pa.	16,588
Lockport, N. Y.	17,553	Norristown, Pa.	24,582	Salt Lake, Utah*	90,000	Williamsport, Pa.	30,220
Logansport, Ind.	18,765	North Adams, Mass.	22,150	San Antonio, Texas*	93,000	Wilmington, Del.	90,077
Long Branch, N. J.	12,183	Northampton, Mass.	19,957	San Diego, Calif.*	45,000	Wilmington, N. C.	22,000
Lorain, Ohio.	26,076	N. Tonawanda, N.Y.	10,157	Sandusky, Ohio.	20,738	Winona, Minn.	20,334
Los Angeles, Calif.*	325,000	North Yakima, Wash.*	12,000	San Francisco, Cal.*	425,000	Winston-Salem, N.C.*	18,000
Louisville, Ky.	243,973	Norwich, Conn.	18,014	San José, Calif.*	30,000	Woburn, Mass.	14,402
Lowell, Mass.	94,889	Oakland, Calif.*	190,000	Saratoga Spgs., N.Y.	12,999	Woonsocket, R. I.	34,841
Lynchburg, Va.	18,891	Ogdensburg, N. Y.	13,179	Sault Ste. Marie, Mich.	11,442	Worcester, Mass.	148,710
Lynn, Mass.	77,042	Ogden, Utah	17,681	Savannah, Ga.	64,194	Yonkers, N. Y.	61,716
McKeesport, Pa.	46,354	Oil City, Pa.	15,363	Schenectady, N. Y.	58,387	York, Pa.	45,332
Macon, Ga.*	50,000	Oklahoma, Okla.*	30,000	Scranton, Pa.	126,156	Youngstown, Ohio.	55,385
Madison, Wis.	24,301	Olean, N. Y.	10,163	Seattle, Wash.*	250,000	Zanesville, Ohio.	25,302
Mahanoy City, Pa.	15,051	Omaha, Neb.	136,662	Sedalia, Mo.	16,043		

CONCENTRATES

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Useful Information

Useful Numbers in Calculating Weights, Measures, Etc.

Feet multiplied by .00019 equals miles.
Yards multiplied by .0006 equals miles.
Links multiplied by .22 equals yards.
Links multiplied by .66 equals feet.
Feet multiplied by 1.515 equals links.
Square inches multiplied by .00695 equals square feet.
Circular inches multiplied by .00546 equals square feet.
Square feet multiplied by .111 equals square yards.
Acres multiplied by .4840 equals square yards.
Square yards multiplied by .0002066 equals acres.
Width in chains multiplied by .8 equals acres per mile.
Cubic feet multiplied by .03704 equals cubic yards.
Cubic inches multiplied by .00058 equals cubic feet.
U. S. bushels multiplied by .0461 equals cubic yards.
U. S. bushels multiplied by 1.2444 equals cubic feet.
U. S. bushels multiplied by 2150.42 equals cubic inches.
Cubic feet multiplied by .8036 equals U. S. bushels.
Cubic inches multiplied by .000465 equals U. S. bushels.
U. S. gallons multiplied by .13367 equals cubic feet.
U. S. gallons multiplied by .231 equals cubic inches.
Cubic feet multiplied by 7.48 equals U. S. gallons.
Cylindrical feet multiplied by .0034 equals U. S. gallons.
Pounds multiplied by .009 equals cwt.
Pounds multiplied by .00045 equals long tons.
Cubic foot of water multiplied by 62.5 equals lbs. avoird.
Cubic inch of water multiplied by .03608 equals lbs. avoird.
Cylindrical inch of water multiplied by .02842 equals lbs. avoird.
Cylindrical foot of water multiplied by 49.1 equals lbs. avoird.
Cubic inches multiplied by .004329 equals U. S. gallons.
Cylindrical feet multiplied by 5.874 equals U. S. gallons.
U. S. gallons of water multiplied by 13.44 equals one cwt.
U. S. gallons of water multiplied by 268.8 equals one ton.
Cubic feet of water multiplied by 1.8 equals one cwt.
Cubic feet of water multiplied by 35.88 equals one ton.
Cylindrical foot of water multiplied by 5.875 equals U. S. gallons.
Diameter of a circle multiplied by 3.14159265 equals circumference.
Diameter of a circle multiplied by .8862 equals side of an equal square.
Diameter of a circle multiplied by .7071 equals side of an inscribed square.
Square of a diameter multiplied by .7854 equals area of circle.
Circumference of a circle multiplied by .31831 equals diameter.
Side of a square multiplied by 1.128 equals diameter of equal circle.
Square foot of an area multiplied by 1.12837 equals diameter of equal circle.
Square of the diameter of a sphere multiplied by 3.1416 equals convex surface.
Cube of the diameter of a sphere multiplied by .5236 equals solidity.
Diameter of a sphere multiplied by .806 equals dimensions of equal cube.
Diameter of a sphere multiplied by .6667 equals length of equal cylinder.
Cylindrical inches multiplied by .0004546 equals cubic feet.
Cylindrical feet multiplied by .02909 equals cubic yards.
Cubic inches multiplied by .003607 equals imperial gallons.
Cubic feet multiplied by .6232 equals imperial gallons.
Cylindrical inches multiplied by .002832 equals imperial gallons.
Cylindrical feet multiplied by 4.895 equals imperial gallons.
Lineal feet multiplied by .00019 equals statute miles.
Lineal yards multiplied by .000568 equals statute miles.
Column of water 12 inches high, 1 inch in diameter, equals .341 lbs.
183.346 circular inches equals 1 square foot.
2200 cylindrical inches equals 1 cubic foot.
French metres multiplied by 3.28 equals feet.
Kilogrammes multiplied by 2.205 equals avoird. lbs.
Grammes multiplied by .002205 equals avoird. lbs.
Square of diameter of cylinder in feet multiplied by depth in feet and by .14 equals barrels of 42 gallons.

Table of Weights and Measures

LONG MEASURE.

12 inches	1 foot
3 feet	1 yard
2 yards	1 fathom
16½ feet	1 rod
4 rods	1 chain
10 chains	1 furlong
8 furlongs	1 mile
3 miles	1 league

SQUARE MEASURE.

9 square feet	1 square yard
30¼ square yards	1 square rod
40 square rods	1 rood
8 roods	1 acre
640 acres	1 square mile

An acre is 209 square feet.

DRY MEASURE.

2 pints	1 quart
4 quarts	1 peck
4 pecks	1 bushel

LIQUID MEASURE.

4 gills	1 pint
2 pints	1 quart
4 quarts	1 gallon

TROY WEIGHT.

24 grains	1 pennyweight
20 pennyweights	1 ounce
12 ounces	1 pound

AVOIRDUPOIS WEIGHT.

16 drams	1 ounce
16 ounces	1 pound
25 pounds	1 quarter
4 quarters	1 hundred
20 hundreds	1 ton

APOTHECARIES WEIGHT.

20 grains	1 scruple
3 scruples	1 dram
8 drams	1 ounce
12 ounces	1 pound

TIME MEASURE.

60 seconds	1 minute
60 minutes	1 hour
24 hours	1 day
7 days	1 week
52 weeks 12 calendar months 365 days	1 year

CUBIC MEASURE.

1728 cubic inches	1 cubic foot
27 cubic feet	1 cubic yard
16 cubic feet	1 cord foot
8 cord feet 128 cubic feet	1 cord

LAND MEASURE.

7.92 inches	1 link
25 links	1 rod
4 rods	1 chain
80 chains	1 mile

CIRCULAR MEASURE.

60 seconds	1 minute
60 minutes	1 degree
30 degrees	1 sign
60 degrees	1 sextant
90 degrees	1 quadrant
360 degrees	1 circle

TABLE OF QUANTITIES.

12 units	1 dozen
12 dozen	1 gross
20 units	1 score
24 sheets	1 quire
20 quires	1 ream

GENERAL MEASURE.

A mile	5280 feet
A knot	6080.26 feet
A cubit	2 feet
A pace	3 feet
A palm	3 inches
A hand	4 inches
A span	9 inches

Metric System

MEASURES OF WEIGHT.
(Unit Gramme.)

	Grains.	Oz. Troy	Lbs. Avoir.	Cwt.
Centigramme	0.15432	.....	.....	.....
Decigramme	1.54323	0.003	.....	.....
Gramme	15.43235	0.032	0.002	.....
Decagramme	154.32349	0.321	0.022	.....
Hectogramme	1543.23488	3.215	0.220	0.001
Kilogramme	15432.34880	32.150	2.204	0.019

MEASURES OF LENGTH.
(Unit Metre.)

	Inches.	Feet	Yards	Miles
Millimetre	0.03937	0.003	0.001	.....
Centimetre	0.39371	0.032	0.010	.....
Decimetre	3.93708	0.328	0.109	.....
Metre	39.37079	3.280	1.093	.....
Decametre	393.70790	32.808	10.936	0.006
Hectometre	3937.07900	328.089	109.363	0.062
Kilometre	39370.79000	3280.899	1093.633	0.621

CONVENIENT MULTIPLES FOR CONVERSION.

To Convert		
Grains to Grammes	Multiply by	.065
Ounces to Grammes	" "	28.35
Pounds to Grammes	" "	453.6
Pounds to Kilogrammes	" "	.45
Cwts. to Kilogrammes	" "	50.8
Tons to Kilogrammes	" "	1016.
Grammes to Grains	" "	15.4
Grammes to Ounces	" "	0.35
Kilogrammes to Ounces	" "	35.3
Kilogrammes to Pounds	" "	2.2
Kilogrammes to Cwts	" "	.02
Kilogrammes to Tons	" "	.001
Inches to Millimetres	" "	25.4
Inches to Centimetres	" "	2.54
Feet to Metres	" "	.3048
Yards to Metres	" "	.9144
Yards to Kilometres	" "	.0009
Miles to Kilometres	" "	1.6
Millimetres to Inches	" "	.04
Centimetres to Inches	" "	.4
Metres to Feet	" "	3.3
Metres to Yards	" "	1.1
Kilometres to Yards	" "	1093.6
Kilometres to Miles	" "	.62

1 Yard=0.9144 metre. 1 Sq. Metre=1.196 sq. yd.
1 Litre=1.760 Pints or 0.22 Gals.

Weights of Flat Iron

Per lineal foot in pounds.

Thickness in inches.

Width in Inch.	1/4	5/16	3/8	1/2	5/8	3/4	7/8	1	1 1/4	1 1/2
1/2	.422	.52	.634	.....	.....	.....	.....	.....	.....	.....
3/4	.633	.79	.950	1.26	1.58	.....	.....	.....	.....	.....
1	.830	1.05	1.25	1.67	2.08	2.50	2.92	3.33	4.17	5.00
1 1/8	.930	1.18	1.40	1.87	2.34	2.81	3.38	3.75	4.75	5.70
1 1/4	1.04	1.32	1.56	2.08	2.60	3.12	3.64	4.17	5.21	6.25
1 3/8	1.14	1.45	1.71	2.29	2.86	3.40	4.01	4.58	5.77	6.97
1 1/2	1.25	1.58	1.88	2.50	3.13	3.75	4.38	5.00	6.25	7.50
1 3/4	1.46	1.84	2.19	2.92	3.65	4.37	5.10	5.83	7.29	8.75
2	1.67	2.11	2.50	3.33	4.17	5.00	5.83	6.67	8.33	10.00
2 1/4	1.88	2.37	2.81	3.75	4.69	5.63	6.56	7.50	9.37	11.25
2 1/2	2.08	2.63	3.12	4.17	5.21	6.25	7.29	8.33	10.42	12.50
2 3/4	2.29	2.89	3.44	4.59	5.73	6.87	8.02	9.17	11.46	13.75
3	2.50	3.16	3.75	5.00	6.25	7.50	8.75	10.00	12.50	15.00
3 1/4	2.70	3.42	4.06	5.41	6.77	8.12	9.47	10.83	13.65	16.47
3 1/2	2.92	3.68	4.38	5.83	7.29	8.75	10.21	11.67	14.58	17.50
3 3/4	3.11	3.95	4.58	6.25	7.80	9.37	10.93	12.50	15.75	19.00
4	3.33	4.21	5.00	6.67	8.33	10.00	11.67	13.33	16.67	20.00
4 1/2	3.75	4.74	5.63	7.50	9.38	11.25	13.13	15.00	18.75	22.50
5	4.17	5.26	6.25	8.34	10.42	12.50	14.59	16.67	20.84	25.00
6	5.00	6.32	7.50	10.00	12.50	15.00	17.50	20.00	25.01	30.00
7	5.83	7.29	8.75	11.67	14.58	17.50	20.42	23.33	29.18	35.00
8	6.67	8.33	10.00	13.33	16.67	20.00	23.33	26.67	33.35	40.00
10	8.33	10.41	12.50	16.67	20.83	25.00	29.17	33.33	41.63	50.00
12	10.00	12.50	15.00	20.00	25.00	30.00	35.00	40.00	50.01	60.00

Weights of Iron and Steel

U. S. STANDARD GUAGE

Adopted by the U. S. Government July 1, 1893.

No. of Gauge.	Thickness in Inches.		Weight per Square Foot.	No. of Gauge.	Thickness in Inches.		Weight per Square Foot.
	Fraction.	Decimals.			Fraction.	Decimals.	
0000000	1/2	.5	20.00	12	7/64	.109	4.375
000000	15/32	.468	18.75	13	3/32	.093	3.75
00000	7/16	.437	17.50	14	5/64	.078	3.125
0000	13/32	.406	16.25	15	9/128	.070	2.8125
000	3/8	.375	15.	16	1/16	.062	2.5
00	11/32	.343	13.75	17	9/160	.056	2.25
0	5/16	.312	12.50	18	1/20	.05	2.
1	9/32	.281	11.25	19	7/160	.043	1.75
2	17/64	.265	10.625	20	3/80	.037	1.50
3	1/4	.25	10.	21	11/320	.034	1.375
4	15/64	.234	9.375	22	1/32	.031	1.25
5	7/32	.218	8.75	23	9/320	.028	1.125
6	13/64	.203	8.125	24	1/40	.025	1.
7	3/16	.187	7.5	25	7/320	.021	.875
8	11/64	.171	6.875	26	3/160	.018	.75
9	5/32	.156	6.25	27	11/640	.017	.6875
10	9/64	.140	5.625	28	1/64	.015	.625
11	1/8	.125	5.	30	1/80	.012	.5

The U. S. Standard Gauge is the one commonly used in the United States.

BIRMINGHAM GUAGE

No. of Gauge.	Thickness in Inches	Weight Square Foot	
		Iron.	Steel.
0000	.454	18.22	18.46
000	.425	17.05	17.28
00	.38	15.25	15.45
0	.34	13.64	13.82
1	.3	12.04	12.20
2	.284	11.40	11.55
3	.259	10.39	10.53
4	.238	9.55	9.68
5	.22	8.83	8.95
6	.203	8.15	8.25
7	.18	7.22	7.32
8	.165	6.62	6.71
9	.148	5.94	6.02
10	.134	5.38	5.45
11	.12	4.82	4.88
12	.109	4.37	4.43
13	.095	3.81	3.86
14	.083	3.33	3.37
15	.072	2.89	2.93
16	.065	2.61	2.64
17	.058	2.33	2.36
18	.049	1.97	1.99
19	.042	1.69	1.71
20	.035	1.40	1.42
21	.032	1.28	1.30
22	.028	1.12	1.14
23	.025	1.00	1.02
24	.022	.883	.895
25	.02	.803	.813
26	.018	.722	.732
27	.016	.642	.651
28	.014	.562	.569
29	.013	......	......
30	.012	......	......
31	.01	......	......

Weights of Round and Square Steel per Lineal Foot

(Based on 489.6 lbs. per cubic foot).

SIZE. Inches.	Wt. of Round 1 ft. lg.	Wt. of Square 1 ft. lg.	SIZE. Inches.	Wt. of Round 1 ft. lg.	Wt. of Square 1 ft. lg.	SIZE. Inches.	Wt. of Round 1 ft. lg.	Wt. of Square 1 ft. lg.	SIZE. Inches.	Wt. of Round 1 ft. lg.	Wt. of Square 1 ft. lg.
0 1/32	.0026	.0033	2	10.68	13.60	4	42.73	54.40	6	96.14	122.4
" 1/16	.0104	.0133	" 1/16	11.36	14.46	" 1/16	44.07	56.11	" 1/16	98.14	125.0
" 1/8	.0417	.0531	" 1/8	12.06	15.35	" 1/8	45.44	57.85	" 1/8	100.2	127.6
" 3/16	.0938	.1195	" 3/16	12.78	16.27	" 3/16	46 83	59.62	" 3/16	102.2	130.2
" 1/4	.1669	.2123	" 1/4	13.52	17.22	" 1/4	48.24	61.41	" 1/4	104.3	132.8
" 5/16	.2608	.3333	" 5/16	14.28	18.19	" 5/16	49.66	63.23	" 5/16	106.4	135.5
" 3/8	.3756	.4782	" 3/8	15.07	19.18	" 3/8	51.11	65.08	" 3/8	108.5	138.2
" 7/16	.5111	.6508	" 7/16	15.86	20.20	" 7/16	52.58	66.95	" 7/16	110.7	140.9
" 1/2	.6676	.8500	" 1/2	16.69	21.25	" 1/2	54.07	68.85	" 1/2	112.8	143.6
" 9/16	.8449	1.076	" 9/16	17.53	22.33	" 9/16	55.59	70.78	" 9/16	114.9	146.5
" 5/8	1.043	1.328	" 5/8	18.40	23.43	" 5/8	57.12	72.73	" 5/8	117.2	149.2
" 11/16	1.262	1.608	" 11/16	19.29	24.56	" 11/16	58.67	74.70	" 11/16	119.4	152.1
" 3/4	1.502	1.913	" 3/4	20.20	25.00	" 3/4	60.25	76.71	" 3/4	121.7	154.9
" 13/16	1.763	2.245	" 13/16	21.12	26.90	" 13/16	61.84	78.74	" 13/16	123.9	157.8
" 7/8	2.044	2.603	" 7/8	22.07	28.10	" 7/8	63.46	80.81	" 7/8	126.2	160.8
" 15/16	2.347	2.989	" 15/16	23.04	29.34	" 15/16	65.10	82.89	" 15/16	128.5	163.6
1	2.670	3.400	3	24.03	30.60	5	66.76	85.00	7	130.9	166.6
" 1/16	3.014	3.838	" 1/16	25.04	31.89	" 1/16	68.44	87.14	" 1/8	135.6	172.6
" 1/8	3.379	4.303	" 1/8	26.08	33.20	" 1/8	70.14	89.30	" 1/4	140.4	178.7
" 3/16	3.766	4.795	" 3/16	27.13	34.55	" 3/16	71.86	91.49	" 3/8	145.3	184.9
" 1/4	4.173	5.312	" 1/4	28.20	35.92	" 1/4	73.60	93.72	" 1/2	150.2	191.3
" 5/16	4.600	5.857	" 5/16	29.30	37.31	" 5/16	75.37	95.96	" 5/8	155.2	197.7
" 3/8	5.019	6.428	" 3/8	30.42	38.73	" 3/8	77.15	98.23	" 3/4	160.3	204.2
" 7/16	5.518	7.026	" 7/16	31.56	40.18	" 7/16	78.95	100.5	" 7/8	165.6	210.8
" 1/2	6.008	7.650	" 1/2	32.71	41.65	" 1/2	80.77	102.8	8	171.0	217.6
" 9/16	6.520	8.301	" 9/16	33.90	43.14	" 9/16	82.62	105.2	" 1/8	176.3	224.5
" 5/8	7.051	8.978	" 5/8	35.09	44.68	" 5/8	84.49	107.6	" 1/4	181.8	231.4
" 11/16	7.604	9.682	" 11/16	36.31	46.24	" 11/16	86.38	110.0	" 3/8	187.3	238.5
" 3/4	8.178	10.41	" 3/4	37.56	47.82	" 3/4	88.29	112.4	" 1/2	193.0	245.6
" 13/16	8.773	11.17	" 13/16	38.81	49.42	" 13/16	90.22	114.9	" 5/8	198.7	252.9
" 7/8	9.388	11.95	" 7/8	40.10	51.05	" 7/8	92.17	117.4	" 3/4	204.4	260.3
" 15/16	10.02	12.76	" 15/16	41.40	52.71	" 15/16	94.14	119.9	" 7/8	210.3	267.9

These figures represent the theoretical weights of steel. Iron will run about 2 per cent lighter.

GENERAL RULE.

For round iron, the weight per foot may be found by taking the diameter in quarter inches, squaring it, and dividing by 6.

EXAMPLE.

What is the weight of 2″ round iron?

2″ = 8 quarter inches. $8^2 = 64$.

$\frac{64}{6} = 10\frac{2}{3}$ lbs. per foot of 2″ round.

EXAMPLE.

What is the weight of ¾″ round iron?

¾″ = 3 quarter inches. $3^2 = 9$.

$\frac{9}{6} = 1\frac{1}{2}$ lbs. per foot of ¾″ round.

The above rule is highly convenient, and enables mental calculations of weight to be made quickly and accurately.

Circumferences and Areas of Circles.

Diam.	Circumference.	Area.	Diam.	Circumference.	Area.	Diam.	Circumference.	Area.
1/32	.098	.0007	9	28.27	63.61	47	147.65	1734.94
1/16	.196	.0030	1/4	29.05	67.20	48	150.80	1809.56
1/8	.392	.0122	1/2	29.84	70.88	49	153.94	1885.74
3/16	.589	.0276	3/4	30.63	74.66	50	157.08	1963.50
1/4	.785	.0490	10	31.41	78.53	51	160.22	2042.82
5/16	.981	.0766	1/4	32.20	82.51	52	163.36	2123.72
3/8	1.178	.1104	1/2	32.98	86.59	53	166.50	2206.18
7/16	1.374	.1503	3/4	33.77	90.76	54	169.65	2290.22
1/2	1.570	.1963	11	34.55	95.03	55	172.79	2375.83
9/16	1.767	.2485	1/4	35.34	99.40	56	175.93	2463.01
5/8	1.963	.3067	1/2	36.12	103.86	57	179.07	2551.76
11/16	2.159	.3712	3/4	36.91	108.43	58	182.21	2642.08
3/4	2.356	.4417	12	37.69	113.09	59	185.35	2733.97
13/16	2.552	.5184	1/4	38.48	117.85	60	188.50	2827.43
7/8	2.748	.6013	1/2	39.27	122.71	61	191.64	2922.47
15/16	2.945	.6902	3/4	40.05	127.67	62	194.78	3019.07
1	3.141	.7854	13	40.84	132.73	63	197.92	3117.25
1/8	3.534	.9940	1/4	41.62	137.88	64	201.06	3216.99
1/4	3.927	1.227	1/2	42.41	143.13	65	204.20	3318.31
3/8	4.319	1.484	3/4	43.19	148.48	66	207.34	3421.19
1/2	4.712	1.767	14	43.98	153.93	67	210.49	3525.65
5/8	5.105	2.073	1/4	44.76	159.48	68	213.63	3631.68
3/4	5.497	2.405	1/2	45.55	165.13	69	216.77	3739.28
7/8	5.890	2.761	3/4	46.33	170.87	70	219.91	3848.25
2	6.283	3.141	15	47.12	176.78	71	223.05	3959.19
1/8	6.675	3.546	16	50.26	201.06	72	226.19	4071.50
1/4	7.068	3.976	17	53.40	226.98	73	229.34	4185.39
3/8	7.461	4.430	18	56.54	254.47	74	232.48	4300.84
1/2	7.854	4.908	19	59.69	283.53	75	235.62	4417.86
5/8	8.246	5.411	20	62.83	314.16	76	238.76	4536.46
3/4	8.639	5.939	21	65.97	346.36	77	241.90	4656.63
7/8	9.032	6.491	22	69.11	380.13	78	245.04	4778.36
3	9.424	7.068	23	72.25	415.48	79	248.19	4901.67
1/4	10.21	8.295	24	75.39	452.39	80	251.33	5026.55
1/2	10.99	9.621	25	78.54	490.87	81	254.07	5153.00
3/4	11.78	11.044	26	81.68	530.93	82	257.61	5281.02
4	12.56	12.566	27	84.82	572.56	83	260.75	5410.61
1/4	13.35	14.186	28	87.96	615.75	84	263.89	5541.77
1/2	14.13	15.904	29	91.10	660.52	85	267.04	5674.50
3/4	14.92	17.720	30	94.24	706.86	86	270.18	5808.80
5	15.70	19.635	31	97.38	754.77	87	273.32	5944.68
1/4	16.49	21.647	32	100.53	804.25	88	276.46	6082.12
1/2	17.27	23.758	33	103.67	855.30	89	279.60	6221.14
3/4	18.06	25.967	34	106.81	907.92	90	282.74	6361.73
6	18.84	28.274	35	109.96	962.11	91	285.88	6503.88
1/4	19.63	30.679	36	113.10	1017.88	92	289.03	6647.61
1/2	20.42	33.183	37	116.24	1075.21	93	292.17	6792.91
3/4	21.20	35.784	38	119.38	1134.11	94	295.31	6939.78
7	21.99	38.484	39	122.52	1194.59	95	298.45	7088.22
1/4	22.77	41.282	40	125.66	1256.64	96	301.59	7238.23
1/2	23.56	44.178	41	128.81	1320.25	97	304.73	7389.81
3/4	24.34	47.173	42	131.95	1385.44	98	307.88	7542.96
8	25.13	50.265	43	135.09	1452.20	99	311.02	7697.69
1/4	25.91	53.456	44	138.23	1520.53	100	314.16	7853.98
1/2	26.70	56.745	45	141.37	1590.43	101	317.30	8011.85
3/4	27.48	60.132	46	144.51	1661.90	102	320.44	8171.28

Workshop Recipes

BRAZING.—The edges filed or scraped clean and bright, covered with spelter and powdered borax, and exposed in a clear fire to a heat sufficient to melt the solder.

CASE HARDENING WITH PRUSSIATE OF POTASH.—Heat the articles, after polishing, to a bright red, rub the surface over with prussiate of potash, allow it to cool to a dull red, and immerse it in water.

CASE HARDENING MIXTURES.—Three parts of prussiate of potash to one part of sal ammoniac, mixed; or two parts of sal ammoniac, two parts of bone dust, and one part of prussiate of potash.

MIXTURE FOR WELDING STEEL.—One part of sal ammoniac and ten parts of borax pounded together and fused until clear, when it is poured out, and when cool reduced to powder.

TEMPERING STEEL.—Steel in its hardest state being too brittle for most purposes, the requisite strength and elasticity are obtained by tempering—or letting down the temper, as it is termed—which is performed by heating the hardened steel to a certain degree and cooling it quickly. The requisite heat is usually ascertained by the color which the surface of the steel assumes from the film of oxide thus formed. The degrees of heat to which these several colors correspond are as follows:

At 430, a very faint yellow. At 450, a pale straw color.

Suitable for hard instruments; as hammer faces, drills, etc.

At 470, a full yellow. At 490, a brown color.

For instruments requiring hard edges without elasticity; as shears, scissors, turning tools, etc.

At 510, brown, with purple spots. At 538, purple.

For tools, for cutting wood and soft metals; such as plane-irons, knives, etc.

At 550, dark blue. At 560, full blue.

For tools requiring strong edges without extreme hardness; as cold chisels, axes, cutlery, etc.

At 600, grayish blue, verging on black.

For spring temper, which will bend before breaking; as saws, sword blades, etc.

If the steel is heated higher than this, the effect of the hardening process is destroyed.

ANNEALING STEEL.—For small pieces of steel, take a piece of gas-pipe two or three inches in diameter, and put the pieces in it, first heating one end of the pipe, and drawing it together, leaving the other end open to look into. When the pieces are of a cherry red, cover the fire with sawdust, use a charcoal fire, and leave the steel in over night.

TO RENEW WORN FILES.—Thoroughly cleanse them from grease or oil with alkali, then dip them in a solution made with one part nitric acid, three parts sulphuric acid, seven parts water by weight; time, five seconds to five minutes, according to fineness of cut. Wash in hot water, dip in lime water, dry and oil them.

Specially Useful to Engineers in the Mining Districts.

CEMENT FOR CAST IRON.—Two ounces sal ammoniac, one ounce sulphur and sixteen ounces of borings or filings of cast iron, to be mixed well in a mortar and kept dry. When required for use, take one part of this powder to twenty parts of clear iron borings or filings, mix thoroughly in a mortar; make the mixture into a stiff paste with a little water, and then it is ready for use. A little fine grindstone sand improves the cement.

RED LEAD CEMENT FOR FACE JOINTS.—Equal parts of white and red lead mixed with linseed oil to the consistency.

CEMENT—STEAM BOILER.—Litharge in fine powder two parts, very fine sand and quicklime (that has been allowed to slack spontaneously in a damp place), of each one part; mix, and keep it from the air.

Used to mend cracks in boilers and to secure steam joints.

It is made into a paste with boiled oil before application.

CEMENT—STEAM PIPE.—Good linseed-oil varnish is ground with equal weights of white lead, oxide of manganese and pipe clay.

CEMENT—HYDRAULIC.—Made by slaking lime with water containing about two per cent. of gypsum and adding a little sand to the product.

The presence of the gypsum tends to delay the slaking of the lime, and also to harden the substance formed after the slaking.

CEMENT—CUTLERS'.—Black resin four parts, beeswax one part, finely powdered brickdust one part; mix well. Used to fix tools into their handles.

CEMENT—LEATHER.—Gutta-percha one pound, caoutchouc four ounces, pitch two ounces, shellac one ounce, linseed oil two ounces, melted together; must be melted before being applied.

Used for uniting leather or rubber.

SOLDERS.—For Lead, one of tin and one and one-half of lead.

For Tin, one of tin, and two of lead.

For Pewter, two of tin and one of lead.

For Brazing (hardest), three of copper and one of zinc.

For Brazing (hard), one of copper and one of zinc.

For Brazing (soft), one of tin, four of copper and three of zinc; or two of tin and one of antimony.

FLUXES FOR SOLDERING OR WELDING.—For Iron or Steel, borax or sal ammoniac.

For Tinned Iron, resin or chloride of zinc.

For Copper and Brass, sal ammoniac or chloride of zinc.

For Zinc, chloride of zinc.

For Lead, tallow or resin.

For Lead and Tin Pipes, resin and sweet oil.

TO HARDEN CAST IRON.—Many times it is very convenient to make an article of cast iron that needs to be finished, and which should be very hard. Cast iron can be hardened as easily as steel, and to such a degree of hardness that a file will not touch it. Take one-half pint of vitriol, one peck of common salt, one-half pound of saltpeter, two pounds of alum, one-quarter pound prussic potash, one-quarter pound cyanide of potash, all to be dissolved in ten gallons of soft water. Be sure that all the articles are dissolved. Heat the iron to a cherry red and dip it in the solution. If the article needs to be very hard, heat and dip the second time, and even the third time.

Workshop Recipes

(Continued)

TO INSCRIBE METAL.—Cover the part with melted beeswax; when cold, write what you desire plainly in the wax clean to the metal with scriber, then apply a mixture of ½ oz. nitric acid, 1 oz. muriatic acid, with a feather, carefully fill each letter; let it remain from one to ten minutes, according to appearance desired, then throw on water to stop the process of cutting, heat wax to remove it, and you have your inscription.

TO KEEP MACHINERY FROM RUSTING.—Take one ounce of camphor and dissolve it in one pound of melted lard; take off the scum, amd mix in as much fine black as will give it iron color. Clean the machinery and smear it with the mixture. After twenty-four hours rub clean with a soft linen cloth. It will keep clean for months under ordinary circumstances.

TO REMOVE RUST FROM STEEL.—Steel which has been rusted can be cleaned by brushing with a paste compound of ½ oz. cyanide potassium, ½ oz. castile soap, 1 oz. whiting, and water sufficient to form a paste. The steel should be washed with a solution of ½ oz. cyanide potassium in 2 oz. water.

RUST JOINT, QUICK SETTING.—Take flour of sulphur, two pounds, powdered sal ammoniac one pound, iron filings eighty pounds; mix to a paste with water.

RUST JOINT, SLOW SETTING.—Take flour of sulphur one pound, powdered sal ammoniac two pounds, iron filings or borings, two hundred pounds. This is much the better joint, if time can be given to set.

HOW TO MIX PAINTS FOR TINTS.

Mixing Red and Black makes	Brown
Mixing Lake and White makes	Rose
Mixing White and Brown makes	Chestnut
Mixing White, Blue and Lake makes	Purple
Mixing Blue and Lead Color makes	Pearl
Mixing White and Carmine makes	Pink
Mixing Indigo and Lamp-Black makes	Silver Gray
Mixing White and Lamp-Black makes	Lead Color
Mixing Black and Venetian Red makes	Chocolate
Mixing White and Green makes	Bright Green
Mixing Purple and White makes	French White
Mixing Light Green and Black makes	Dark Green
Mixing White and Green makes	Pea Green
Mixing White and Emerald Green makes	Brilliant Green
Mixing Red and Yellow makes	Orange
Mixing White and Yellow makes	Straw Color
Mixing White, Blue and Black makes	Pearl Gray
Mixing White, Lake and Vermilion makes	Flesh Color
Mixing Umber, White and Venetian Red makes	Drab
Mixing White, Yellow and Venetian Red makes	Cream
Mixing Red, Blue, Black and Red makes	Olive
Mixing Yellow, White and a little Venetian Red makes	Buff

Approximate Cost of Erecting Mill Buildings
Exclusive of Power House

5 STAMPS

FREE MILLING		WITH CONCENTRATORS	
Lumber, 32 M. ft. at $25.00	$800.00	Lumber, 38 M. ft. at $25.00	$950.00
Labor, at $25.00 per M. ft	800.00	Labor, at $25.00 per M. ft	950.00
Labor, setting machinery	156.00	Labor, setting machinery	187.00
Shingle roof*	105.00	Shingle roof*	204.00
Hardware	45.00	Hardware	60.00
Windows, 12	53.00	Windows, 18	80.00
	$1,959.00		$2,431.00

10 STAMPS

FREE MILLING		WITH CONCENTRATORS	
Lumber, 52 M. ft. at $25.00	$1,300.00	Lumber, 60 M. ft. at $25.00	$1,500.00
Labor, ar $25.00 per M. ft	1,300.00	Labor, at $25.00 per M. ft	1,500.00
Labor, setting machinery	315.00	Labor, setting machinery	375.00
Shingle roof*	145.00	Shingle roof*	250.00
Hardware	62.00	Hardware	95.00
Windows, 16	71.00	Windows, 20	88.00
	$3,193.00		$3,808.00

20 STAMPS

FREE MILLING		WITH CONCENTRATORS	
Lumber, 63 M. ft. at $25.00	$1,575.00	Lumber, 85 M. ft at $25.00	$2,125.00
Labor, at $25.00 per M. ft	1,575.00	Labor, at $25.00 per M. ft	2,125.00
Labor, setting machinery	470.00	Labor, setting machinery	562.00
Shingle roof*	250.00	Shingle roof*	440.00
Hardware	77.00	Hardware	255.00
Windows, 20	88.00	Windows, 26	115.00
	$4,035.00		$5,622.00

30 STAMPS

FREE MILLING		WITH CONCENTRATORS	
Lumber, 90 M. ft. at $25.00	$2,250.00	Lumber, 106 M. ft. at $25.00	$2,650.00
Labor, at $25.00 per M. ft	2,250.00	Labor, at $25.00 per M. ft	2,650.00
Labor, setting machinery	550.00	Labor, setting machinery	750.00
Shingle roof*	330.00	Shingle roof*	605.00
Hardware	220.00	Hardware	320.00
Windows, 24	106.00	Windows, 30	132.00
	$5,706.00		$7,107.00

40 STAMPS

FREE MILLING		WITH CONCENTRATORS	
Lumber, 108 M. ft. at $25.00	$2,700.00	Lumber, 130 M. ft. at $25.00	$3,250.00
Labor, at $25.00 per M. ft	2,700.00	Labor, at $25.00 per M. ft	$3,250.00
Labor, setting machinery	715.00	Labor, setting machinery	875.00
Shingle roof*	430.00	Sningle roof*	770.00
Hardware	319.00	Hardware	390.00
Windows, 28	125.00	Windows, 34	150.00
	$6,989.00		$8,685.00

* Add 20 per cent. to roof item for No. 26 corrugated iron roofing.

Amount of Material Required for Buildings

SHINGLES.—250 to 1 bundle. 4 bundles = 1,000 shingles, will cover 100 sq. ft. of surface, laid 4″ to the weather.

1 bundle of 16″ shingles will cover 30 sq. ft., while the same number of 18″ shingles will cover 33 sq. ft. when laid 5½″ to the weather.

LATH.—1,000 laths will cover 70 sq. yds. of surface.

SHAKES.—1,000 shakes, 6″x36″, laid 16″ to the weather, will cover 650 sq. ft. of surface; add for doubling top and bottom courses one extra shake for each ft. in the length of roof.

CORRUGATED GALVANIZED ROOFING.—Size of sheets, 26 inches by from 6 to 10 ft. flat steel, made corrugated with corrugations about 1″ in depth and 5″ between centers of corrugations, laying 24″ wide, with from 3″ to 6″ lap, according to pitch of roof, weigh about one-third more than flat sheets of same area.

For roofing, No. 24 is more generally used, while No. 26 is used for siding. Tack with wire nails on ends only and lap one corrugation on sides and from one to two inches on ends. The nail heads are sometimes soldered to assure absolute impermeability. The usual method, however, is to place lead washers under the heads.

LUMBER.—When computing the amount of material required to cover a specified area, add to the area:

For 1″x6″ tongue and groove, 20%.
" 1″x4" " " " 25%.
" 1″x4″ " " " kiln dried, 30%.
" rustic, 25%.

NAILS.—For 1,000 shingles allow 4 lbs. of 4d nails or 3½ lbs. of 3d nails.

For 1,000 lath allow 6 lbs. 3d fine nails.
" 1,000 ft. of clapboarding allow 18 lbs. of 6d box nails.
" 1,000 ft. of board siding allow 20 lbs. 8d or 25 lbs. 10d common nails.
" 10 ft. of partition studding allow 1 lb. of 10d common nails.
" 1,000 ft. of 1″x3″ flooring allow 45 lbs. 10d common nails.
" 1,000 ft. of 1″x2″ flooring allow 65 lbs. 10d common nails.
" 1,000 ft. of pine finish allow 30 lbs. of 8d wire nails.

BRICK.—A 4½″ wall requires 7 brick per sq. ft. of surface
9″ " " 14 " " " " "
13″ " " 20 " " " " "
18″ " " 26½ " " " " "
21″ " " 33 " " " " "
27″ " " 39½ " " " " "

The weight of brickwork is 112 pounds per cu. ft.

Laid brick will crush at 500 lbs. per sq. in. or at 72,000 lbs. per sq. ft.

Fire brick weighs 150 lbs. per cu. ft.

Cement concrete weighs 140 lbs. per cu. ft.

A bricklayer should average 1,500 bricks in 8 hours, and 2,000 to 2,400 when starting wall before staging or ladder is used. Staging is used above 4 ft.

Brick at $10.00 and labor at $7.50 per 1,000 should be considered good work.

CONCRETE.

Formula No. 1.

For retaining walls and machinery foundations.
60 cu. ft. of rock that will pass a 3-inch mesh screen.
20 cu. ft. of clean, sharp, coarse sand.
10 cu. ft. of Portland cement.

Formula No. 2.

For concrete mortar blocks for stamp batteries.
52 cu. ft. of rock.
32 cu. ft. of sand.
16 cu. ft. of cement.

If broken rock is not available, clean creek gravel of the same size may be substituted, but in no case use clay, loam or very fine sand.

Mix all together dry. When required for use, mix small quantities with sufficient water to make a thick mortar, use immediately and tamp with a tamping bar.

Concrete will set sufficiently in 24 hours to sustain a load, and in from three to four days in medium dry weather machinery may be run on the foundations.

Water and Pumping

A United States gallon of fresh water weighs 8.33 pounds and contains 231 cubic inches.

A cubic foot of water weighs 62.4 pounds and contains 1728 cubic inches, or 7.5 gallons.

A British Imperial gallon contains 277.27 cubic inches, which is equivalent to 1.20 United States gallons, or 10 pounds in weight.

The normal pressure of the atmosphere is 14.7 pounds per square inch; it is equal to a column of water 34 feet high, though 20 feet is the greatest suction lift it is advisable to use.

To find the pressure in pounds per square inch of a column of water, multiply the height of the column in feet by .434. To find the head in feet, multiply the pressure in pounds by 2.31.

The term "head" in connection with pumps is understood to be the sum of the actual elevation and the friction head. The elevation, or lift, is the vertical distance from the surface of the suction water to the center of the discharge outlet.

Friction is that due to the passage of water through the suction and discharge pipes.

In practice, the size of the suction and discharge pipes is usually larger than the openings in the pump. This is especially desirable when the pipe is of any length. The friction head may be greater than the actual elevation, and the cost of the increased pipe size will be saved in a short time by the difference in horse-power. The friction increases with the velocity, and users are reminded that rather than to run the pump considerably above its capacity, it is better to install a larger pump and pipe line.

Doubling the diameter of a pipe increases its capacity four times. Friction of liquids in pipes increases as the square of the velocity.

To find the diameter of a pump cylinder to move a given quantity of water per minute (100 feet of piston being the standard of speed), divide the number of gallons by 4, then extract the square root, and the product will be the diameter in inches of the pump cylinder.

To find quantity of water elevated in one minute, running at 100 feet of piston speed per minute. Square the diameter of the water cylinder in inches and multiply by 4.

Example—Capacity of a 5 inch cylinder is desired. The square of the diameter (5 inches) is 25, which, multiplied by 4, gives 100, the number of gallons per minute (approximately).

To find the horsepower necessary to elevate water to a given height, multiply the weight of the water elevated per minute in pounds by the height in feet, and divide the product by 33,000, (an allowance should be added for water friction, and a further allowance for loss in steam cylinder, say from 20 to 30 per cent).

The area of the steam piston, multiplied by the steam pressure, gives the total amount of pressure that can be exerted. The area of the water piston, multiplied by the pressure of water per square inch, gives the resistance. A margin must be made between the power and the resistance to move the pistons at the required speed, say from 20 to 40 per cent., according to speed and other conditions.

Quantity of water in gallons per minute and velocity of flow in feet per second being given to find area of pipe in square inches, multiply quantity by 231 and divide by velocity multiplied by 720. Area of pipe and velocity being given, to find quantity delivered, multiply area of pipe by velocity and by 720, and divide product by 231.

A "miners inch" of water in California is regulated by law and is equal to a flow of one and one-half cubic feet of water per minute through any opening and under any pressure.

Standard Dimensions of Wrought-Iron Pipe for Water, Gas or Steam

Nominal Size.	Actual Inside Diameter.	Actual Outside Diameter.	Diameter at Bottom of Thread at End of Pipe	Diameter at Top of Thread at End of Pipe	Number of Threads per Inch.	Length of Perfect Screw.	Weight per Foot of Length.	Contents in U. S. Gallons per Foot.
INCH.	INCH.	INCH.	INCH.	INCH.		INCH.	LBS.	
1/8	.270	.405	.334	.393	27	.19	.241	.0006
1/4	.364	.540	.433	.522	18	.29	.420	.0026
3/8	.494	.675	.567	.656	18	.30	.559	.0057
1/2	.623	.840	.701	.815	14	.39	.837	.0102
3/4	.824	1.050	.911	1.025	14	.40	1.115	.0230
1	1.048	1.315	1.144	1.283	11½	.51	1.668	.0408
1¼	1.380	1.660	1.488	1.627	11½	.54	2.244	.0638
1½	1.610	1.900	1.727	1.866	11½	.55	2.678	.0918
2	2.067	2.375	2.200	2.339	11½	.58	3.609	.1632
2½	2.468	2.875	2.620	2.820	8	.89	5.739	.2550
3	3.067	3.500	3.241	3.441	8	.95	7.536	.3673
3½	3.548	4.000	3.738	3.938	8	1.00	9.001	.4998
4	4.026	4.500	4.235	4.435	8	1.05	10.665	.6528
4½	4.508	5.000	4.732	4.932	8	1.10	12.490	.8263
5	5.045	5.563	5.291	5.491	8	1.16	14.502	1.020
6	6.065	6.625	6.346	6.546	8	1.26	18.762	1.469
7	7.023	7.625	7.340	7.540	8	1.36	23.271	1.999
8	7.982	8.625	8.334	8.534	8	1.46	28.177	2.611
9	9.000	9.625	9.327	9.527	8	1.57	33.701	3.300
10	10.019	10.750	10.445	10.645	8	1.68	40.065	4.081
12	12.000	12.750	12.431	12.631	8	1.87	48.985	5.875

1¼ inch and below are butt-welded and tested to 300 lbs. per sq. in.
1½ inch and above are lap-welded and tested to 500 lbs. per sq. in.

Light Wrought-Iron Artesian, Salt, Oil and Gas Well Casing

Nominal Inside Diameter. Inches.	Actual Outside Diameter. Inches.	Nominal Weight per Foot. Pounds.	No. Threads per Inch of Screw.	Nominal Inside Diameter. Inches.	Actual Outside Diameter. Inches.	Nominal Weight per Foot. Pounds.	No. Threads per Inch of Screw.
2	2¼	2.22	14	5⅝	6	10.46	14
2¼	2½	2.82	14	5⅝	6	12.04	11½
2½	2¾	3.13	14	5⅝	6	14.20	11½
2¾	3	3.45	14	5⅝	6	16.70	11½
3	3¼	4.10	14	6¼	6⅝	11.58	14
3¼	3½	4.45	14	6¼	6⅝	13.32	14 and 11½
3½	3¾	4.78	14	6¼	6⅝	17.02	11½
3¾	4	5.56	14	6⅝	7	12.34	14
4	4¼	6.00	14	6⅝	7	17.51	11½ and 10
4¼	4½	6.36	14	7¼	7⅝	13.55	14
4¼	4½	9.38	14	7⅝	8	15.41	11½
4½	4¾	6.73	14	7⅝	8	20.17	11½
4½	4¾	9.39	14	8¼	8⅝	16.07	11½
4¾	5	7.80	14	8¼	8⅝	20.10	11½
5	5¼	8.20	14	8¼	8⅝	24.38	11½ and 8
5	5¼	9.86	14	8⅝	9	17.60	11½
5	5¼	12.80	11½	9⅝	10	21.90	11½
5	5¼	15.88	11½	10⅝	11	26.72	11½
5 3/16	5½	8.62	14	11⅝	12	30.35	11½
5 3/16	5½	12.49	11½	12½	13	33.78	11½

Horse Power or Capacity of Boilers

Steam Boilers are nearly always rated and sold on the basis of a certain number of square feet of heating surface. The basis of the rating heating surface varies, however, so much by different builders, that it is a very unsatisfactory method of rating. For instance Boilers are rated:

Return Tabular at from 12 to 15 square feet for each horse power.

Portable Locomotive and Vertical Boilers on from 9 to 11 square feet.

Water Tube and Scotch Marine Boilers on from 7½ to 10 square feet.

The Centennial Rating of boiler capacity is the most practical and satisfactory. It provides for the evaporation or turning into steam of 30 pounds of water for each horse power per hour. This is a moderate rating, and any boiler that is not capable of evaporating that amount of water for each horse-power of its rated capacity and without forcing the firing or draft, must be in bad condition or over-rated. The safest method for all purchasers, will be to first ascertain the number of horse-power of work required from the engines for which the boiler is to be provided and then calculate the amount of steam the engine or engines will consume in developing that amount of power. By dividing by 30 they will arrive at the horse-power of boiler required to supply the engines.

Amount of Steam Required by Various Engines

The following allowance of pounds of water or steam for each indicated horse-power for engines of different kinds, will be found a safe calculation:

Triple Expansion (Condensing) Engines	15	pounds
Triple Expansion (Non-Condensing) Engines	20	"
Compound Condensing Corliss Engines	18	"
Compound Non-Condensing Corliss Engines	22	"
Simple or Single Corliss Engine (Condensing)	23	"
Simple or Single Corliss Engine (Non-Condensing)	25	"
Automatic Compound Condensing Engines	23	"
Automatic Compound Engine (Non-Condensing)	30	"
High-Speed Automatic Engines	33	"
Side Valve Engines with Adjustable Cut-off	35	"
Plain Slide Valve Engines	40	"
Steam Pumps (Compound Condensing)	40	"
Steam Pumps (Compound Non-Condensing)	60	"
Steam Pumps, Single or Duplex	75	"

Water Consumption of Boilers

From the foregoing, it is evident that to arrive at the amount of water required by a boiler, it is only a matter of multiplying its horse-power by 30 pounds of water per hour. In some cases, an allowance of as much as 60 pounds or 7½ gallons of water per horse-power of boilers is allowed, but this is excessive, and a boiler should not be expected to evaporate more than 30 to 40 pounds of water per horse-power per hour, except under stress.

Fuel Consumption of Boilers

Provided that feed water is delivered to a boiler as hot as it can be made with exhaust steam, that is at 200° F., a good boiler with ample draft and grate surface and carefully fired should be capable of evaporating from 8 to 10 pounds of water for each pound of good coal.

In practice, however, the question of water evaporated for each pound of coal varies between 6 and 8 pounds of water and in many larger plants where mine slack is used, the evaporation of water, is between 6 and 7 pounds.

The average consumption of coal for steam boilers is 12 lbs. per hour for each square foot of grate surface.

To evaporate one cubic foot of water requires the consumption of 7½ lbs. of ordinary coal, or about 1 lb. of coal to 1 gallon of water.

One pound of crude petroleum will evaporate 12 to 16 lbs. of water.

One pound of natural gas (25 cubic feet) will evaporate about 20 lbs. of water. One ton of coal is equal to about 22,450 cubic feet natural gas. (Atmospheric pressure).

One ton of coal is equal to 3½ to 4 barrels of petroleum.

One ton of coal is equal to one cord of hickory.

One ton of coal is equal to 1¼ cords of white oak.

One ton of coal is equal to 1⅓ cords of black oak.

One ton of coal is equal to 2 cords of pine.

One cubic foot of anthracite coal weighs about 53 pounds.

One cubic foot of bituminous coal weighs from 47 to 50 pounds.

Safety Valve Rules

To find the distance, ball should be placed on lever when the weight is known, or to find weight when distance is known:

Multiply the pressure required by area of valve, then multiply this answer by the fulcrum, subtract the weight of the lever, valve and stem, and divide by the weight of the ball for distance; or divide by distance for the weight of the ball with the same example.

To find the pressure when the area of the valve, the weight of lever valve and stem, the fulcrum and the weight of ball is known:

Divide fulcrum into length of lever, multiply the answer by weight of ball, add weight of lever, valve and stem, and divide by area of valve; the answer will be the steam pressure.

The mean effective weight of valve lever and stem is found by connecting the lever at fulcrum, tie the valve stem to lever, attach a spring scale to lever immediately over the valve, and raise until the valve is clear of its seat.

By the fulcrum is meant the distance the valve stem is from where the lever is connected.

Safety valves should be allowed to blow straight out into the room and not hitched on to a leading pipe which may allow water to stand on the valve, increasing its weight, or to freeze up if the boiler is laid up. When the valve blows into the room it will be known when steam is escaping, whether from leakage or over pressure.

Don't depend too much upon the glass gauge, but try the cocks often enough to keep your hand in, in telling the height of water by them. If a gauge cock has a tendency to leak, fix it thoroughly; if you do not, you will neglect to use it for fear of the work which you may have, to stop the leak after using.

To determine the heating surface in the Tubes of any Boiler multiply the number of feet of Tubes by .523 for 2 inch; by .654 for 2½ inch; by .785 for 3 inch; by .916 for 3½ inch, and by 1.047 for 4 inch.

Horse Power

A Standard Engine Horse Power is 33,000 foot-pounds per minute—that is 33,000 pounds raised one foot in one minute, or 3,300 pounds raised ten feet, or 330 pounds raised one hundred feet, and so on.

To calculate the horse power of an engine, multiply together the area of the steam piston in square inches, the piston speed in feet per minute and the mean effective pressure of the steam in pounds per square inch and divide the result by 33,000. This will give the horse power in the cylinder, or Indicated Horse Power. From this must be taken the horse power consumed by the engine in friction, etc., to obtain the Net or Actual Horse Power.

Table of Mean Effective Pressure

The M. E. P. in the table are for non-condensing Engines. One pound is allowed for back pressure of Exhaust. Ten pounds added to any of the M. E. P. given will give the M. E. P. for Condensing Engines.

Initial Pressure in Pounds per Square Inch.	Points of Cut-Off.													
	¼	2/7	3/16	⅓	⅜	2/5	3/7	4/9	½	5/9	3/5	⅝	⅔	¾
30	10.75	12.75	13.75	15.50	17.50	18.50	19.50	20.00	22.00	23.50	24.75	25.25	26.00	27.25
35	13.75	16.00	17.00	19.00	21.00	22.25	23.50	24.25	26.25	28.00	29.25	29.50	30.75	32.35
40	16.75	19.25	20.25	22.50	24.75	26.00	27.00	28.25	30.50	32.50	33.75	34.50	35.50	37.00
45	19.75	22.50	23.75	26.00	28.50	30.00	31.50	32.25	34.75	36.75	38.25	39.25	40.25	41.75
50	22.75	25.75	27.00	29.50	32.25	33.75	35.50	36.25	39.00	40.50	42.75	43.75	45.00	46.50
55	25.75	29.00	30.25	33 00	36.00	37.50	39.25	40.25	43.25	45.75	47.25	48.25	49.50	51.50
60	28.75	32.25	33.75	36.50	39.75	41.50	43.25	44.25	47.50	50.00	51.75	52.75	54.25	56.25
65	31.75	35.50	37.00	40.00	43.50	45.25	47.25	48.25	51.75	54.50	56.50	57.50	59.90	61.25
70	34.75	38.50	40.00	43.50	47.00	49.00	51.25	52.25	56.00	58.75	61.00	62.00	63.50	66.00
75	37.75	41.75	43.00	47.00	50.75	53.00	55.25	56.25	60.25	63.25	65.50	66.50	68.50	71.00
80	40.75	45.00	46.75	50.50	54.50	56.75	59.25	60.25	64.50	67.75	70.00	71.25	73.00	75.75
85	43.75	48.25	50.25	54.00	58.25	60.50	63.00	64.50	68.75	72.00	74.50	75.75	77.75	80.50
90	46.75	51.50	53.25	57.00	62.00	64.25	67.00	68.50	73.00	76.50	79.25	80.50	82.25	85.25
95	49.75	54.75	57.00	61.50	65.75	68.25	71.00	72.50	77.25	81.00	83.50	85.00	87.00	90.25
100	52.50	58.00	60.25	64.50	69.50	72.00	75.00	76.50	81.25	85.25	88.25	89.50	91.75	95.00
105	55.50	61.25	63.50	68.00	73.00	75.75	78.75	80.50	85.50	89.75	92.75	94.25	96.50	99.75
110	58.50	64.50	66.75	71.50	76.75	79.75	82.75	84.50	89.75	94.25	97.25	98.75	101.00	104.75
115	61.50	67.50	70.00	75.00	80.50	83.50	86.25	88.50	94.00	98.50	101.75	103.50	105.75	109.50
120	64.50	70.75	73.25	78.50	84.25	87.50	90.25	92.50	98.25	102.75	106.25	108.00	110.00	114.25
125	67.50	73.75	76.50	81.00	88.00	91.25	94.25	96.50	102.25	107.00	110.75	112.50	114.50	119.25

How to Center an Engine

The "dead center" is the point in the stroke where the crank and piston rod are in the same right line. To find dead center, turn engine in the direction it runs until cross-head is within a short distance of its limit of motion. Mark guide at end of cross-head shoe. Mark some revolving circular part of engine, as disk crank or fly wheel, and place one point of a fixed tram in this mark and the other on some fixed object in line. Now turn engine past the center in the direction she runs until end of cross-head shoe passes mark on guide. Turn back till shoe reaches mark. Holding tram still on the fixed object, place other point on selected revolving part and mark as before. Bisect distance between marks on revolving part and turn engine till point of tram rests on central mark, and the engine is on "dead center."

Horizontal engines, when practicable, should be run over rather than under, as the thrust will then come downward upon the foundation rather than upon the caps of the boxes and the upper guides.

Power Required for Different Parts of Gold and Silver Mills

Each Stamp, Dropping 100 Times per Minute, Requires:

Weight per stamp in lbs........	750	800	850	900	950	1000	1050	1100	1200	1300	1350
Horse Power each Stamp	1.5	1.6	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.6	2.7

Each Dodge Crusher, Requires:

Size of crusher........	6x6	7x8	8x12	11x15
Horse power..........	4	6	8	12
Revolutions per minute.	350	300	250	225

Each Blake Type Crusher, Requires:

Size of crusher.....	6x7½	7x9	8x12	10x16
Horse power.......	4	5	8	12
Rev. per minute....	275	275	250	225

Each Standard Crushing Rolls, Requires:

Size of rolls..........................	20x8	20x12	27x14	30x14	36x16
Horse power..........................	3-6	4–8	5–10	8–15	10–20
Revolutions per minute................	100-150	100-150	75–125	65–85	50–75

Each 6-foot Belt Concentrator, requires about ½ horse-power.
Each 18-inch Amalgam Barrel, requires from 1 to 2 horse-power.
Each 24-inch Amalgam Barrel, requires from 2 to 3 horse-power.
Each 36-inch Clean-up Pan, requires from 1 to 1½ horse-power.
Each 48-inch Clean-up Pan requires from 1½ to 2 horse-power.
Each 4-foot Combination Pan, 65 revolutions per minute, requires from 3 to 6 horse-power.
Each 5-foot Combination Pan, 65 revolutions per minute, requires from 5 to 10 horse-power.
Each 8-foot Settler, 14 revolutions per minute, requires 2.5 horse-power.
Each 8-foot Agitator, 16 revolutions per minute, requires 3 horse-power.
Each Quicksilver Elevator requires from .25 to 2 horse-power.
Each Revolving Dryer requires 5 horse-power.
Each Howell-White Roasting Furnace requires from 4 to 6 horse-power.
Each Bruckner Furnace, 8 x 18 feet, requires from 5 to 8 horse-power.

Above estimates include the friction of the parts named, but not that of the power transmitting machinery, for which an additional allowance should be made.

Water Required for Various Parts of Gold and Silver Mills

Boiler feed for each horse-power, per hour, 5 gallons.
For each stamp, per hour, from 60 to 80 gallons.
For each 5-foot Pan, per hour, 100 gallons.
For each 8-foot Settler, per hour, 80 gallons.
For each Concentrator, per hour, from 200 to 300 gallons.
For each Graupner or Huntington 5-foot mill, per hour, 1000 to 1200 gallons.

When water is settled and returned to the mill for re-use, a reduction of 50 per cent. may be safely estimated for all except the boiler, which must have clear water.

Horse-Power Shafting Will Transmit

Diameter of Shaft.	Weight per Foot.	Revolutions per Minute.									
		100	125	150	175	200	225	250	300	350	400
$\frac{15}{16}$	2.05	1.2	1.4	1.7	2.1	2.4	2.6	3.1	3.6	4.3	5.0
$1\frac{3}{16}$	3.77	2.4	3.1	3.7	4.3	4.9	5.5	6.1	7.3	8.5	9.7
$1\frac{7}{16}$	5.52	4.3	5.3	6.4	7.4	8.5	9.5	10.5	12.7	14.8	16.9
$1\frac{11}{16}$	7.61	6.7	8.4	10.1	11.7	13.4	15.1	16.7	20.1	23.4	26.8
$1\frac{15}{16}$	10.03	10.0	12.5	15.0	17.5	20.0	22.5	25.0	30.0	35.0	40.0
$2\frac{3}{16}$	12.80	14.3	17.8	21.4	24.9	28.5	32.1	35.6	42.7	49.8	57.0
$2\frac{7}{16}$	15.89	19.5	24.4	29.3	34.1	39.0	44.1	48.7	58.5	68.2	78.0
$2\frac{11}{16}$	19.31	26.0	32.5	39.0	43.5	52.0	58.5	65.0	78.0	87.0	104.0
$2\frac{15}{16}$	23.06	33.8	42.2	50.6	59.1	67.5	75.9	84.4	101.3	118.2	135.0
$3\frac{3}{16}$	27.16	43.0	53.6	64.4	75.1	85.8	96.6	107.3	128.7	150.3	171.6
$3\frac{7}{16}$	31.58	53.6	67.0	79.4	93.8	107.2	120.1	134.0	158.8	187.6	214.4
$3\frac{11}{16}$	36.40	65.9	82.4	97.9	115.4	121.8	148.3	164.8	195.7	230.7	243.6
$3\frac{15}{16}$	41.40	80.0	100.0	120.0	140.0	160.0	180.0	200 0	240.0	280.0	320.0
$4\frac{7}{16}$	52.58	113.9	142.4	170.8	199.3	227.8	256.2	284.7	341.7	398.6	455.6
$4\frac{15}{16}$	65.10	156.3	195.3	234.4	273.4	312.5	351.5	390.6	468.7	546.8	625.0

To Obtain the Size and Speed of Pulleys, Gears, or Sprocket Wheels

Diameter of Driver—Diameter of driven multiplied by revolutions of driven, and the product obtained divided by the revolutions of driver.

Diameter of Driven—Diameter of driver multiplied by revolutions of driver, and the product obtained divided by revolutions of driven.

Revolutions of Driven.—Diameter of driver multiplied by revolutions of driver, and the product obtained divided by the revolutions of driven.

Revolutions of Driver.—Diameter of driven multiplied by the revolutions of driven, and the product obtained divided by the diameter of the driver.

The driving pulley is called the driver, and the driven pulley the driven.

If the number of teeth in gears or sprocket wheels are used instead of diameter in these calculations, number of teeth must be substituted whenever diameter occurs.

Horse-Power of Gearing

The following table is for cast-iron gears, and is based upon a factor of safety of eight, with an ultimate tensile strength of 30,000 pounds.

Speed of gear, 100 feet per minute at pitch line.

Spur Gears, Horse Power.	Pitch.	Face.	Bevel Gears, Horse Power.
1.40	1	2½	1.01
2.52	1¼	3¼	1.78
3.84	1½	4	2.61
5.48	1¾	5	3.73
6.83	2	6	4.68
8.98	2¼	6½	6.39
10.70	2½	7	7.52
15.39	3	9	10.54

The horse-power of gears increases and decreases directly with the speed.

Belting

SINGLE LEATHER

Speed in Feet per Minute.	Width of Belt in Inches.									
	2	3	4	5	6	8	10	12	14	16
	H.-P.	H.-P.	H.-P.	H.-P.	H.-P.	H.-P.	H.-P.	H.-P.	H.-P.	H.-P.
400	1	1½	2	2½	3	4	5	6	7	8
600	1½	2¼	3	3¾	4½	6	7½	9	10½	12
800	2	3	4	5	6	8	10	12	14	16
1000	2½	3¾	5	6¼	7½	10	12½	15	17½	20
1200	3	4½	6	7½	9	12	15	18	21	24
1500	3¾	5¾	7½	9½	11½	15	18¾	22½	26½	30
1800	4½	6¾	9	11¼	13½	18	22½	27	31½	36
2000	5	7½	10	12½	15	20	25	30	35	40
2400	6	9	12	15	18	24	30	36	42	48
2800	7	10½	14	17½	21	28	35	42	49	56
3000	7½	11¼	15	18¾	22½	30	37½	45	52½	60
3500	8¾	13	17½	22	26	35	44	52½	61	70
4000	10	15	20	25	30	40	50	60	70	80
4500	11¼	17	22½	28	34	45	57	69	78	90
5000	12½	19	25	31	37½	50	62½	75	87½	100

DOUBLE LEATHER

Speed in Feet per Minute.	Width of Belt in Inches.								
	4	6	8	10	12	14	16	18	20
	H.-P.	H.-P.	H.-P.	H.-P.	H.-P.	H.-P.	H.-P.	H.-P.	H.-P.
400	2¾	4¼	5¾	7¼	8½	10	11½	13	14½
600	4¼	6½	8¾	11	13	15	17½	19½	22
800	5¾	8½	11½	14½	17½	20½	23	26	29
1000	7¼	11	14½	18¼	21½	25½	29	32½	36
1200	8½	13	17½	22	26	30½	34½	39	44
1500	10¾	16¼	21¾	27¼	32½	38	43½	49	54½
1800	13	19½	26	32¾	39	45½	52	59	65½
2000	14½	21¾	29	36½	43½	50½	58	65½	72½
2400	17¼	26	34¾	44	52½	60½	69½	78½	88
2800	20¼	30½	40½	51	61	71	81	91½	102
3000	21½	32½	43½	54½	65½	76	87½	98	108
3500	25½	38	50¾	63½	76	89	101	114	127
4000	29	43½	58¼	72¾	87	101	116	131	145
4500	32½	49	65	82	98	114	131	147	163
5000	36½	51½	72¾	91	109	127	145	163	182

The above tables are based on the following equivalents:

Single Belting, one inch wide, 800 feet per minute = one horse-power, equal to four ply rubber = working tension of 42 pounds.

Double Belting, one inch wide, 550 feet per minute = one horse-power, equal to six ply rubber = Working tension of 60 pounds.

Board Measure

Length in Feet.

SIZE.	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
1x8	8	9⅓	10⅔	12	13⅓	14⅔	16	17⅓	18⅔	20	21⅓	22⅔	24	25⅓	26⅔
1x10	10	11⅔	13⅓	15	16⅔	18⅓	20	21⅔	23⅓	25	26⅔	28⅓	30	31⅔	33⅓
1x12	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
1x14	14	16⅓	18⅔	21	23⅓	25⅔	28	30⅓	32⅔	35	37⅓	39⅔	42	44⅓	46⅔
1x16	16	18⅔	21⅓	24	26⅔	29⅓	32	34⅔	37⅓	40	42⅔	45⅓	48	50⅔	53⅓
2x3	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
2x4	8	9⅓	10⅔	12	13⅓	14⅔	16	17⅓	18⅔	20	21⅓	22⅔	24	25⅓	26⅔
2x6	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
2x8	16	18⅔	21⅓	24	26⅔	29⅓	32	34⅔	37⅓	40	42⅔	45⅓	48	50⅔	53⅓
2x10	20	23⅓	26⅔	30	33⅓	36⅔	40	43⅓	46⅔	50	53⅓	56⅔	60	63⅓	66⅔
2x12	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80
2x14	28	32⅔	37⅓	42	46⅔	51⅓	56	60⅔	65⅓	70	74⅔	79⅓	84	88⅔	93⅓
2x16	32	37⅓	42⅔	48	53⅓	58⅔	64	69⅓	74⅔	80	85⅓	90⅔	96	101⅓	106⅔
3x4	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
3x6	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60
3x8	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80
3x10	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
3x12	36	42	48	54	60	66	72	78	84	90	96	102	108	114	120
3x14	42	49	56	63	70	77	84	91	98	105	112	119	126	133	140
3x16	48	56	64	72	80	88	96	104	112	120	128	136	144	52	160
4x4	16	18⅔	21⅓	24	26⅔	29⅓	32	34⅔	37⅓	40	42⅔	45⅓	48	50⅔	53⅓
4x6	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80
4x8	32	37⅓	42⅔	48	53⅓	58⅔	64	69⅓	74⅔	80	85⅓	90⅔	96	101⅓	106⅔
4x10	40	46⅔	53⅓	60	66⅔	73⅓	80	86⅔	93⅓	100	106⅔	113⅓	120	126⅔	133⅓
4x12	48	56	64	72	80	88	96	104	112	120	128	136	144	152	160
4x14	56	65⅓	74⅔	84	93⅓	102⅔	112	121⅓	130⅔	140	149⅓	158⅔	168	177⅓	186⅔
4x16	64	74⅔	85⅓	96	106⅔	117⅓	128	138⅔	149⅓	160	170⅔	181⅓	192	202⅔	213⅓
6x6	36	42	48	54	60	66	72	78	84	90	96	102	108	114	120
6x8	48	56	64	72	80	88	96	104	112	120	128	136	144	152	160
6x10	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200
6x12	72	84	96	108	120	132	144	156	168	180	192	204	216	228	240
6x14	84	98	112	126	140	154	168	182	196	210	224	238	252	266	280
6x16	96	112	128	144	160	176	192	208	224	240	256	272	288	304	320
8x8	64	74⅔	85⅓	96	106⅔	117⅓	128	138⅔	149⅓	160	170⅔	181⅓	192	202⅔	213⅓
8x10	80	93⅓	106⅔	120	133⅓	146⅔	160	173⅓	186⅔	200	213⅓	226⅔	240	253⅓	266⅔
8x12	96	112	128	144	160	176	192	208	224	240	256	272	288	304	320
8x14	112	130⅔	149⅓	168	186⅔	205⅓	224	242⅔	261⅓	280	298⅔	317⅓	336	354⅔	373⅓
8x16	128	149⅓	170⅔	192	213⅓	234⅔	256	277⅓	298⅔	320	341⅓	362⅔	384	405⅓	426⅔
10x10	100	116⅔	133⅓	150	166⅔	183⅓	200	216⅔	233⅓	250	266⅔	283⅓	300	316⅔	333⅓
10x12	120	140	160	180	200	220	240	260	280	300	320	340	360	380	400
10x14	140	163⅓	186⅔	210	233⅓	256⅔	280	303⅓	326⅔	350	373⅓	396⅔	410	443⅓	466⅔
10x16	160	186⅔	213⅓	240	266⅔	293⅓	320	346⅔	373⅓	400	426⅔	453⅓	480	506⅔	533⅓
12x12	144	168	192	216	240	264	288	312	336	360	384	408	432	456	480
12x14	168	196	224	252	280	308	336	364	392	420	448	476	504	532	560
12x16	192	224	256	288	320	352	384	416	448	480	512	544	576	608	640
14x14	196	228⅔	261⅓	294	326⅔	359⅓	392	424⅔	457⅓	490	522⅔	555⅓	588	620⅔	653⅓
14x16	224	261⅓	298⅔	336	373⅓	410⅔	448	485⅓	522⅓	560	597⅓	634⅔	672	709⅓	746⅔
16x16	256	298⅔	341⅓	384	426⅔	469⅓	512	554⅔	597⅓	640	682⅔	725⅓	768	810⅔	853⅓

Note—By simply multiplying or dividing the above amounts, the number of feet contained in other dimensions can be obtained.

Board and Timber Measure

BOARD MEASURE

In board measure boards are assumed to be one inch in thickness.

To compute the measure or surface in square feet—

When all dimensions are in feet:

Rule—Multiply the length by the breadth, and the product will give the surface required.

When either of the dimensions are in inches:

Rule—Multiply as above and divide the product by 12.

When all dimensions are in inches:

Rule—Multiply as before and divide product by 144.

TIMBER MEASURE

To compute the volume of round timber—

When all dimensions are in feet:

Rule—Multiply the length by the square of one-quarter of the main girt, and the product will give the measurement in cubic feet.

When length is given in feet and girt in inches:

Rule—Multiply as before and divide by 144.

When all the dimensions are in inches:

Rule—Multiply as before and divide by 1,728.

Sawed or hewed timber is measured by the cubic foot.

To compute the volume of square timber—

When all dimensions are in feet:

Rule—Multiply the product of the breadth by the depth by the length, and the product will give the volume in cubic feet.

When either of the dimensions are in inches:

Rule—Multiply as above and divide the product by 12.

When any two of the dimensions are in inches:

Rule—Multiply as before and divide the product by 144.

Simple Problems in Air Compression

Extracts from an address delivered before the Mining Association of the University of California, By Edward A. Rix.

Allow 20 hp. for every 100 cu. ft. of cylinder-displacement, to compress air to 90 or 95 lb. receiver gauge-pressure at sea-level.

It would be well in small plants, up to 400 cu. ft. capacity to make no distinction between single and two-stage machines.

In using compressed air at 90 lb. pressure cold, it will take 24 cu. ft. free air per minute to give one horse-power in plain slide-valve engines and 15 cu. ft. with good expansion-valve gearing; between these two limits will lie all the various types of engines. If the air be re-heated to about 300° F, it will reduce the above quantities about one-third.

For operating ordinary station and sinking pumps of the direct-acting type, which is the ordinary stock pump used in mining operations, it will be safe to calculate that one cubic foot of free air compressed to 90 lb. gauge-pressure will do 135 foot-gallons of pumping.

Ordinary mining hoists have a mechanical efficiency of about 75 per cent.

For the determination of sizes of pipes, losses of pressure, and terminal pressures for compressed-air transmission, use the formula:

$$P_1^2 - P_2^2 = \frac{0.0006V^2L}{A^5}$$

P_1 = absolute initial air-pressure.
P_2 = absolute terminal air-pressure.
V = free air equivalent passing through the pipe.
L = length of pipe in feet.
A = diameter in inches.

Problem.—Given a water-power distant 5000 ft. from a mine, it is desired to generate compressed air and transmit it to the collar of the shaft to perform work as follows:

One hundred tons of ore and waste to be hoisted in 20 hours.
Thirty gallons of water per minute to be pumped.
Five 2¼-in standard piston rock-drills to be operated.
Three air-hammer drills to be operated.

General Conditions:

Depth of shaft, 600 ft.
Weight of skip and rope, 1,000 lb.
Weight of ore hoisted, 1 ton.
Initial air-pressure, 95 lb.
Final air-pressure, 90 lb.
Altitude, sea-level.
Geared hoist and unbalanced hoisting.

Required:

Size of compressor.
Diameter of air-pipe.
Brake horse-power.
Altitude factors.
Re-heating coefficients.

Note: Reduce all requirements to cubic feet of free air, because free air is the basis for all power calculations.

To determine the free air required for hoisting:

100 tons of ore and waste hoisted in 20 hours = 5 tons per hour, each load contains one ton = a load hoisted every 12 minutes. 2000 lb. material and 1000 lb. rope and skip = a total of 3000 lb. 3000 lb. lifted 600 ft. = 1,800,000 foot-pounds, or 54 hp. theoretical, at 75% efficiency, the 54 hp. becomes 72 brake-power actually required. Using cold air, it requires, 24 cu. ft. free air per horse-power. Then the hoist will consume to make a lift, 24x72 = 1728 cu. ft. of free air. This gives us direct results without taking into consideration the element of time or the dimensions of the hoist.

Simple Problems in Air Compression

(Continued)

If 1728 cu. ft. are required to make a hoist every 12 minutes the compressor must furnish 144 cu. ft. free air per minute continuously, and we assume that we hoist at the rate of 300 ft. per min.; it will take 2 minutes to make the lift, and the hoist will be lowering and idle during the next 10 minutes, the compressor delivering 10x144 = 1440 cu. ft. free air which must be stored. Sufficient storage capacity is the vital point of hoisting economically with compressed air.

While we have allowed 4 hours in 24, or 1 hr. 20 min. on each shift, for hoisting and lowering men, timbers, supplies, etc., it is probable that at least once every hour someone will be going up and down the shaft, and it would be practical therefore to say that the hoist would handle 6 loads per hour, instead of 5, and we must therefore add 20% to the 144 cu. ft. making the hoisting requirement say, 175 cu. ft. per min.

To determine the amount of compressed air required for pumping:

For pumping 30 gallons per min. 600 ft., requires 30x600, or 18,000 foot gallons of work. If one cu. ft. of free air at 90 lb. gauge-pressure will give 135 ft-gal., we shall require 133 cu. ft. free air for the pumping. This requirement is constant.

To determine the amount of compressed air required for drilling:

Five 2¼-in. rock-drills will require 50 ft. free air each, or 250 cu. ft.

Three air-hammer drills will require 25 cu. ft. each, or 75 cu. ft.

To get these amounts, take about 80% of the requirements as stated in rock-drill catalogues, which always give quantities in compressor-cylinder displacement, which do not deliver on an average within 20% of their displacement, except in large machines.

Total requirements will therefore be:

Work.	Cubic Feet.
Hoisting	175
Pumping	133
Drilling	325
Total	633

Allow for a 5% pipe-leakage on the entire system. This would bring requirement up to 665.

Allow for a volumetric efficiency of at least 80%, this will require a total cylinder displacement of 830 cu. ft. per minute, and with the power factor of 20 hp. per 100 cu. ft., 166 hp. delivered on the water-wheel shaft is required to drive compressor.

To determine the size of the pipe: Allow 5 lb. drop in pressure for friction loss.

$$\text{Formula:}\quad P_1^2 - P_2^2 = \frac{0.0006V_2L}{A^5}$$

P_1, initial pressure absolute = 95+14.7, or 109.7, and its square is 12034.

P_2, the terminal pressure, 5 lb. less than the initial, or 90 lb., or 104.7 absolute, and, its square is 10962.

The difference between these two or $P_1^2 - P_2^2 = 1072$.

Simple Problems in Air Compression

(Continued)

Substituting this in our equation, and also the values for L and V, we have

$$1072 = \frac{6x5000x633x633}{10,000xA^5.}$$

reducing, we have

$$1072xA^5 = 3x633^2, \text{ or } A^5 = 1121$$

$$A = 4\text{-in. pipe.}$$

In General:

Refer to trade catalogues and tables and look up a satisfactory compressor, having a displacement of 830 cu. ft. For this capacity it is advisable to select a two-stage compressor, because it has a higher volumetric efficiency, requires less power to operate, is easier to lubricate on account of lower temperatures and has less strain on mechanism.

The first thing to consider is the speed at which the compressor will operate. If a limited sum is to be expended, as high a working speed as possible will be selected, because, the higher the speed, the smaller the compressor. If the future is to be taken into consideration, more air will be wanted as shaft goes deeper and more water encountered. It would then be wise to select a machine which at say two-thirds of its rated speed would produce the present requirements and give a 50 per cent. margin for the future.

Altitude: (original)

As the altitude increases, the initial absolute pressure diminishes and as the final pressure remains the same, the pressure ratio grows larger as the altitude increases. For example, at 10,000 ft. elevation the atmospheric pressure is 10 lbs. instead of 14.7 lbs at sea level. In the problem, the ratio of compression at sea level is 7.5 while at 10,000 feet elevation it would be 10.5. The sea-level compressor must be increased, therefore, 10.5 ÷ 7.5, or 1.4 times, to give the same weight of compressed air at 10,000 ft. altitude. In other words the altitude compressor must be about 40 per cent. larger to do the same work.

TABLE OF EFFICIENCIES AND CAPACITIES AT VARIOUS ALTITUDES.

Altitude above Sea-level Feet.	Absolute Pressure per sq. in. Lbs.	Barometric Pressure Inches.	Cubic Feet of Free Air Remaining Constant.		Cubic Feet of Compressed Air Remaining Constant.	
			Volumetric Efficiency	Power Required.	Increased Capacity of Compressor	Increased Horse Power Required.
0	14.70	30.0	100%	100%	0%	0%
1000	14.15	28.8	97%	98.2%	3.3%	2.2%
2000	13.61	27.8	93%	96.5%	7.6%	3.9%
3000	13.10	26.7	90%	94.8%	10.3%	5.6%
4000	12.61	25.7	87%	93.1%	14%	7.3%
5000	12.14	24.8	84%	91.5%	18%	8.9%
6000	11.68	23.8	81%	89.9%	22%	10.6%
7000	11.24	22.9	78%	88.4%	26%	12.3%
8000	10.82	22.1	76%	86.9%	31%	14.2%
9000	10.42	21.3	73%	85.4%	36%	16.2%
10000	10.03	20.5	70%	83.9%	40%	18.2%
11000	9.66	19.7	68%	82.4%	45%	20.3%
12000	9.30	19.0	65%	80.9%	50%	22.4%

Simple Problems in Air Compression

(Continued)

To determine the amount of compressed air required by re-heating:

It is practical to re-heat air to from 300 to 400° F in various ways, and great economy is realized especially for pumping and hoisting, and if it is possible you may reduce the quantities of cold air figured for this character of work by the ratio of the atmospheric to the compressed-air temperatures absolute. Thus, if the atmosphere is at 60° F or 520° absolute, and the compressed air is used at 300° F or 760° absolute, then the volume of cold air for your work may be taken at the ratio of 520 ÷ 760, or about 70%, thus making a saving of 30 per cent.

TABLE 1.—CUBIC FEET OF FREE AIR REQUIRED TO RUN ONE DRILL OF THE SIZE AND AT THE PRESSURE STATED BELOW.

Guage Pressure	Cylinder Diameter of Drill.												
	2″	2¼″	2½″	2¾″	3″	3⅛″	3 3/16″	3¼″	3½″	3⅝″	4¾″	5″	5½″
60	50	60	68	82	90	95	97	100	108	113	130	150	164
70	56	68	77	93	102	108	110	113	124	129	147	170	181
80	63	76	86	104	114	120	123	127	131	143	164	190	207
90	70	84	95	115	126	133	136	141	152	159	182	210	230
100	77	92	104	126	138	146	149	154	166	174	199	240	252

TABLE II.—MULTIPLIERS TO DETERMINE COMPRESSOR CAPACITY REQUIRED TO OPERATE FROM 1 TO 70 ROCK DRILLS AT ALTITUDES COMPARED WITH SEA LEVEL.

Altitude Above Sea Level	NUMBER OF DRILLS																		
	1	2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	60	70
	MULTIPLIERS																		
0	1.	1.8	2.7	3.4	4.1	4.8	5.4	6.0	6.5	7.1	8.1	9.5	11.7	13.7	15.8	21.4	25.5	29.4	33.2
1000	1.03	1.85	2.78	3.5	4.22	4.94	5.56	6.18	6.69	7.3	8.34	9.78	12.05	14.1	16.3	22.0	26.26	30.3	34.2
2000	1.07	1.92	2.89	3.64	4.39	5.14	5.78	6.42	6.95	7.60	8.67	10.17	12.52	14.66	16.9	22.9	27.28	31.46	35.52
3000	1.10	1.98	2.97	3.74	4.51	5.28	5.94	6.6	7.15	7.81	8.91	10.45	12.87	15.07	17.38	23.54	28.05	32.34	36.52
4000	1.14	2.05	3.08	3.88	4.67	5.47	6.15	6.84	7.41	8.09	9.23	10.83	13.34	15.62	18.01	24.4	29.07	33.52	37.8
5000	1.17	2.10	3.16	3.98	4.8	5.62	6.32	7.02	7.61	8.31	9.48	11.12	13.69	16.03	18.49	25.04	29.84	34.4	38.84
6000	1.20	2.16	3.24	4.08	4.9	5.76	6.48	7.2	7.8	8.52	9.72	11.4	14.04	16.44	18.96	25.68	30.6	35.4	39.84
7000	1.23	2.21	3.32	4.18	5.04	5.9	6.64	7.38	7.99	8.73	9.96	11.68	14.39	16.85	19.43	26.32	31.36	36.16	40.84
8000	1.26	2.27	3.40	4.28	5.17	6.05	6.8	7.56	8.19	8.95	10.21	11.97	14.74	17.26	19.9	26.96	32.13	37.04	41.83
9000	1.29	2.32	3.48	4.39	5.29	6.19	6.96	7.74	8.38	9.16	10.45	12.26	15.09	17.67	20.38	27.6	32.9	37.92	42.83
10000	1.32	2.38	3.56	4.49	5.41	6.34	7.13	7.92	8.58	9.37	10.69	12.54	15.44	18.08	20.86	28.25	33.66	38.8	43.82
12000	1.37	2.47	3.7	4.66	5.62	6.57	7.4	8.22	8.9	9.73	11.1	13.02	16.03	18.77	21.64	29.32	34.94	40.28	45.48

Example.—Required the amount of free air necessary to operate thirty 5 inch drills at 9,000 feet altitude, using to operate these drills air at a guage pressure of 80 pounds per square inch.

From Table I we find, when operating the drills at 80 pounds guage pressure at sea level, that one 5-inch drill requires 190 cubic feet of free air per minute.

From Table II we also find that the factor for 30 drills at 9,000 feet altitude is 20.38; multiplying 190 cubic feet by 20.38 gives 3,872 cubic feet free air per minute, which is the displacement of a compressor for the above outfit under average conditions, to which must be added pipe line losses, such as friction and leakage.

Table for Computing Effective Strains and Loads on Inclines

I. Degree.	II. Sine.	III. Cosecant.	I. Degree.	II. Sine.	III. Cosecant.
90	1.000	1.000	45	.707	1.414
89	1.000	1.000	44	.695	1.440
88	.999	1.001	43	.682	1.466
87	.999	1.001	42	.669	1.494
86	.998	1.002	41	.656	1.524
85	.996	1.004	40	.643	1.556
84	.995	1.006	39	.629	1.589
83	.993	1.008	38	.616	1.624
82	.990	1.010	37	.602	1.662
81	.988	1.012	36	.588	1.701
80	.985	1.015	35	.574	1.743
79	.982	1.019	34	.559	1.788
78	.978	1.022	33	.545	1.836
77	.974	1.026	32	.530	1.887
76	.970	1.031	31	.515	1.942
75	.966	1.035	30	.500	2.000
74	.961	1.040	29	.485	2.063
73	.956	1.046	28	.469	2.130
72	.951	1.051	27	.454	2.203
71	.946	1.058	26	.438	2.281
70	.940	1.064	25	.423	2.366
69	.934	1.071	24	.407	2.459
68	.927	1.079	23	.391	2.559
67	.921	1.086	22	.375	2.669
66	.914	1.095	21	.358	2.790
65	.906	1.103	20	.342	2.924
64	.899	1.113	19	.326	3.071
63	.891	1.122	18	.309	3.236
62	.883	1.133	17	.292	3.420
61	.875	1.143	16	.276	3.628
60	.866	1.155	15	.259	3.864
59	.857	1.167	14	.242	4.134
58	.848	1.179	13	.225	4.445
57	.839	1.192	12	.208	4.810
56	.829	1.206	11	.191	5.241
55	.819	1.221	10	.174	5.759
54	.809	1.236	9	.156	6.392
53	.799	1.252	8	.139	7.185
52	.788	1.269	7	.122	8.206
51	.777	1.287	6	.105	9.567
50	.766	1.305	5	.087	11.474
49	.755	1.325	4	.070	14.336
48	.743	1.346	3	.052	19.107
47	.731	1.367	2	.035	28.654
46	.719	1.390	1	.017	57.299

The table will be found useful where hoisting is done in inclined shafts. It may also be applied to "gravity tramways" or "inclined planes."

The following examples will show its uses: Suppose the weight of ore is 10,000 lbs.; skip, 6,000 lbs.; rope, 7,500 lbs.; and that the shaft has an inclination of 55 degrees from the horizontal. What is the strain of the rope? Total load, 10,000 + 6,000 + 7,500 = 23,500.

(Continued from page 124)

Rule:—For each pound weight, the effective load on rope for the angle of incline from the horizontal given in column I will be found opposite in column II.

Therefore, find 55 degrees in column I and opposite in column II is .819, which multiplied by 23,500 = 19,246.5 lbs., the total effective strain on rope.

Suppose an engine can raise 5,000 lbs. in a vertical shaft, what can it pull up an incline 30 degrees from the horizontal?

Rule:—For each pound which an engine can lift vertically, it can raise the amount given in column III up an incline of the angle given in column I. Therefore, find 30 degrees in column I, and opposite in column III is 2, which multiplied by 5,000 = 10,000 lbs., the amount engine can pull up a 30 degree incline.

If the proper working strain of the rope were 5,000 lbs., on a vertical lift, it would be 10,000 lbs. on a 30 degree incline; the process is the same.

Note:—In using the table, it must not be overlooked that the friction of drawing the car, skip or cage on the rails or guides is to be added to the effective weight in order to obtain the total amount of strain borne by the rope. This friction is termed "traction" or "tractile effort" and varies between thirty and one hundred pounds per ton, according to circumstances and is of more importance on inclines of small angle.

Standard Hoisting Ropes

Composed of 6 Strands of 19 wires each, with Hemp Center.

Dia.	Weight per foot in pounds.	Allowable working strain in tons of 2,000 lbs. Factor of Safety = 5.				Minimum Size of Drum or Sheave in Feet.			
		Plough Steel.	Ex. Strong Crucible Steel.	Cast Steel.	Swedish Iron.	Plough Steel.	Ex. Strong Crucible Steel.	Cast Steel.	Swedish Iron.
2¾	12.	61.	53.	45.	22.8	11	10	10	16
2½	10.	50.	45.	38.	18.9	10	9½	9½	15
2¼	8.	41.	36.	31.	15.6	9	8½	8½	13
2	6.30	33.	28.	24.	12.4	8	8	8	12
1¾	4.85	25.	22.	19.	9.6	7½	7¼	7¼	10
1⅝	4.15	22.	19.	16.	8.4	6	6¼	6¼	8½
1½	3.55	19.	16.	14.	7.2	5½	5¾	5¾	7½
1⅜	3.00	16.	14.	12.	6.2	5¼	5½	5½	7
1¼	2.45	13.	11.	10.	5.0	5	5	5	6½
1⅛	2.00	11.	9.8	8.4	4.2	4½	4½	4½	6
1	1.58	8.8	7.8	6.8	3.4	4¼	4	4	5¼
⅞	1.20	6.8	6.0	5.2	2.6	3¾	3½	3½	4½
¾	0.89	5.0	4.4	3.88	1.94	3½	3	3	4
⅝	0.62	3.6	3.16	2.72	1.36	3	2¼	2¼	3½
9/16	0.50	2.9	2.54	2.20	1.10	2½	1¾	1¾	2¾
½	0.39	2.28	2.02	1.76	.88	2	1½	1½	2¼
7/16	0.30	1.77	1.56	1.36	.68	1½	1¼	1¼	2
⅜	0.22	1.31	1.15	1.00	.50	1	1	1	1½
5/16	0.15	0.90	0.81	0.68	.34	⅞	⅔	⅔	1
¼	0.10	0.60	0.54	0.48	.24	⅔	½	½	¾

Practical Hints Regarding Saw Mills and the Care of Saws

A Right Hand Mill has the saw at the sawyer's right and runs toward him.

A Left Hand Mill has the saw at the sawyer's left and runs toward him.

SIZE OF SAWS.—With the Variable Feed Mill, any size saw can be used according to the size of logs—regardless of the amount of power used. With a large saw, a large pulley must be used on the mandrel to reduce the speed to correspond with the size of the saw and the power. The diameter of the saw should be about one and a half times the diameter of the log to be cut—a 36-inch log requires a 54-inch saw—a 40-inch log requires a 60-inch saw, and so on.

SPEED OF SAWS.—Speeding saws too high is a very common mistake—usually a serious and a foolish error of judgment. Manufacturers, in their catalogues, give the maximum speeds at which their saws may be operated with safety on the basis of the highest power the saws are calculated to withstand. These speeds cannot properly be used for portable mills for the reason that often the power used is not sufficient—they are put there for selling purposes of the saw-makers and to show what the saw will stand, not what it is supposed to do in practical work. While speed is power—it's easy to consume all the power in speed without doing any work. A 48-inch saw run by a 10 H. P. engine should have a speed of 300 revolutions a minute—slower if the saw has the usual number of teeth. About twenty-four teeth are necessary to give the best results at 300 revolutions—the usual number is 30—and usually works satisfactorily.

PORTABLE MILLS running with 20 H. P. and under should run the rim of the saw at a speed not exceeding 360 ft. per minute to each horse power. For example, multiply 360 by 10 H. P., and divide this by 12 ft. (circumference of the 48-inch saw), and you get 300 revolutions per minute. For smaller power the speed should be some higher in proportion, but the saw should have fewer teeth to make up for the higher speed. 20 H. P. and above should have more speed in proportion to the larger number of teeth. With this power the teeth should be 5 inches apart, which will give 30 teeth to the 48-inch saw. For a larger power, the teeth should be closer together until they reach the limit of 3 inches apart, and then as the power is increased the speed of the saw is increased to correspond. A saw must be speeded right to give the best results.

To aid in the selection of a saw and to determine its proper speed, we give the following table, based on a saw 48 inches in diameter:

Power	Distance from Point to Point of Teeth	Number of Teeth	Speed of Saw
6 H. P.	7 inches	22	300
8 "	7 "	22	300
10 "	6 "	24	300
12 "	6 "	24	350
15 "	5 "	30	400
20 "	5 "	30	450

To find the proper speed of larger or smaller saws, multiply the speed given of a 48-inch saw by 48 and divide the product by the size of the saw selected. A larger saw should have a greater number of teeth, and a smaller saw a lesser number, the distance apart remaining approximately the same.

Saws for cutting hardwood or frozen timber are usually run at higher speed and have a greater number of teeth.

Practical Hints Regarding Saw Mills and the Care of Saws

(Continued)

In ordering a saw mill or saw, the amount of power used, size and speed of driving pulley should always be given so that a pulley of the proper size may be sent with the mill and a suitable saw selected.

PROPER GAUGE OF SAWS.—For portable mills as a general rule we recommend 8″x9″ gauge saws. For larger power where saws are run at high speed, or for cutting valuable hard woods we recommend 9″x10″ gauge.

HOW TO HANG AND LINE SAWS.—It does not follow that because one saw will work well that another will do so on the same mandrel, or that two saws will hang alike on the same mandrel.

In hanging a new saw, after screwing it up between the collars examine carefully on the front or log side, and see if the front of the saw is flat. If it is found to be rounding on the log side, cut a ring of paper about half an inch wide, the size of the collar on the outside, oil it and stick iton the face of the fast collar around the outer edge. Then cut another ring of paper the same width, making the hole the same size as the hole in the loose collar; put this small ring between the loose collar and the saw, and screw up the collar. If the two rings are not enough, put in more until the saw comes flat and true. If the saw hangs dishing on the log side, reverse the rings of paper; that is, put the small rings between the saw and the fast collar, and the large ring against the loose collar. To do proper work, the saw must be perfectly flat and straight on the side next to the log.

DIRECTIONS FOR RUNNING CHISEL TOOTH SAWS.—First the saw should be placed on the mandrel where it is to be run, observing directions for hanging circular saws.

Should the saw run a little out of true on the rim, it may be made to run true by packing with writing paper between the saw and fast collar. It is necessary that the saw mandrel should be **perfectly level** so that the saw will hang **exactly plumb.**

Never attempt to run a saw **that is dishing** on the log side as it will be sure to draw towards the log. **The carriage track must be straight and level, so that the carriage can run true.**

HOW TO FILE AND KEEP IN ORDER CIRCULAR SAWS.—It is not well to file all of the teeth of circular saws from the same side of the saw, especially if each alternate tooth is bent for the set, but file one-half of the teeth from each side of the saw, and of the teeth that are bent from you, so as to leave them on a slight bevel—leave the outer corners a little the longest.

Never file any saw to sharp or acute angles at the throats or roots of the teeth, but on circular lines, as all saws are liable to crack from sharp corners.

Keep your saw round, so that each tooth will do its proportional part of the work.

Saw teeth wear narrow at the extreme points; consequently they must be kept spread so that they will be widest at the very points of the teeth; otherwise saws will not work successfully.

Teeth should be kept as near a uniform shape and distance apart as possible, in order to keep a circular saw in balance and condition for business.

Frosted steel is always brittle. No intelligent woodsman will use a good chopping axe on hard frozen timber until after he has taken the frost out of it, and no intelligent sawyer will attempt to set teeth of any saw without taking out the frost.

Practical Hints Regarding Saw Mills and the Care of Saws

(Continued)

The greatest wear on the saw is on the under edges of the teeth. File nearly to an edge (but not quite), leaving a short bevel of $\frac{1}{32}$ of an inch wide on the under side of the point. **But in no instance file to a fine point and thin wire edge.**

Be sure that the saw hangs properly on the mandrel.

The saw must be in proper line with the carriage and the carriage run true.

The mandrel must be level and run freely in the boxes.

Do nearly all the filing on the under sides of the teeth, and see that they are **well spread** at the points; file square and have them project alike on both sides of the saw.

If the saw heats in the center when the mandrel runs cool in the boxes, cool it off and line it into the log a little.

If the saw heats on the rim and not in the center, cool it off and line it out of the log a little—and vice versa if it heats in the centre. Every sawyer should have a side file to keep the teeth the same width.

Before commencing to insert the teeth, provide a cup of oil, which, together with the teeth, place conveniently near where you will stand, at the back of the saw. Take the wrench, place the pins in the holes in the shank, and turn it so that the hook projects sufficiently to receive the bit, pick up a tooth with the other hand and dip its grooved segment into the oil; then place in position and hold it firmly and even with the sides of the blade, while at the same time press the wrench downward until the shank fits into its place.

The chisel teeth are exact in width, and the spread uniformly good, and make smoother lumber than is made by the solid saw, even when not in the hands of first-class sawyers; but if extra nice work is desired, try a gauge on the side of each tooth, and if any are found to project a trifle too far, reduce them with a side file, being careful to preserve the same relief of the corner. No flat surface should be allowed on the sides of the teeth; they must be relieved from the very edge; then the saw will run straight, and with the least possible expenditure of power, and make smooth lumber. Practical use of the chisel bits has proven conclusively that in order to get the most and best use of them, when a set has been inserted and properly adjusted, they should remain until they are worn out, and as often as may be required edge them up by applying a file to their face or under side; after being sharpened several times they should be relieved on the side, so as to keep their corners sharp. Should a shank become straight or compressed, by reason of the saw having been run on iron, so that it will not hold the bit firmly, lay it on an anvil and strike it with a hammer on the inner edge until expended sufficiently to hold the bit.

Do not try the experiment of bending each alternate tooth for the set when using Inserted Tooth Saws.

Use a light hammer in swedging, about ¾ to 1 pound weight, holding the swedge so that the teeth will be spread at the points.

IN FILING SOLID-TOOTH CIRCULAR SAWS keep the throats or roots of the teeth round, or as the saws are when new. **Angles or square corners** filed at the roots of the teeth will almost invariably cause a saw to crack. The filing of such angles or square corners will cancel the warranty on any saw. **The back or top of the tooth leads or guides the saw** and should be filed square across. The under sides of the teeth may be filed a little beveled when they are bent alternately for the set, so as to leave the outer corner of the cutting edge longest.

LIST *of* BULLETINS

Issued to date by the

Joshua Hendy Iron Works

Iron Founders, Engineers and
Machinery Merchants

75 Fremont St., San Francisco, Cal.

No.	Subject	Date	Condition
100	Pinder Concentrator . . .	Nov. 1906,	Issued
101	Hendy Two and Three-stamp Mills,	Nov. 1906,	Exhausted (See No. 113)
102	Davis Horse Whim . . .	Oct. 1906,	Issued
103	Ore and Water Buckets . .	Jan. 1907,	Issued
104	Hendy Standard Ore Cars . .	Mar. 1907,	Issued
105	Hydraulic Water Gates, etc. .	Feb. 1907,	Issued
106	Hendy Hydraulic Giants . .	April 1907,	Issued
107	Ore Crushers	May 1907,	Exhausted (See No. 117)
108	Winches, Derricks, etc. . .	Nov. 1907,	Issued
110	Hendy Fire Monitors . . .	Nov. 1907,	Issued
111	Hendy Gravel Elevators . .	Aug. 1908,	Issued
113	Hendy Two and Three-stamp Mills,	June 1908,	Issued
114	Tangential Water Wheels, etc. .	Dec. 1908,	Issued
115	Matteson Ore Cars . . .	Dec. 1908,	Issued
116	Graupner Centrifugal Roller Mill .	Dec. 1908,	Issued
117	Crushers and Crushing Rolls .	Dec. 1908,	Exhausted (See No. 121)
118	Challenge Ore Feeders . .	Dec. 1908,	Issued
119	Stamp Mills, Standard . .	Jan. 1910,	In Press
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