ELISHA HANSON

THE

NATIONAL GEOGRAPHIC MAGAZINE

VOLUME VI

JANUARY, 1894, TO MAY, 1895

W J McGee, *Chairman* C. Hart Merriam
Publication Committee

WASHINGTON
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1895

OFFICERS OF THE NATIONAL GEOGRAPHIC SOCIETY

1894 AND TO MAY 31, 1895

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WASHINGTON

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ILLUSTRATIONS

PUBLICATIONS OF THE NATIONAL GEOGRAPHIC SOCIETY

Regular Publications

In addition to announcements of meetings and various circulars sent to members from time to time, the Society issues a single serial publication entitled The National Geographic Magazine. During the first two years of the existence of the Society this serial was issued in quarterly numbers. With the beginning of the third year of the Society and the third volume of the *Magazine* the form of publication was changed, and the serial appeared at irregular intervals in parts or brochures (designated by pages and designed either for separate preservation or for gathering into volumes), consisting either of single memoirs or of magazine brochures made up of articles, notes, abstracts, and other geographic matter, together with the Proceedings and other administrative records of the Society. By reason of a change in the Society's season and fiscal year, volume VI extended from January 1, 1894, to May 31, 1895, and later volumes will coincide with the new season, namely, June 1 to May 31. Moreover, the numbers will be issued regularly hereafter, at periods to be announced in the first number of the new volume.

The *Magazine* is forwarded gratuitously to all members of the Society. The subscription price to the public will be, hereafter, $2.00 a year. Members of the Society who want extra copies, and subscription agencies for the sale of the *Magazine*, are allowed a discount of thirty per cent.

National Geographic Magazine, Volumes I–VI

Table of Contents.	Prices. To members and agents.	Prices. To the public.	Number of copies on hand for sale.
Volume I, 1889: 4 numbers, 337 pages, 16 plates, and 26 figures	$1 40	$2 00	
No. 1: pp. 1–98, i–ii, 6 plates	35	50	171
Announcement. Introductory Address by the President, Gardiner G. Hubbard. Geographic Methods in Geologic Investigation; by W. M. Davis. The Classification of Geographic Forms by Genesis; by W J McGee. The Great Storm of March 11–14, 1888: Summary of Remarks by A. W. Greely. The Great Storm off the Atlantic Coast of the United States, March 11–14, 1888; by Everett Hayden. The Survey of the Coast; by Herbert G. Ogden. The Survey and Map of Massachusetts; by Henry Gannett. Proceedings. Certificate of Incorporation. By-laws. Officers, 1888. Members.			

Table of Contents.	Prices. To members and agents.	Prices. To the public.	Number of copies on hand for sale.
No. 2: pp. 99–182, 1 plate. Africa, its Past and Future; Annual Address by the President, Gardiner G. Hubbard. Report—Geography of the Land; by Vice-President Herbert G. Ogden. Report—Geography of the Sea; by Vice-President George L Dyer. Report—Geography of the Air; by Vice-President A. W. Greely. Report—Geography of Life; by Vice-President C. Hart Merriam. Annual Report of the Treasurer, Auditing Committee, and Secretaries. Certificate of Incorporation. Officers, 1889. By-laws. Members.	$0 35	$0 50	*
No. 3: pp. 183–276, 2 plates and 26 figures. The Rivers and Valleys of Pennsylvania; by William Morris Davis. Topographic Models; by Cosmos Mindeleff. Abstract of Minutes. International Literary Contest.	35	50	116
No. 4: pp. 277–335, 7 plates. Irrigation in California; by William Hammond Hall. Round about Asheville; by Bailey Willis. A Trip to Panama and Darien; by Richard U. Goode. Across Nicaragua with Transit and Machéte; by R. E. Peary.	35	50	
Volume II, 1890: 5 numbers, 347 pages, 9 plates, and 11 figures.	$1 40	$2 00	
No. 1: pp. 1–80. On the Telegraphic Determinations of Longitudes by the Bureau of Navigation; by J. A. Norris. Report—Geography of the Land; by Vice-President Herbert G. Ogden. Report—Geography of the Air; by Vice-President A. W. Greely. Reports of Treasurer, Auditing Committee, and Recording Secretary. Abstract of Minutes. Officers, 1890. Members.	35	50	6
No. 2: pp. 81–170, 1 plate and 7 figures. The Rivers of Northern New Jersey, with Notes on the Classification of Rivers in General; by William Morris Davis. A Critical Review of Bering's First Expedition, 1725–'30, together with a Translation of his Original Report; by Wm. H. Dall.	35	50	*
No. 3: pp. 171–230, 6 plates and 4 figures. The Arctic Cruise of the U. S. S. *Thetis* in the Summer and Autumn of 1889; by Charles H. Stockton. The Law of Storms Considered with Special Reference to the North Atlantic; by Everett Hayden. The Irrigation Problem in Montana; by H. M. Wilson.	35	50	*

Table of Contents.	Prices. To members and agents.	Prices. To the public.	Number of copies on hand for sale.
No. 4: pp. 231–286, 2 plates. Korea and the Koreans; by J. B. Bernadou. The Ordnance Survey of Great Britain; by Josiah Pierce, Jr. Geographic Nomenclature; by Herbert G. Ogden, Gustave Herrle, Marcus Baker, and A. H. Thompson.	$0 35	$0 50	12
No. 5: pp. 287–339, i–viii. Officers, 1890. Contents and Illustrations, volumes I and II. Announcement. Proceedings. Third Annual Report of the Secretaries. Report of the Treasurer and Auditing Committee. Summary of Reports on the Mount Saint Elias Expedition. By-laws. Standing Rules of the Board of Managers. Rules relating to Publication. Officers, 1891. Members, March 25, 1891. Index to Volumes I and II.	18	25	3
Volume III, 1891: 5 numbers, 296 pages, 21 plates, and 8 figures	$1 60	$3 00	169
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No. 4: pp. 53-204 (with 8 figures), plates 2–20, May 29, 1891. An Expedition to Mount St Elias; by I. C. Russell.	85	1 50	181
No. 5: Magazine brochure, pp. 205-261, i-xxxv, plate 21, February 19, 1892. The Cartography and Observations of Bering's First Voyage; by A. W. Greely. Height and Position of Mount Saint Elias; by I. C. Russell. The Heart of Africa; by E. C. Hore. Report of Committee on Exploration in Alaska. Notes. Index. Officers, 1891. Contents. Illustrations. Publications. Proceedings. Officers, 1892. Members, 1892.	40	75	197

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No. 4: Magazine brochure, pp. 59–96 (with 3 figures), plate 21, July 10, 1893. The Natural Bridge of Virginia; by C. D. Walcott. The Geographical Position and Height of Mount Saint Elias; by T. C. Mendenhall. The Improvement of Geographical Teaching; by W. M. Davis. An Undiscovered Island off the Northern Coast of Alaska; by Marcus Baker, E. P. Herendeen, and A. W. Greely. The Geologist at Blue Mountain, Maryland; by C. D. Walcott. The Great Populous Centers of the World; by A. W. Greely. Our Youngest Volcano; by J. S. Diller.	25	50	58
No. 5: pp. 97–256, January 31, 1894. Proceedings of the International Geographic Conference in Chicago, July 27–28, 1893: Introduction. Minutes of the Conference. Memoirs and Addresses. The Relations of Air and Water to Temperature and Life; by Gardiner G. Hubbard. The Relations of Geography to History; by Francis W. Parker. Norway and the Vikings; by Magnus Andersen. Geographic Instruction in the Public Schools; by W. B. Powell. The Relations of Geology to Physiography in our Educational System; by T. C. Chamberlin. The Relations of the Gulf Stream and the Labrador Current; by William Libbey, Jr. The Arid Regions of the United States; by F. H. Newell. Recent Explorations in Alaska; by Eliza Ruhamah Scidmore. The Caravels of Columbus; by Victor Maria Concas. In the Wake of Columbus; by Frederick A. Ober. Recent Disclosures concerning pre-Columbian Voyages to America in the Archives of the Vatican; by William Eleroy Curtis. Early Voyages along the Northwestern Coast of America; By George Davidson.	50	75	112
No. 6: Administrative brochure, pp. 257–263, i–lxviii, May 5, 1894. Officers, 1893. Contents. Illustrations. Publications. Proceedings. Sixth Annual Report of the Secretaries and Treasurer. Report of the Auditing Committee. By-laws. Officers, 1894. Honorary Members. Members, 1894. Index.	40	50	185

Table of Contents.	Prices. To members and agents.	Prices. To the public.	Number of copies on hand for sale.
Volume VI, 1894 and to May 31, 1895: 9 numbers, 291 pages, 15 plates, and 11 figures............	$2 10	$3 00	*
No. 1: pp. 1–22, February 17, 1894................ Geographic Progress of Civilization; Annual Address by the President, Gardiner G. Hubbard.	15	25	*
No. 2: pp. 23–34 (with 3 figures), plates 1–3, March 17, 1894 .... Shawangunk Mountain; by N. H. Darton.	15	25	*
No. 3: pp. 35–62, April 25, 1894.. .... Weather Making, Ancient and Modern; by Mark W. Harrington.	15	25	*
No. 4: pp. 63–126 (with 3 figures), plates 4–6, May 23, 1894...................... .... Geomorphology of the Southern Appalachians; by C. Willard Hayes and Marius R. Campbell.	40	75	*
No. 5: pp. 127–148 (with 1 figure), plates 7 and 8, June 22, 1894.... .... The Battle of the Forest; by B. E. Fernow.	15	25	*
No. 6: pp. 149–178 (with 1 figure), plate 9, November 1, 1894..... .... Surveys and Maps of the District of Columbia; by Marcus Baker.	25	50	*
No. 7: Magazine brochure, pp. 179–238 (with 3 figures), plates 10–14, December 29, 1894 .... The First Landfall of Columbus; by J. W. Redway. Japan; by D. W. Stevens. Geography of the Air; Annual Address by Vice-President A. W. Greely. Sir Francis Drake's Anchorage; by E. L. Berthoud. Note on the Height of Mount Saint Elias; by I. C. Russell. Geographic Notes; by Cyrus C. Babb. Laws of Temperature Control of the Geographic Distribution of Terrestrial Animals and Plants; Annual Address by Vice-President C. Hart Merriam.	35	50	*
No. 8: pp. 239–284, April 20, 1895................. Oregon: its History, Geography, and Resources; by John H. Mitchell.	35	50	280
No. 9: Administrative brochure, pp. lxxxiii, plate 15, October 31, 1895............ .... Officers, 1894. Contents. Illustrations. Publications. Proceedings. Seventh Annual Report of the Recording Secretary and Treasurer. Report of the Auditing Committee. By-laws. Officers, Season of 1895–'96. Members. Index.	15	25	500

*Edition exhausted. A limited number of copies will be purchased by the Society upon notification of copies for sale.

Orders for volumes or single numbers may be sent to booksellers or direct to the Secretary of the Society, 1515 H street N. W., Washington, D. C.

Irregular Publications

In the interest of exact bibliography, the Society takes cognizance of all publications issued either wholly or partly under its auspices. Each author of a memoir published in The National Geographic Magazine receives 25 copies, and is authorized to order any number of additional copies at a slight advance on the cost of press-work and paper. Contributors to the magazine are authorized to order any number of copies of their contributions at a slight advance on cost of presswork and paper, provided these separates bear the original pagination and a printed reference to the serial and volume from which they are extracted; such separates are, of course, bibliographically distinct. The *Magazine* is not copyrighted, and articles may be reprinted freely; a record of such reprints, so far as known, is kept.

PROCEEDINGS

OF THE

NATIONAL GEOGRAPHIC SOCIETY

January, 1894, to May, 1895

Abstract of Minutes

January 12, 1894. *89th meeting.*

Assembly Hall of Cosmos Club, 8 p m. Vice-President Mendenhall in the chair. Attendance, 125.

Report of Auditing Committee, appointed the 5th instant, read and approved.

The general topic, "Surveys and Explorations in Southeastern Alaska for the Alaska Boundary Commission," was discussed by Dr T. C. Mendenhall, Mr J. E. McGrath, Mr H. G. Ogden, Mr W. C. Hodgkins, Mr P. A. Welker, and Mr H. P. Ritter. The subject was illustrated by maps and lantern slides.

January 19, 1894. *Special meeting.*

National Rifles' Hall, 8 p m. President Hubbard in the chair. Attendance, 700.

Rev E. C. Smith delivered an illustrated lecture on The Ascent of Mount Rainier.

January 8, 11, 15, 18, 22, and 25, 1894.
Special course of afternoon lectures.

Large Hall of Columbian University, 4.15 p m.

Special course by Mr G. K. Gilbert on The Shaping of the Earth's Surface, under the divisions (1) Uplift and Erosion; (2 and 3) Water Work; (4) Interaction; (5) Ice Work; (6) Wind Work.

January 26, 1894. *90th meeting.*

Assembly Hall of Cosmos Club, 8 p m. President Hubbard in the chair. Attendance, 75.

The thanks of the Society were voted to Mr G. K. Gilbert for his able and instructive course of afternoon lectures.

The general topic, Alaskan Boundary Surveys, was discussed in detail by Mr J. A. Flemer, Mr E. F. Dickins, Mr O. H. Tittmann, Mr J. F. Pratt, and Lieutenant A. P. Niblack, U. S. N., the last three of whom used lantern-slide illustrations.

February 2, 1894. *91st meeting.*

Builders' Exchange Hall, 8 p m. Attendance, 300.

Annual address by the President, Hon Gardiner G. Hubbard, on The Geographic Progress of Civilization, illustrated by lantern slides.

February 9, 1894. *92d meeting.*

Assembly Hall of Cosmos Club, 8 p m. President Hubbard in the chair.

Hon Edwin Willits introduced the speaker, Dr C. Hart Merriam, who read a paper on Geographic Discoveries Made by the Biological Expeditions of the United States Department of Agriculture.

February 16, 1894. *Special meeting.*

Builders' Exchange Hall, 8 p m. President Hubbard in the chair. Attendance, 500.

Hon George C. Perkins, United States Senate, delivered an illustrated lecture on Pacific and Arctic Ocean Whaling Industry.

February 23, 1894. *93d meeting.*

Assembly Hall of Cosmos Club, 8 p m. President Hubbard in the chair. Attendance, 50.

Professor Mark W. Harrington read a paper on Weather Making, Ancient and Modern.

March 2, 1894. *Special meeting.*

Builders' Exchange Hall, 8 p m. President Hubbard in the chair. Attendance, 300.

Major J. W. Powell delivered an address upon The Water Supply of the United States.

March 9, 1894. *94th meeting.*

Assembly Hall of Cosmos Club, 8 p m. Vice-President Gannett in the chair. Attendance, 50.

Dr C. Willard Hayes delivered an address upon The Physiography of a Portion of the Southern Appalachians, as Illustrated by a Relief Map of the Chattanooga District; and Mr M. R. Campbell read a paper on Tertiary Changes in the Drainage of Southwestern Virginia.

March 16, 1894. *Special meeting.*

National Rifles' Hall, 8 p m. President Hubbard in the chair. Attendance, 700.

Professor William H. Pickering delivered an illustrated lecture upon Explorations in the Andes of South America.

March 23, 1894. *95th meeting.*

Assembly Hall of Cosmos Club, 8 p m. President Hubbard in the chair. Attendance, 125.

The amendments to the by-laws proposed February 23 were laid upon the table. (These proposed amendments created five classes of members—Active Members, Fellows, Honorary Members, Honorary Fellows, and Corresponding Members.)

Mr Marcus Baker delivered an address upon The Survey and Maps of the District of Columbia.

March 30, 1894. *Special meeting.*

Builders' Exchange Hall, 8 p m. President Hubbard in the chair. Attendance, 550.

Mr Willard D. Johnson delivered an illustrated lecture upon The Problem of the Yosemite.

April 4, 1894. *Special meeting.*

Assembly Hall of Cosmos Club, 8 p m. Mr W J McGee in the chair. Attendance, 125.

Dr Carl Lumholtz delivered an illustrated address upon The Cliff-dwellers of Mexico.

April 6, 1894. *96th meeting.*

Assembly Hall of Cosmos Club, 8 p m. Mr G. K. Gilbert in the chair. Attendance, 50.

Mr Henry Gannett read a paper upon Statistics of our Industries.

April 13, 1894. *Special meeting.*

Builders' Exchange Hall, 8 p m. President Hubbard in the chair.

Mr H. M. Wilson delivered an illustrated address entitled From Bombay to the Himalayas.

April 19, 1894. *97th meeting.*

Assembly Hall of Cosmos Club, 8 p m. Mr Henry Gannett in the chair. Attendance, 75.

The general topic was The Public Lands of the United States, discussed under the following heads and by the following speakers: The National Domain, by Mr F. H. Newell; The Texas Land System, by Mr R. U. Goode; The Public Lands of Idaho, by E. T. Perkins, Jr.; and The Public Domain in its Social Aspect, by Mr Arthur P. Davis. The papers were discussed by Mr J. B. Thompson and Mr W. A. Croffut.

April 20, 1894. *Field meeting.*

Eighty members and guests attended an excursion to Virginia Beach and the Dismal Swamp. Mr G. K. Gilbert and Dr David T. Day took charge of the two parties, and in the evening a meeting was held at the Princess Anne Hotel, Virginia Beach.

April 21, 1894. *Special meeting.*

National Rifles' Hall, 8 p m. President Hubbard in the chair. Attendance, 500.

Mr Frank Hamilton Cushing delivered an illustrated lecture upon The Geographic Origin and Distribution of the Pueblo Indians.

May 4, 1894. *98th meeting.*

Assembly Hall of Cosmos Club, 8 p m. Mr G. K. Gilbert in the chair. Attendance, 125.

Mr Henry Farquhar, in behalf of the excursion party to the Dismal Swamp, thanked the committee for the able and efficient manner in which the plans were carried out.

Mr R. T. Hill delivered an illustrated lecture upon The Mountains of Mexico, and remarks were made by Mr H. M. Wilson and Señor Don M. Romero, the Mexican minister.

May 11, 1894. *Special meeting.*

Builders' Exchange Hall, 8 p m. President Hubbard in the chair. Attendance, 600.

Mr Paul B. Du Chaillu delivered an illustrated lecture upon The Dwarfs and Forests of Central Africa.

May 18, 1894. *99th meeting.*

Assembly Hall of Cosms Club, 8 p m. Dr C. Hart Merriam in the chair. Attendance, 75.

Dr T. C. Mendenhall read a paper upon The Northeastern Boundary of the United States.

Professor R. T. Hill spoke of The Geography of Cuba; and Professor C. V. Riley discussed The Periodic Appearance of the Cicada.

May 25, 1894. *Special meeting.*

Builders' Exchange Hall, 8 p m. President Hubbard in the chair. Attendance, 500.

Mr Alfred F. Sears delivered an illustrated lecture upon Peru.

June 1, 1894. *100th meeting.*

Large Hall of Columbian University, 8 p m. President Hubbard in the chair. Attendance, 250.

Letters of congratulation to the Society upon the occasion of its one hundredth regular meeting were read from Hon Charles P. Daly, president of the American Geographical Society, and from Mr P. S. Moxom, president of the Appalachian Mountain Club. General A. W. Greely, U. S. A., spoke upon The Work of Foreign Geographic Societies, and remarks were made by Bishop John J. Keane, Hon J. H. Outhwaite, Dr J. C. Welling, and Mr Charles D. Walcott.

(For remaining meetings, up to May 31, 1895, see accompanying Calendar, season of 1894–'95.)

NATIONAL GEOGRAPHIC SOCIETY CALENDAR, SEASON OF 1894–'95

Oct. 19.* Japan: its Geography, Resources, and Future, Hon D. W. Stevens
Introductory Remarks by His Excellency Mr Kurino, the Japanese Minister.
Oct. 26.* The Elements of Physiography.........Major J. W. Powell
Nov. 2.† The Science of Geography...General A. W. Greely, U. S. A.
The First Landfall of Columbus in the Light of Early Cartography.............................Mr J. W. Redway
Nov. 9.* Physiographic Processes.................Major J. W. Powell
Nov. 16.† The Origin and Configuration of the Upper Alpine Passes, Dr Lafayette C. Loomis
Nov. 23.* From Cape Town into the Countries of the Ma-Shukulumbe, Dr Emil Holub
Nov. 30.† Recent Results in Oceanography, Ensign Everett Hayden, U. S. N.
The Sigsbee Deep-sea Sounding Machine, Commander C. D. Sigsbee, U. S. N.
The Outfit and Cruises of the U. S. F. C. S. *Albatross*, Commander Z. L. Tanner, U. S. N.
§Dec. 7.* The Land of the Midnight Sun......Mr Paul B. Du Chaillu
Dec. 14.† The Geographic Distribution of Soils, Professor Milton Whitney
The Geographic Distribution of Life....Dr C. Hart Merriam
Dec. 21.* The Political Geography of Asia........Hon John W. Foster
Dec. 28. The Economic Aspects of Erosion.....Professor N. S. Shaler
Joint Meeting with American Forestry Association, in the National Museum. Introductory Remarks by Hon J. Sterling Morton, Secretary of Agriculture.
Jan. 4.* Labor and Industries of the South....Hon Carroll D. Wright
Jan. 11.† The Northern Appalachians...............Mr Bailey Willis
Jan. 18.* The Nicaragua Canal...................Hon John R. Procter
Jan. 25.† The Pikean, Julian, Plantagenian, and Itascan Sources of the Mississippi.....................Elliott Coues, M. D.
§Feb. 1.* The Seine, the Meuse, and the Moselle, Professor William M. Davis
Feb. 8.† Topographic Forms, Major Gilbert Thompson, Mr G. W. Littlehales
§Feb. 15.* Shakespeare's England..................Rev G. Arbuthnot
Feb. 22.† Practical Results of the Bering Sea Arbitration, Mr J. Stanley-Brown
§Mar. 1.* Recent Discoveries in Assyria and Babylonia, Rev Dr Francis Brown

§Mar. 8.‖ The International Boundary between Mexico and the United States . . . . Mr A. T. Mosman, Mr Stehman Forney, Captain E. A. Mearns, U. S. A.

§Mar. 15.* The Ottoman Empire . . . . Dr Cyrus Adler

§Mar. 18.¶ Washington to Pittsburg and to Niagara Falls:
Across the Appalachians . . . . Dr David T. Day
Side Trip to Niagara Falls . . . . Mr G. K. Gilbert

Mar. 20. Reception at the Arlington Hotel, Washington, D. C., 9 to 12 p m.

§Mar. 22.¶ Pittsburgh to Yellowstone National Park:
Pittsburgh to St Paul, through the Oil and Gas Regions, Professor Edward Orton
St Paul to Yellowstone National Park; Wonderland of the Yellowstone . . . . Mr Henry Gannett

§Mar. 22.‖ The Alaskan Boundary Survey, Mr J. E. McGrath, Mr J. F. Pratt, Mr H. P. Ritter

§Mar. 25.‡ Yellowstone National Park to Sacramento:
The Northern Rockies; Down the Columbia; Mount Rainier and Portland . . . . Mr E. T. Perkins, Jr.
Portland to Crater Lake; Mount Shasta and Sacramento, Mr J. S. Diller

§Mar. 29.‡ Sacramento to Northern Arizona:
Sacramento; the Golden Gate; Yosemite; Los Angeles; San Bernardino . . . . Mr Arthur P. Davis
From San Bernardino across the Deserts to San Francisco Mountain, Arizona . . . . Major J. W. Powell

Mar. 29.* Oregon: its Geography, History, and Resources, Hon J. H. Mitchell

§April 2.‡ The Grand Canyon and Sonora, Mexico:
Salt Lake City to the Grand Canyon; a Winter in the Depths of the Canyon . . . . Mr Charles D. Walcott
Prescott, Phœnix, and Tucson, to Sonora, Mexico; Visit to the So-called Cannibals . . . . Mr W J McGee

§April 4.‡ The Zulu-Ma-Atabele, and Modes of Travel in South Africa, Dr Emil Holub

§April 5.‡ Across the Rocky Mountains to Denver:
Northern Arizona, the Rio Grande, and across the Mountains to Denver . . . . Professor A. H. Thompson
The Home of the Pueblo Indians, Mr Frank Hamilton Cushing

April 5.† Some Physical Features of Lake Superior, Professor Mark W. Harrington

§April 8.‡ Denver to Washington:
Denver to Pueblo, down the Arkansas River, and across the Plains to St Louis . . . . Mr F. H. Newell
St Louis to Washington; the Great Caves of Kentucky and Virginia . . . . Major Jed. Hotchkiss

April 12.‖ The Physical Geography, Geology, Agriculture, Religions, and Missionary Literary Institutions of the Turkish Empire, Rev Henry H. Jessup, D. D.

§April 19.† The Geography and Geology of Costa Rica and Panama, Mr Robert T. Hill

§April 26.* The Antiquities and Aborigines of Peru, Mr Frank Hamilton Cushing

§April 29.‡ Siberia: its Geography and Resources...Mr George Kennan

May 3.* Fredericksburg and Vicinity; a Symposium Preparatory to the Field Day:

Geography and Geology (15 minutes)..Mr N. H. Darton

Surveying, Mapping, and Bridging (15 minutes), Major Gilbert Thompson

The Battles:

As seen from the Northern Side (20 minutes), General John Gibbon, U. S. A.

As seen from the Southern Side (20 minutes), Major Jed. Hotchkiss, C. S. A.

May 4. Excursion and Field Meeting, Fredericksburg, Virginia, 9 a m to 6 p m.

§May 10.* President's Annual Address: Russia. (Joint Meeting of the Scientific Societies.)............Hon Gardiner G. Hubbard

May 17.† The United States Commission of Fish and Fisheries and its Relations with the Navy..Commander Z. L. Tanner, U. S. N.

§May 24.‖ The Geography and Geology of Costa Rica and Panama. (Repeated by request.)...................Mr Robert T. Hill

May 31.† Annual Meeting for Reports, Action on Amendments to By-laws, and Election of Officers.

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* National Rifles' Hall, 8 to 9.15 p m.
† Cosmos Club Hall, 8 to 10 p m.
‡ National Rifles' Hall, 4.15 to 5.30 p m.
§ Lecture illustrated by lantern slides.
‖ Columbian University, 8.15 to 9 30 p m.
¶ Columbian University, 4.15 to 5.30 p m.

SEVENTH ANNUAL REPORT OF THE RECORDING SECRETARY

(*Presented to the Society May 31, 1895*)

Office of the Secretary,
1515 H Street N. W.,
Washington, D. C., *May* 31, 1895.

The season ending today has been one of the most successful in the annals of the Society, not only as regards increase of membership, but by reason of the great interest shown in the meetings, the large attendance of members and guests, and the character and number of the papers read.

The present membership is 1,178, consisting of 893 active, 274 corresponding, and 11 honorary members. Of this total number 423 have been elected since January 1, 1894, and 365 since June 1, 1894, numbers largely in excess of those elected during a similar period at any former time in our history.

To illustrate graphically the number of members elected each month since the Society was organized (in January, 1888), the length of time each member has remained in the Society, and the present membership, the accompanying membership diagram has been prepared. A glance at this diagram indicates very clearly the fact that our membership has increased very rapidly, and that a comparatively small proportion of those elected discontinue their membership. (See Plate 15.)

The change in the Society's fiscal year from the calendar year to that of the year from June 1 to May 31, now in effect, has of course been attended with some little embarrassment in connection with the publication of the *Magazine*, the dues of members, etc, but the great advantages of the change more than outweigh such temporary difficulties. By far the greater part of the energy of the Society is expended during the winter season, and it is therefore very desirable that its management should be continuous from summer to summer, rather than that there should be a periodic change, or at least liability to change, of its Board of Managers in the midst of the season of its greatest activity.

Owing to this change, the period now under review covers the interval from January 1, 1894, to date, but for comparison with future seasons, and as a just indication of what may fairly be expected during each coming season, it is of interest to review some of the principal features of our operations during the period from October last up to the present time.

During this season we have had 17 regular meetings and 28 special meetings, the latter including the reception, field meeting, and joint meeting of the Scientific Societies, making a total of 45 meetings, with 75 speakers. The average attendance at the regular or technical meetings (held for the most part in the Assembly Hall of the Cosmos Club) has been 170, and at the special or popular meetings (in National Rifles' Hall), 777. As a comparative measure of the Society's activity it need only be added that in 1890 there were but 17 meetings held altogether, with far smaller average attendance.

Especial interest has been shown in a course of illustrated afternoon lectures descriptive of a trip across the continent and back again, each lecture by two speakers who took up the thread of the story, in turn, and described in a popular way, and with a very fine series of lantern illustrations, the geography and most striking natural and artificial features of the region traversed. Each speaker was a recognized authority regarding his portion of the route, and the course proved to be a brilliant and gratifying success—so much so, in fact, that a similar course will undoubtedly be a feature of each of our coming seasons.

The accompanying calendar gives a brief but complete résumé of the entire series of lectures, so that but little more need be said. Reference should be made, however, to the very successful reception at The Arlington the evening of March 20th, and the excursion to Fredericksburg, Va., on May 4th, where a field-meeting was held and the day passed amidst scenes of great natural beauty as well as of great geographic and historic interest. None of the expense of the reception or excursion was charged to the Society's treasury, but those who participated paid the entire cost, which was, of course, comparatively small, by reason of the excellent management by the committees and the facilities secured by the organization of the Society.

Mention should be made of a lecture delivered under the auspices of the Society by Mrs Robert E. Peary, in aid of the fund to equip an expedition to bring her husband, the distinguished arctic explorer, home this summer, at the close of his season's work in northern Greenland, rather than leave him there to endure the useless delay and hardship of another arctic winter. Our Board of Managers, as a slight recognition of interest in and approval of the plan, voted to appropriate a sum sufficient to pay the expenses of a lecture by Mrs Peary and to give her the gross receipts, and in this way, thanks largely to her own energy and the interest of the public in her fascinating story of arctic life, the Society was enabled, at comparatively small expense, to add $400 to the fund—a result especially gratifying by reason of the fact that Lieutenant Peary is one of our own members. This incident furnishes in itself a good example of the practical effectiveness of our organization in aiding actual geographic research, as well as in increasing and diffusing geographic knowledge.

Strong support has been given during past years by our Board of Managers to the project of uniting into a closer union the various scientific societies of this city, and during the past season this object has been consummated in a way that is gratifying to its earnest supporters and at the same time satisfactory to the more conservative. The present organization and powers of the Joint Commission seem to be worthy of strong support and approval, and there is every reason to believe that its practical results will be satisfactory and mutually advantageous to the societies represented.

The meeting this summer in London of the Sixth International Geographical Congress promises to mark an epoch in the history of geographic progress, and this Society will be represented by a delegation which, by authority of the Board of Managers, will extend a cordial invitation to the Congress to hold its next meeting in this city. It is hoped that this eminent and influential body will soon honor this country with its presence, and our Society can then justly claim to have aided very greatly in the advance of geographic knowledge in the United States, as the far-reaching influence of such a meeting can hardly be overestimated.

The library of the Society has received, in addition to the regular exchanges, a large number of valuable gifts, notable amongst which have been complete sets of Wheeler's and Ives' Reports, through the courtesy of the Chief of Engineers, U. S. Army; several very handsome volumes from His Imperial Highness the Archduke Ludwig Salvator, of Austria; and a number of standard geographic works from Mr E. L. Berthoud, of Golden, Colorado. The library is now well worthy of a larger and more accessible room than has been available hitherto; this matter is now under consideration and will doubtless soon be settled in a way that will add greatly to our facilities for geographic study.

The National Geographic Magazine, the official publication of the Society, has maintained its high standard in spite of the difficulties of publication by a committee whose members can ill afford the time and effort required. It is but fair to state that by far the greater part of the work and responsibility has fallen to the chairman of the committee, Mr W J McGee, to whom credit for results achieved, in spite of many difficulties, is therefore largely due. The accompanying complete statement of the contents of the *Magazine*, volumes I to VI, with a list of prices and number of copies on hand for sale, will, it is thought, be of general interest to members and others. From this statement it will be seen, too, that it is proposed to publish the *Magazine* hereafter bimonthly.

For the coming season it is thought desirable to secure still larger halls for both our popular and technical meetings, as we have entirely outgrown those hitherto used. Arrangements have already been made to bring about this result, and the coming season will doubtless show a still larger membership and attendance. It is likely, too, that a plan will be perfected by which regular notices of meetings can be sent to every member—if not weekly, at least every two weeks—in place of the calendars that have been issued from time to time, at irregular intervals, during the past year. It should be understood, however, that the advantages of such regular notices have not at any time been underestimated, but the item of expense for postage has been very heavy—indeed, far more so than one can realize at first thought. With 900 active members a weekly notice—even using postal cards—costs, including printing and addressing, about $12.00, or say $400 a year, and it was thought that if half of this amount could be saved, without material inconvenience, it was well worth trying; the printing is a small item in comparison with the expense of postage, and the calendars that have been issued, in conjunction with the notices in the daily press each week, would seem to answer the purpose almost as well and at far less expense.

The thanks of the Society are due to the authorities of Columbian University for the use upon several occasions of their large hall free of expense; to the many able and eminent men who have contributed so largely to the value and success of our meetings, animated solely by their love of the subject and their appreciation of the objects of the Society; and to the members of the Board of Managers, who have devoted so much of their time and energy to the duties of their positions, feeling sufficiently rewarded by the growth and success of the Society. Without such earnest and voluntary assistance on every side it would, of course, be wholly impossible to accomplish what we are doing, even with largely increased annual dues, and the fact that this Society, although so young in years, is so firmly established and doing such effective work can justly be regarded as creditable to the United States, and especially to its birthplace, the city of Washington.

EVERETT HAYDEN,
Recording Secretary.

SEVENTH ANNUAL REPORT OF THE TREASURER

(Presented to the Society May 31, 1895)

WASHINGTON, D. C., *May 31, 1895.*

To the President and Members, National Geographic Society:

I have the honor to submit herewith my annual report, together with statement of assets as at the close of the year ending May 31.

On account of alterations made in the by-laws, by which the end of the fiscal year was changed from December 31 to May 31, the present account covers a period from January 1, 1894, to May 31, 1895.

The receipts for dues for the season of 1894 amounted to $2,811, while those for that of 1895 amount to $3,642, or an increase of nearly 30 per cent.

The assets of the Society consist of:

American Security and Trust Company 5 per cent bonds......		$450 00
Cash on hand, deposited with Bell & Co.............	$107 49	
in possession of Secretary............	50 00	
		157 49
Unpaid dues for the years 1894 and 1895....................		1,321 00
		$1,928 49

All bills up to this date have been paid, and therefore there are no liabilities.

Respectfully submitted.

C. J. BELL,
Treasurer.

DR. THE TREASURER *in account with* THE NATIONAL GEOGRAPHIC SOCIETY. CR.

Date	Receipts			
1895. May 31.	To balance on hand January 5, 1894			$307 80
	Cash received for dues: 1892	$30 00		
	" " " " 1893	233 00		
	" " " " 1894	2,809 00		
	Cash received for dues:			
	Season 1894–'95	3,642 00		
	" 1895–'96	99 00		
	Cash received for life membership	50 00		
				6,863 00
	Interest on investment			17 76
	Receipts from sale of magazine			136 33
	" " " lecture tickets			29 50
	Proceeds from exhibit of Sella collection			15 55
	Loan from American Security and Trust Co.			250 00
	Loan from Bell & Co.			150 00
	Amount received from American Book Co. for monographs			400 00
				$8,169 94

Date	Payments		
1895. May 31.	By cash paid for:		
	Publication of magazine		$1,653 25
	Expenses of meetings		2,407 14
	Salaries of Secretaries		1,584 00
	Sundries, including printing, postage, freight, stationery, furniture, joint directory, etc.		1,241 91
	Magazines for library		14 50
	Investment of life membership dues.		150 00
	Repayment of loan, $150, and interest, $2.24 (Bell & Co)		152 24
	Repayment of loan, $250, and interest, $9.41 (American Security and Trust Co.)		259 41
	Rent of Secretary's office		75 00
	Authors' rights in monographs		400 00
	Expenses of Peary lecture		75 00
	Balance on hand with Bell & Co.	$107 49	
	With Secretary	50 00	
			157 49
			$8,169 94

WASHINGTON, D. C., *May 31, 1895.*

C. J. BELL, *Treasurer.*

REPORT OF THE AUDITING COMMITTEE

(*Presented to the Society May 31, 1895*)

WASHINGTON, D. C., *July 10, 1895.*

The President and Members of the National Geographic Society:

We, a committee appointed at the annual meeting of May 31, 1895, to audit the accounts of the Treasurer for the period from January 1, 1894, to May 31, 1895, beg to submit the following report:

The Treasurer's statement of receipts, consisting of dues from members, life-membership fees, interest on investments, sale of magazines and tickets, and of amounts received from miscellaneous sources, has been examined and found correct, as shown by the books of his office.

The vouchers for expenditures have been examined and found correct. The return checks (except fifteen which had not been cashed at time of the closing of the Treasurer's account) were compared with the vouchers and found to agree.

We have examined the bank book, showing the account with Messrs Bell & Co., and found the cash balance to be four hundred and twenty-nine dollars and sixty cents, which exceeded the Treasurer's reported balance of one hundred and seven dollars and forty-nine cents by three hundred and twenty-two dollars and eleven cents, the amount of the fifteen return checks referred to in the paragraph above, one of which represented $50 advanced to the Secretary.

The amount of outstanding dues reported by the Treasurer as $1,326 was carefully examined and found correct. We have prepared a full list of these outstanding dues for the use of the next Auditing Committee.

The four bonds of $100 each and one of $50, registered in the name of the Society, were inspected by us in the hands of the Treasurer.

WM. A. DECAINDRY,
H. C. RIZER,
Auditing Committee.

BY-LAWS

As Adopted with Amendments up to May 31, 1895

ARTICLE I. Name.

The name of this Society is the "National Geographic Society."

ARTICLE II. Object.

The object of this Society is the increase and diffusion of geographic knowledge.

ARTICLE III. Membership.

The members of this Society shall be persons who are interested in geographic science. There may be three classes of members—active, corresponding, and honorary.

Active members only shall be members of the corporation; shall be entitled to vote and may hold office.

Persons residing at a distance from the District of Columbia may become corresponding members of the Society. They may attend its meetings, take part in its proceedings, and contribute to its publications.

Persons who have attained eminence by the promotion of geographic science may become honorary members.

Corresponding members may be transferred to active membership, and, conversely, active members may be transferred to corresponding membership by the Board of Managers.

The election of members shall be entrusted to the Board of Managers.

ARTICLE IV. Officers.

The officers of the Society shall be a President, six Vice-Presidents, a Treasurer, a Recording Secretary, and a Corresponding Secretary.

The above-mentioned officers, together with eight other members of the Society, known as Managers, shall constitute a Board of Managers. Officers and Managers shall be elected annually, by ballot, a majority of the votes cast being necessary to an election; they shall hold office until their successors are elected; and shall have power to fill vacancies occurring during the year.

The President, or, in his absence, one of the Vice-Presidents, shall preside at the meetings of the Society and of the Board of Managers; he shall, together with the Recording Secretary, sign all written contracts and obligations of the Society, and attest its corporate seal; he shall deliver an annual address to the Society.

Each Vice-President shall represent in the Society and in the Board of Managers a department of geographic science, as follows:

Geography of the Land; Geography of the Sea; Geography of the Air; Geography of Life; Geographic Art; Commercial Geography.

The Vice-Presidents shall foster their respective departments within the Society; they shall present annually to the Society summaries of the work done throughout the world in their several departments.

They shall be elected to their respective departments by the Society.

The Treasurer shall have charge of the funds of the Society, shall collect the dues, and shall disburse under the direction of the Board of Managers; he shall make an annual report; and his accounts shall be audited annually by a committee of the Society and at such other times as the Board of Managers may direct.

The Secretaries shall record the proceedings of the Society and of the Board of Managers; shall conduct the correspondence of the Society; and shall make an annual report.

The Board of Managers shall transact all the business of the Society, except such as may be presented at the annual meeting. It shall formulate rules for the conduct of its business. Five members of the Board of Managers shall constitute a quorum at regular meetings and nine members at special meetings.

ARTICLE V. Dues.

The initiation fee for active members shall be two dollars, payable upon notice of election.

The annual dues of active members shall be five dollars, and of corresponding members two dollars.

The fiscal year and season of the Society shall begin on the first day of June and end on the thirty-first day of May, and the annual dues of members shall be payable on or before the last day of October, or, in the case of new members, within thirty days after election.

Annual dues may be commuted and life membership acquired by the payment of fifty dollars.

No member in arrears shall vote at the annual meeting, and the names of members two years in arrears shall be dropped from the roll of membership.

ARTICLE VI. Meetings.

Regular meetings of the Society shall be held on alternate Fridays, from November until May, and excepting the annual meeting they shall be devoted to communications. The Board of Managers shall, however, have power to postpone or omit meetings, when deemed desirable. Special meetings may be called by the President.

The annual meeting for the election of officers shall be the last regular meeting in May.

The Board of Managers shall set apart a time and place for the annual address of the President and Vice-Presidents.

A quorum for the transaction of business shall consist of twenty-five active members.

ARTICLE VII. Publications.

The Society shall publish a journal or periodical under the title The National Geographic Magazine, which shall be sent to all members of the Society and may be placed on sale.

ARTICLE VIII. Amendments.

These by-laws may be amended by a two-thirds vote of the members present at any regular meeting, provided that written notice of the proposed amendment has been given, signed by at least ten active members, at a regular meeting held at least four weeks previously. They may also be amended by a two-thirds vote of the voters present at the annual meeting: provided, however, that written notice of the proposed amendment has been given at a regular meeting held at least four weeks previous to the annual meeting.

Printed notice shall be sent to all active members of amendments proposed for action at the annual meeting.

OFFICERS OF THE SOCIETY

SEASON OF 1895-'96

(*Elected at the Annual Meeting, May 31, 1895*)

President

GARDINER G. HUBBARD

Vice-Presidents

CHAS. W. DABNEY, JR, *Land*
HERBERT G. OGDEN, *Sea*
A. W. GREELY, *Air*
C. HART MERRIAM, *Life*
W. W. ROCKHILL, *Geographic Art*
HENRY GANNETT, *Commercial Geography*

Treasurer

CHARLES J. BELL

Recording Secretary

EVERETT HAYDEN

Corresponding Secretary

ELIZA R. SCIDMORE

Managers

MARCUS BAKER
H. F. BLOUNT
G. K. GILBERT
JOHN HYDE
W J McGEE
F. H. NEWELL
W. B. POWELL
J. R. PROCTER

MEMBERS OF THE NATIONAL GEOGRAPHIC SOCIETY

May 31, 1895

HONORARY MEMBERS

His Excellency Grover Cleveland,
President of the United States,
Washington, D. C.

Don Christóbal Colón de Toledo de la Cerda y Gante,
Duke of Veragua and Marquis of Jamaica,
Madrid, Spain.

Sir Archibald Geikie,
28 Jermyn street, London, England.

Honorable Charles P. Daly,
84 Clinton place, New York, N. Y.

Dr George M. Dawson,
Canadian Geological Survey, Ottawa, Canada.

Emmanuel de Margerie
132 rue de Grenelle, Paris, France.

Dr John Murray,
Challenger office, Edinburgh, Scotland.

Baron Adolf E. Nordenskiöld,
Stockholm, Sweden.

Ferdinand, Freiherr von Richthofen,
Kurfürstenstrasse 117, Berlin W., Germany.

His Imperial Highness the Archduke Ludwig Salvator
of Austria,
Vienna, Austria.

Dr D. Estanislao S. Zeballos,
Buenos Ayres, Argentina.

ACTIVE MEMBERS

ABBE, PROFESSOR CLEVELAND, Weather Bureau.

ABBOTT, MRS G. E., 2611 Fourteenth street.

ABERT, S. T., 722 Seventeenth street.

ABRAHAMS, MISS L. C., 1106 New Hampshire avenue.

ACKERMAN, LIEUTENANT A. A., U. S. Navy, Navy Department.

ACKLEY, LIEUTENANT COMMANDER S. M., U. S. Navy, Commanding U. S. S. *Yantic.*

ADAMS, CYRUS C., 512 Madison street, Brooklyn, N. Y.

ADAMS, MISS JULIA M., Fourth Auditor's office.

ADDISON, A. D., 808 Seventeenth street.

ADDISON, MRS MURRAY, 1756 N street.

ADLER, DR CYRUS, Smithsonian Institution.

ALBRECHT, F. J., 175 Fifth avenue, Chicago, Ill.

ALDEN, COLONEL C. H., U. S. Army, War Department.

ALEXANDER, T. H., 1207 N street.

ALLEN, REVEREND ADOLOS, 905 I street.

ALLEN, MISS A. AUGUSTA, Care of Miss Van Dyke, 1301 K street.

ALLEN, DR J. A., American Museum of Natural History, New York, N. Y.

ALLENDER, CHARLES H., 706 Twelfth street N. E.

ALTON, EDMUND, 1706 Pennsylvania avenue.

ALVORD, MAJOR HENRY E., Lewinsville, Fairfax county, Virginia.

AMES, JOHN G., 1600 Thirteenth street.

ANDERSON, JOS. W., M. D., 1911 Eleventh street.

ANDREWS, COLONEL G. L., U. S. Army, 2400 Columbia road.

ANDREWS, ENSIGN PHILIP, U. S. Navy, U. S. S. *Raleigh*.

ANDREWS, WELLS F., Treasury Department.

APLIN, S. A., JUNIOR, U. S. Geological Survey.

APPLEBY, J. F. R., M. D., 1430 Thirty-third street.

ARRIAGA, SEÑOR DON A. LAZO, E. E. and M. P., 1755 M street.

ASHLEY, OSBORN, 428 New Jersey avenue.

ASPINWALL, REVEREND J. A., 17 Dupont circle.

ATKINSON, WADE H., M. D., 618 Twelfth street.

AUERBACH, CARL, 800 Seventh street.

AUHAGEN, WILHELM, Naval Observatory.

AYDELOTTE, WM., 1352 Q street.

AYRES, MISS SUSAN C., 1813 Thirteenth street.

BABB, CYRUS C., U. S. Geological Survey.

BABCOCK, MAJOR J. B., U. S. Army, 2005 G street.

BACON, MRS E. O., 915 Sixteenth street.

BADGER, COMMODORE O. C., U. S. Navy, 1517 Twentieth street.

BAILEY, PAST ASSISTANT ENGINEER F. H., U. S. Navy, Navy Department.

BAILEY, VERNON, Agricultural Department.

BAKER, MARCUS, U. S. Geological Survey.

BALDWIN, A. L., 722 Sixth street N. E.

BALDWIN, H. L., JUNIOR, U. S. Geological Survey.

BALDWIN, WM. D., 25 Grant place.

BALL, CHARLES B., 942 T street.

BALLANTYNE, WM., 1328 Vermont avenue.

BALLINGER, MRS MADISON A., 1303 Clifton street.

BALLOCH, GENERAL G. W., P. O. Box 557.

BARBER, A. L., 802 F street.

BARBER, AMHERST W., 1216 D street N. E.

BARCLAY, MRS MARY M., 1771 Madison street.

BARKER, CAPTAIN A. S., U. S. Navy, Navy Yard, Mare Island, Cal.

BARNARD, E. C., U. S. Geological Survey.

BARNARD, JOB, 1306 Rhode Island avenue.

BARNARD, R. P., 1011 O street.

BARRINGTON, WM. L., 3514 N street.

BARRY, CHARLES E., 1421 G street.

BARTLE, R. F., Falls Church, Va.

BARTLETT, CAPTAIN J. R., U. S. Navy, Providence, R. I.

BARTON, MISS MARY L., Treasury Department.

BATCHELDER, GENERAL R. N., U. S. Army, War Department.

BATES, MAJOR F. H., U. S. Army, 1519 Thirty-first street.

BATES, DR HENRY H., The Portland.

BATES, MEDICAL DIRECTOR NEWTON L., U. S. Navy, The Shoreham.

BEAMAN, GEORGE HERBERT, 2232 Massachusetts avenue.

BEAMAN, WM. M., U. S. Geological Survey.

BEARDSLEY, MEDICAL DIRECTOR G. S., U. S. Navy, 1704 Connecticut avenue.

BECKHAM, MISS BLANCHE, 2721 N street.

BELL, DR A. GRAHAM, 1331 Connecticut avenue.

Bell, Professor A. Melville, 1525 Thirty-fifth street.

Bell, C. J., 1405 G street.

Bell, Miss Gertrude A., Takoma Park, D. C.

Belt, E. Oliver, M. D., The Albany.

Bennett, F. V., The Arlington.

Benton, Frank, Agricultural Department.

Berger, Adolphe, Pension Office.

Bergmann, H. H., 511 Seventh street.

Besselievre, S. I., Navy Department.

Beveridge, M. W., 1618 H street.

Bien, Julius, 140 Sixth avenue, New York, N. Y.

Bien, Joseph R., C. E., 140 Sixth avenue, New York, N. Y.

Bien, Morris, General Land Office.

Bigelow, Professor Frank H., 1625 Massachusetts avenue.

Bigelow, Otis, Avenel, Md.

Birch, Charles E., Hydrographic office, Navy Department.

Black, H. Campbell, 2516 Fourteenth street.

Blair, H. B., U. S. Geological Survey.

Blanchard, Honorable N. C., U. S. Senate.

Blount, Henry F., 3101 U street.

Blount, Mrs L. E., 3101 U street.

Boardman, W. J., 1801 P street.

Bock, Miss M. C., 619 Maryland avenue N. E.

Bond, Miss Mary E., 813 First street.

BOND, SAMUEL R., 13 Iowa circle.

BONHAM, JOHN M., Cosmos Club.

BOUDE, JOHN K., M. D., 905 R street.

BOYLE, PEYTON, 1425 New York avenue.

BRACE, MRS HELEN D., 1316 Thirtieth street.

BRADFORD, COMMANDER R. B., U. S. Navy, 1522 P street.

BRADLEY, HONORABLE A. C., 2013 Q street.

BRADLEY, GEORGE L., 2035 P street.

BRADLEY, MRS J. M., 816 K street.

BRANNER, DR J. C., Leland Stanford Junior University, Cal.

BRECKINRIDGE, GENERAL J. C., U. S. Army, War Department.

BREWER, MISS CLARA G., 1009 Thirteenth street.

BREWER, MISS KATE, 1409 Thirtieth street.

BREWER, PROFESSOR WM. H., 418 Orange street, New Haven, Conn.

BRIGHT, RICHARD R., 130 B street N. E.

BRINTON, MRS E. S., 1414 Fourteenth street.

BRITTON, A. T., 622 F street.

BROCK, FENELON, 818 North Carolina avenue S. E.

BROOKS, ALFRED H., U. S. Geological Survey.

BROOKS. NEWTON M., 233 Second street S. E.

BROWN, DR B. W., The Grafton

BROWN, EDWARD J., 820 Twentieth street.

BROWNE, A. B., 622 F street.

BROWNE, GENERAL WM. H., 1645 K street.

Bryan, Samuel M., 2025 Massachusetts avenue.

Buck, Miss Ada P., 635 Maryland avenue N. E.

Buckman, Mrs S. A., 717 Tenth street.

Buell, Herbert L., 1701 V street.

Bulkley, Barry, 1723 N street.

Bunce, Admiral F. M., U. S. Navy, Com'd'g U. S. Naval Force, North Atlantic Station.

Burchell, N. L., 1102 Vermont avenue.

Burdett, General S. S., 925 F street.

Burgess, Charles H., Eighth and O streets.

Burgess, Edward S., Normal College, New York.

Burr, Wm. H., 1017 K street.

Burton, Professor A. E., Massachusetts Institute of Technology, Boston, Mass.

Busey, S. C., M. D., 1545 I street.

Butler, Mrs Jo: Chestney, 1416 K street.

Butler, W. H., 609 C street.

Byrnes, W. F., M. D., 35 B street S. E.

Cahill, Timothy, 1808 Sixteenth street.

Calver, J. V., M. D., 207 A street S. E.

Calvo, Señor J. B., 1509 Twentieth street.

Campbell, Miss J. S., 136 C street S. E.

Campbell, M. R., U. S. Geological Survey.

Cantacuzene, Prince., E. E. and M. P., 1829 I street.

Capps, Assistant Naval Constructor W. L., U. S. Navy, Navy Department.

Carleton, M. A., Agricultural Department.

Carman, Miss Ada, 1351 Q street.

Carpenter, Frank G., 1318 Vermont avenue.

Carr, General E. A., U. S. Army, The Richmond.

Carrothers, Miss C. F., 1802 Twentieth street.

Carter, Lieutenant R. G., U. S. Army, Sixteenth street, Mt Pleasant.

Catlin, Captain Robert, U. S. Army, 1428 Euclid place.

Cerqueira, General, Care Brazilian Legation, 1800 N street.

Chandler, G. V., 213 C street S. E.

Chaney, Honorable J. C., 1320 F street.

Chapman, R. H., U. S. Geological Survey.

Chatard, Dr T. M., 1758 K street.

Cherry, Charles H., 1115 S street.

Chesnut, Victor K., Agricultural Department.

Chester, Miss J. M., 1016 Eleventh street.

Chickering, Professor J. W., Kendall Green.

Childs, Reverend T. S., 1308 Connecticut avenue.

Chilton, William B., U. S. Coast and Geodetic Survey.

Christie, Alex. S., General Delivery.

Christie, P. H., 1934 Fifth street.

Clark, Charles S., Dennison school.

Clark, Egbert A., M. D., 600 Thirteenth street.

Clark, E. B., U. S. Geological Survey.

Clark, Professor Isaac, Howard University.

Clark, Miss May S., Bureau of Ethnology.

Clarke, Mrs F. W., . 1612 Riggs place.

Clements, Miss L. H., 1610 Q street.

Clover, Lieutenant Commander Richardson, U. S. Navy, 1535 New Hampshire avenue.

Colby, Honorable Leonard W., 1325 Tenth street.

Cole, G. R. Lee, M. D., 424 Seventh street S. W.

Cole, T. L., 12 Corcoran building.

Coleman, Major F. W., The Richmond.

Colton, Francis, 1635 Connecticut avenue.

Comstock, Mrs S. C., 1464 Rhode Island avenue.

Connelly, Miss Mary, 1724 L street.

Connolly, Miss Louise, 1416 Sixth street.

Cooke, J. G., 3320 N street.

Coon, Charles E., —— ——.

Corson, Miss Ida, 914 Farragut square.

Corthell, E. L., C. E., 71 Broadway, New York, N. Y.

Coues, Dr Elliott, Smithsonian Institution.

Covarrubias, Señor Don M., 1307 Connecticut avenue.

Covell, L. W., Civil Service Commission.

Coville, Frederick V., Agricultural Department.

Cowsill, Arthur, 634 I street N. E.

Coyle, Bernard J., 834 Thirteenth street.

Crane, Augustus, Junior, 1344 F street.

Cross, Whitman, U. S. Geological Survey.

Crowell, Mrs A. S., 938 I street.

Cummings, Professor George J., Howard University.

Cummings, Miss M. B., 520 Sixth street.

Cummings, Miss S. E., 520 Sixth street.

Cunningham, Miss M. E., 1234 Tenth street.

Cunningham, Mrs W. O., 1723 K street.

Curry, W. W., 1510 Ninth street.

Curtis, William Eleroy, 1801 Connecticut avenue.

Cushing, Frank Hamilton, Bureau of Ethnology.

Cushing, Miss S. C., 310 Indiana avenue.

Custis, G. W. N., M. D., 112 East Capitol street.

Custis, Miss Villa C., 112 East Capitol street.

Cutter, W. P., Agricultural Department.

Dabney, Dr C. W., Junior, The Concord.

Dalby, Z. Lewis, Civil Service Commission.

Dall, Mrs Caroline H., 1526 Eighteenth street.

Dall, Dr Wm. H., Smithsonian Institution.

Dana, General J. J., U. S. Army, Cosmos Club.

Darton, N. H., U. S. Geological Survey.

Davis, Miss Adelaide, 1320 Fifteenth street.

Davis, Allan, Business High School, First street.

Davis, Mrs J. T., 1426 Q street.

Davis, Professor Wm. M., 2 Bond street, Cambridge, Mass.

Dawson, Miss A. B., U. S. Geological Survey.

Dawson, Thomas F., U. S. Senate annex.

Day, C. A., 1405 G street.

Day, Dr David T., U. S. Geological Survey.

Day, E. Warren, 38 Times building, New York, N. Y.

De Caindry, Wm. A., War Department.

Deckert, Dr E., 1489 Howard avenue.

De Merritt, Dr J. H., 1335 Vermont avenue.

Denman, Colonel H., 1623 Sixteenth street.

Detweiler, F. M., 420 Eleventh street.

Dickens, Commander F. W., U. S. Navy, Commanding U. S. S. *Constellation.*

Diebitsch, Emil, C. E., 2014 Twelfth street.

Dieudonné, Frank J., Ohio National Bank building.

Diller, J. S., U. S. Geological Survey.

Dodge, Charles C., Office Naval Intelligence, Navy Department.

Donn, E. W., 1708 Sixteenth street.

Doolittle, M. H., U. S. Coast and Geodetic Survey.

Doubleday, H. H., 715 H street.

Douglas, E. M., U. S. Geological Survey.

Doyle, John T., Civil Service Commission.

Duffield, General W. W., U. S. Coast and Geodetic Survey.

Duncklee, John B., 940 Westminster street.

Dutton, Major C. E., U. S. Army, San Antonio, Tex.

Dyer, Frank L., 918 F street.

Dyer, Lieutenant G. L., U. S. Navy, Annapolis, Md.

Easterling, H. V., Record and Pension Office.

Eaton, Lieutenant Commander J. G., U. S. Navy, Navy Department.

Eddy, Mrs Mary H., The Shoreham.

Edmands, Professor J. R., Harvard University, Cambridge, Mass.

Edson, John Joy, 1003 F street.

Edson, Joseph R., 927 F street.

Edwards, J. A., 1009 Thirteenth street.

Egleston, N. H., M. D., 1530 Sixteenth street.

Eimbeck, William, U. S. Coast and Geodetic Survey

Eldridge, George H., U. S. Geological Survey.

Eliot, Charles, Brookline, Mass.

Elliott, Miss Elizabeth, 1114 Fifteenth street.

Elliott, W. St George, M. D., 25 E. Forty-fourth street, New York, N. Y.

Emmons, Lieutenant George T., U. S. Navy, U. S. S. *Pinta*, Sitka, Alaska.

Erbach, John, U. S. Geological Survey.

Evans, H. C., U. S. Geological Survey.

Evans, Mrs John O., 1219 Sixteenth street.

Evans, W. W., M. D., 1756 M street.

Evermann, Professor B. W., 1859 Harewood avenue.

Ewell, Reverend Professor J. L., Howard University.

von Ezdorf, Richard, 918 N street.

Fairfield, George A., 1407 Staughton street

Fairfield, W. B., U. S. Coast and Geodetic Survey.

Faris, R. L., U. S. Coast and Geodetic Survey.

Farquhar, Henry, Agricultural Department.

Fernow, B. E.,	Agricultural Department.
Ffoulke, Charles M.,	2013 Massachusetts avenue.
Fischer, E. G.,	U. S. Coast and Geodetic Survey.
Fisher, Louis A.,	U. S. Coast and Geodetic Survey.
Fisher, Robert J.,	614 F street.
Fitch, Charles H.,	3025 N street.
Fitch, Chief Engineer H. W., U. S. Navy,	1518 Connecticut avenue.
Flemer, J. A.,	414 A street S. E.
Fletcher, Miss A. M.,	1437 Kenesaw avenue.
Fletcher, L. C.,	U. S. Geological Survey.
Fletcher, Robert, M. D.,	Army Medical Museum.
Flint, Mrs Laura A.,	1734 I street.
Flint, Dr Weston,	1213 K street.
Flynn, Harry F.,	U. S. Coast and Geodetic Survey.
Foote, Allen R.,	Takoma Park, D. C.
Foote, Aug. R. S.,	2021 H street.
Forney, Stehman,	U. S. Coast and Geodetic Survey.
Forrest, Julius C.,	Hydrographic Office, Navy Department.
Foster, Honorable John W.,	1405 I street.
Foster, Professor Richard,	Howard University.
Fowler, E. H.,	1126 East Capitol street.
Fowler, Francis,	1449 Q street.
Fraser, Daniel,	458 Pennsylvania avenue.
French, George N., M. D.,	1831 I street.

French, Owen B., 2011 F street.

Frisbie, Professor Edgar, U. S. Navy, 1607 Thirty-first street.

Frost, Floyd T., Navy Department.

Fuller, Miss A. H., 1321 Rhode Island avenue.

Fuller, Thomas J. D., 1509 H street.

Gage, N. P., Seaton school.

Gannett, Henry, U. S. Geological Survey.

Gannett, S. S., U. S. Geological Survey.

Gardner, C. L., 1750 Q street.

Garnett, Henry Wise, 1319 New York avenue.

Garnier, Miss M. A., 6 Grant place.

Garrison, Miss C. L., 944 S street.

Gerdine, Thomas G., General Land Office.

Gibbon, General John, U. S. Army, 912 Nineteenth street.

Gibbs, Edwin A., M. D., 1608 Thirteenth street.

Gibbs, Miss H. H., 2905 N street.

Gibson, George, Thirteenth street and Pennsylvania avenue.

Gilbert, G. K., U. S. Geological Survey.

Gill, Dr Theodore N., Smithsonian Institution.

Gilman, President D. C., Johns Hopkins University, Baltimore, Md.

Glavis, George O., Junior., U. S. Geological Survey.

Goddard, F. J., 3077 Dumbarton avenue.

Goode, Dr G. Brown, National Museum.

Goode, Richard U., U. S. Geological Survey.

Goodfellow, Edward,
1618 Sixteenth street.

Goodrich, Harold B.,
U. S. Geological Survey.

Gorham, George C.,
1763 Q street.

Gough, Right Honorable Viscount,
1721 I street.

Graham, Miss Agnes M.,
1714 Q street.

Graham, Andrew B.,
1230 Pennsylvania avenue.

Granger, F. D.,
U. S. Goast and Geodetic Survey.

Grant, Miss A. L.,
507 East Capitol street.

Graves, Miss A. E.,
319 East Capitol street.

Graves, Louis B.,
2504 Fourteenth street.

Graves, Walter H.,
Crow Indian Reservation, Mont.

Greegor, W. H.,
Fourteenth and G streets.

Greely, General A. W., U. S. Army,
War Department.

Green, Bernard R.,
1738 N street.

Green, Assistant Engineer C. M., U. S. Revenue Marine,
Treasury Department.

Green, Darius A.,
Navy Department.

Greenlees, Archibald,
3129 U street.

Grice, Francis E.,
Navy Department.

Griffing, Don H.,
Civil Service Commission.

Guyer, Miss C. C.,
1911 N street.

Guzmán, Dr Don Horacio, E. E. and M. P.,
1623 Massachusetts avenue.

Hackett, Merrill,
U. S. Geological Survey.

Hagan, Mrs Cornelia J.,
1332 V street.

Hagner, Judge A. B.,
1818 H street.

Hague, Dr Arnold, U. S. Geological Survey.

Haines, Miss M. S., Eighth street and Pennsylvania avenue S. E.

Haines, Thomas L., 175 Fifth avenue, Chicago, Ill.

Halderman, General John A., Metropolitan Club.

Hamilton, William, Bureau of Education.

Hamlin, Dr Teunis S., 1306 Connecticut avenue.

Hamma, Reverend M. W., 1336 Massachusetts avenue.

Hance, T. F., M. D., Pension Office.

Hanford, Levi, 409 G street.

Hanks, H. M., 446 L street.

Hansen, John, 605 H street.

Hansmann, Max, 1726 Corcoran street.

Hanvey, Frank L., 234 New Jersey avenue.

Harding, Miss Gena R., The Shoreham.

Hardy, Edward D., Howard University.

Harlan, Mr Justice John M., Fourteenth street and Euclid avenue.

Harrington, Professor Mark W., State University, Seattle, Wash.

Harris, Honorable Wm. T., Bureau of Education.

Harrod, Major B. M., Masonic building, New Orleans, La.

Hart, Professor A. B., 15 Appian way, Cambridge, Mass.

Hart, Amos W., 712 Tenth street.

Hasbrouck, E. M., 154 A street N. E.

Hay, Professor Robert, P. O. box 562, Junction City, Kans.

Hayden, Ensign Everett, U. S. Navy, 1802 Sixteenth street.

Hayden, Miss Lilian, Bryn Mawr School, Baltimore, Md.

Hayes, Miss Annie M., Bureau of Engraving and Printing.

Hayes, Dr C. Willard, U. S. Geological Survey.

Hayward, H. A., 926 Massachusetts avenue.

Hazard, Daniel L., U. S. Coast and Geodetic Survey.

Head, Colonel J. F., U. S. Army, 2015 R street.

Heard, Honorable Augustine, Metropolitan Club.

Hearst, Mrs P. A., 1400 New Hampshire avenue.

Heaton, A. G., 1618 Seventeenth street.

Hedrick, H. B., Nautical Almanac Office.

Heilprin, G. F., 1227 Pennsylvania avenue.

Henderson, J. B., Junior, Sixteenth street and Florida avenue.

Hendges, Matthew, General Land Office.

Hendrickson, Professor W. W., U. S. Navy, 1706 P street.

Henry, A. J., 948 S street.

Herbert, Honorable Hilary A., Navy Department.

Herrle, Gustave, Hydrographic Office, Navy Department.

Herron, William H., U. S. Geological Survey.

Hewett, G. C., 1744 Corcoran street.

Hickey, Miss S. G., 1322 Ninth street.

Higgins, M. T., Civil Service Commission.

Hight, Sherman, 1426 F street.

Hill, George William, Agricultural Department.

Hill, Robert T., U. S. Geological Survey.

Hillebrand, Dr W. F., U. S. Geological Survey.

Hiller, A. H., Civil Service Commission.

Hillman, Myra T., 227 Third street.

Hills, Charles W., 1345 Vermont avenue.

Hinman, Russell, 806 Broadway, New York, N. Y.

Hitt, Honorable R. R., 1507 K street.

Hitz, John, Thirty-fifth and Q streets.

Hodgkins, W. C., U. S. Coast and Geodetic Survey.

Hoffman, Emil O., Light-house Board, Treasury Department.

Holden, Mrs L. E., The Hollenden, Cleveland, Ohio.

Hollerith, Herman, 1521 Thirty-first street.

Holt, Henry Peter Renouf, Takoma Park, D. C.

Holtzman, R. O., Tenth and F streets.

Hood, James F., 622 F street.

Hopkins, J. H., 1407 F street.

Hopkins, Miss M. G., 2034 G street.

Hornblower, J. C., 1402 M street.

Horsford, Miss Cornelia, 27 Cragie street, Cambridge, Mass.

Hosmer, Edward S., 29 Nassau street, New York, N. Y.

Hotchkiss, Major Jed, Staunton, Va.

Hough, Miss Helen M., 202 Indiana avenue.

Hough, Walter, National Museum.

Hovey, Reverend Dr H. C., 60 High street, Newburyport, Mass.

Howell, D. J., 918 F street.

Howell, E. E.,
612 Seventeenth street.

Hoyt, Honorable John W.,
Pacific building.

Hubbard, Honorable Gardiner G.,
"Twin Oaks," Woodley lane.

Huddleson, S. M.,
Agricultural Department.

Hudson, John R., Junior,
U. S. Geological Survey.

Hume, Frank,
454 Pennsylvania avenue.

Hunt, Mrs Alice U.,
Tenley, D. C.

Hunt, C. B.,
District building.

Hurd, Henry M., M. D.,
Johns Hopkins Hospital, Baltimore, Md.

Hutchinson, John,
1524 P street.

Hutchinson, W. J.,
1707 Massachusetts avenue.

Hutchison, Miss J. E.,
516 Third street.

Hyam, Miss V. W.,
1314 S street.

Hyde, Miss E. R.,
1326 I street.

Hyde, G. E.,
U. S. Geological Survey.

Hyde, John,
Agricultural Department.

Hyde, Miss Josephine,
434 K street.

Inch, Chief Engineer Philip, U. S. Navy,
1748 P street.

Irish, General Charles W.,
Agricultural Department.

Jackson, Reverend Sheldon,
The Concord.

Jackson, Mrs S. V.,
1711 P street.

James, Mrs J. F.,
1475 Kenesaw avenue.

Janney, B. T.,
1671 Thirty-first street.

Jarvis, Lieutenant D. H., U. S. Revenue Marine,
New Bedford, Mass.

Jennings, Miss H. R., 1714 Johnson place.

Jennings, J. H., U. S. Geological Survey.

Jewell, Claudius B., 1324 Vermont avenue.

Johnson, A. B., Light-house Board, Treasury Department.

Johnson, Miss A. B., 501 Maple avenue.

Johnson, H. L. E., M. D., 1400 L street.

Johnson, J. B., Howard University.

Johnson, James L., U. S. Geological Survey.

Johnson, Theo. H., 1115 S street.

Johnson, Willard D., U. S. Geological Survey.

Johnston, A. D., 1332 V street.

Johnston, Miss E. B., 1320 Florida avenue.

Johnston, W. W., M. D., 1603 K street.

Jones, Edward S., M. D., 1505 R street.

Judd, John G.,* 420 Eleventh street.

Kasson, Honorable John A., 1726 I street.

Kauffmann, S. H., 1421 Massachusetts avenue.

Keane, Bishop J. J., Catholic University.

Keith, Arthur, U. S. Geological Survey.

Kelley, Miss Fannie L., 1620 Seventeenth street.

Kelly, Miss M. G., 715 East Capitol street.

Kennan, George, Care of J. B. Pond, Everett House, New York, N. Y.

Kennedy, George G., M. D., 284 Warren street, Roxbury, Mass.

---

*Died July 23, 1895.

KENNON, LIEUTENANT L. W. V., U. S. Army, 1429 New York avenue.

KENT, MISS PRISCILLA, 1311 Connecticut avenue.

KEYSER, MISS A. K., 2019 Massachusetts avenue.

KIMBALL, E. F., 1316 Rhode Island avenue.

KIMBALL, HONORABLE S. I., Life Saving Service, Treasury Department.

KING, MISS ANNA S., 1315 Twelfth street.

KING, PROFESSOR F. H., 1500 University avenue, Madison, Wis.

KING, GEORGE A., 1420 New York avenue.

KING, MISS METELLA, 721 Irving street.

KING, R. A., 1430 Corcoran street.

KING, WILLIAM B., 1328 Twelfth street.

KIU, SURH BEUNG, Korean Legation, Iowa circle.

KLAKRING, ALFRED, Hydrographic office, Navy Department.

KNAPP, HONORABLE M. A., Sun building.

KNOWLTON, PROFESSOR F. H., National Museum.

KÜBEL, EDWARD, 326 First street N. E.

KÜBEL, S. J., U. S. Geological Survey.

KUMMELL, CHARLES H., U. S. Coast and Geodetic Survey.

KURINO, SHINICHIRO, E. E. and M. P., Japanese Legation, 1310 N street.

LADD, GEORGE E., —— ——.

LANDER, MRS J. M. D., 45 B street S. E.

LANGLEY, DR S. P., Smithsonian Institution.

LAWRENCE, ROBERT M., M. D., 1525 Eighteenth street.

LAWRENCE, MISS MARGARET, 1515 Corcoran street.

LEDYARD, L. W., Cazenovia, N. Y.

LEE, REVEREND THOMAS S., St Matthew's rectory, 1415 H street.

LEITER, L. Z., Dupont circle.

LENMAN, MISS I. H., 1100 Twelfth street.

LEVERING, THOMAS H., 1435 Chapin street.

LINDENKOHL, A., U. S. Coast and Geodetic Survey.

LINDENKOHL, H., U. S. Coast and Geodetic Survey.

LITTLEHALES, G. W., Hydrographic Office, Navy Department.

LJUNGSTEDT, O. A., U. S. Geological Survey.

LONG, CAPTAIN OSCAR F., U. S. Army, War Department.

LOOKER, HENRY B., C. E., Surveyor's office.

LOOMIS, MISS A. E., Fernandina, Fla.

LOOMIS, DR LAFAYETTE C., Winthrop heights.

LORD, EDWIN C. E., M. D., 2024 G street.

LORD, CAPTAIN THOMAS W., U. S. Army, 608 Twelfth street.

LORENZ, FRED. A., Central School Supply House, Chicago, Ill.

LOURY, MISS H. S., 1309 F street.

LOVELL, W. H., U. S. Geological Survey.

LOWE, CHIEF ENGINEER JOHN, U. S. Navy, 203 East Capitol street.

LUDINGTON, COLONEL M. I., U. S. Army, Army building, Chicago, Ill.

LYMAN, HONORABLE CHARLES, 1243 New Jersey avenue.

LYNCH, JOHN A., 205 A street S. E.

MACFARLAND, JOSEPH, 1727 F street.

MACK, MISS NELLIE M., 624 A street S. E.

Mackay-Smith, Reverend Dr Alex., 1325 Sixteenth street.

Magruder, John H., 1644 Twenty-first street.

Mahon, Mrs M. H. B., 1329 Corcoran street.

Maier, John G., 415 I street S. E.

Mallett, Miss Anna S., 1454 Rhode Island avenue.

Manderson, Honorable Charles F., Omaha, Neb.

Mann, H. L., M. D., 334 Indiana avenue.

Mann, Miss Mary E., 437 Seventh street.

Manning, Van H., U. S. Geological Survey.

Marean, M., 1900 Lincoln avenue N. E.

Marindin, Henry L., U. S. Coast and Geodetic Survey.

Marsh, Lieutenant C. C., U. S. Navy, U. S. F. S. *New York*.

Marshall, R. B., U. S. Geological Survey.

Martin, Artemas, 1534 Columbia street.

Martin, Miss Frances, 1850 Wyoming avenue.

Martin, R. H., Columbian University.

Marvine, Mrs A. R., 1323 N street.

Matsui, K., Secretary, Japanese Legation, 1310 N street.

Matthews, Commodore E. O., U. S. Navy, 1761 Q street.

Matthews, Surgeon Washington, U. S. Army, 1262 New Hampshire avenue.

Mattingly, William F., 435 Seventh street.

Maury, Judge Wm. A., 1767 Massachusetts avenue.

Maxcy, F. E., M. D., 18 Iowa circle.

Maynard, George C., 1407 Fifteenth street.

Maynard, Commander W., U. S. Navy, Navy Department.

McAdie, Alexander, U. S. Weather Bureau, San Francisco, Cal.

McAllister, C. A., Treasury Department.

McCarty, Mrs O. V., 1324 S street.

McCeney, Miss Mary E., The Shoreham.

McCormick, L. M., Glen Island, N. Y.

McCulloch, Miss Mary, P. O. box 646.

McCullough, Mrs L. V., 820 Twelfth street N. E.

McCurdy, Arthur W., Baddeck, C. B.

McGee, W J, Bureau of Ethnology.

McGill, Miss M. C., 1447 Q street.

McGrath, John E., —— ——.

McGuire, F. B., 1333 Connecticut avenue.

McKee, Redick H., U. S. Geological Survey.

McLanahan, G. W., 1601 Twenty-first street.

McLaughlin, T. N., M. D., 1226 N street.

McNeil, Eaton K., M. D., 930 K street.

McPherson, Mrs Mary E., 1227 I street.

Meade, Admiral R. W., U. S. Navy, 220 Winona avenue, Germantown, Pa.

Mearns, Captain E. A., U. S. Army, Fort Myer, Va.

Meloy, Wm. A., 118 C street.

Melville, Engineer-in-Chief G. W., U. S. Navy, Navy Department.

de Mendonça, Senhor M. D. F., Brazilian Legation, 1800 N street.

de Mendonça, Senhor Salvador, E. E. and M. P., Brazilian Legation, 1800 N street.

Menocal, Civil Engineer A. G., U. S. Navy, Norfolk Navy Yard, Va

Merriam, Dr C. Hart, Agricultural Department.

Mertwago, Captain D. T., Imperial Russian Navy, 1725 H street.

Meston, R. D., 1227 L street.

Metzerott, F. B., 1110 F street.

Michler, Paymaster A. K., U. S. Navy, Navy Department.

Middleton, Jefferson, U. S. Geological Survey.

Miller, E. H., 1109 M street.

Mills, Colonel Anson, U. S. Army, 2 Dupont circle.

Milmore, Mrs Mary L., 1713 Corcoran street.

Miner, Lieutenant R. H., U. S. Navy, Navy Yard, Mare Island, Cal.

Mitchell, Professor Henry, 54 Burroughs street, Jamaica Plain, Mass.

Miyoaka, Captain N., Imperial Japanese Navy, Japanese Legation, 1310 N street.

Montague, Professor A. P., Columbian University.

Moore, F. L., 1680 Thirty-first street.

Moore, Mrs M. R., P. O. box 505.

Moqué, J. Oliver, 1009 Thirteenth street.

Morgan, General M. R., U. S. Army, 1633 Massachusetts avenue.

Morrison, J. R. D., 1326 F street.

Morrison, W. C., 1415 Rhode Island avenue.

Mosman, A. T., U. S. Coast and Geodetic Survey.

Muir, Professor John, Martinez, Cal.

Muller, Frank C., Agricultural Department

Muncaster, M., M. D., 1510 H street

Murch, B. W.,	Force school.
Murlin, A. E.,	U. S. Geological Survey.
Murphy, Reverend Jos. W.,	927 M street.
Murphy, Captain P. St. Clair, U. S. M. C.,	U. S. Marine Barracks.
Murray, B. P.,	10 Third street N. E.
Mytinger, Miss Caroline,	1214 O street.
Nassau, Wm. B.,	204 Arthur place.
Needham, Judge Charles W.,	1730 Sixteenth street.
Nelson, Commander Thomas, U. S. Navy,	Navy Yard, Portsmouth, N. H.
Newbold, Captain Charles,	1025 Vermont avenue.
Newcomb, Professor Simon, U. S. Navy,	1620 P street.
Newell, F. H.,	U. S. Geological Survey.
Niles, Professor William H.,	Massachusetts Institute of Technology, Boston, Mass.
Norighian, M., Effendi,	Turkish Legation, 1631 Q street.
Noyes, Crosby S.,	Editor Evening Star.
Noyes, Theodore W.,	Office of The Evening Star.
Oakes, General James, U. S. Army,	The Portland.
Ogden, Herbert G.,	U. S. Coast and Geodetic Survey.
Olberg, Charles R.,	810 H street.
O'Leary, T. S.,	Hydrographic office, Navy Department.
Oliver, Mrs M. E.,	922 Nineteenth street.
Olney, Charles F.,	137 Jennings avenue, Cleveland, O.
Owen, F. D.,	1423 New York avenue.
Owen, Colonel Wm. H.,	2213 Washington circle.

Painter, Mrs U. H., 900 Fourteenth street.

Palmer, T. S., Agricultural Department.

Pancoast, Miss M. E., 1507 Corcoran street.

Parke, General John G., U. S. Army, 16 Lafayette square.

Parker, E. W., U. S. Geological Survey.

Parker, Medical Inspector J. B., U. S. Navy, Navy Yard, Portsmouth, N. H.

Parker, Miss L. M., 1621 Seventeenth street.

Parker, Myron M., 1020 Vermont avenue.

Parker, Major Richard C., U. S. Army, Soldiers' Home.

Parmenter, Ensign H. E., U. S. Navy, 1710 G street.

Parsons, F. H., 210 First street S. E.

Parsons, Miss K., 1529 O street.

Patten, John D., 3033 P street.

Patterson, Mrs A. M., 20 Iowa circle.

Patterson, H. J., Maryland Agricultural Experiment Station, College Park, Md.

Patterson, Miss M. A., 937 New York avenue.

Patterson, Miss M. E., 1100 Vermont avenue.

Paul, Henry M., Naval Observatory.

Pawling, Jesse, Junior, Johns Hopkins University, Baltimore, Md.

Payne, James G., 2112 Massachusetts avenue.

Peabody, W. F., U. S. Coast and Geodetic Survey.

Peary, Civil Engineer R. E., U. S. Navy, 2014 Twelfth street.

Peelle, Judge Stanton J., The Concord.

Pellew, Henry E., 1637 Massachusetts avenue.

PENROSE, R. A. F., JUNIOR, M. D.,	1331 Spruce street, Philadelphia, Pa.
PERKINS, E. T., JUNIOR,	U. S. Geological Survey.
PERKINS, HONORABLE G. C.,	U. S. Senate.
PERRY, R. ROSS,	1309 P street.
PERRY, SEATON,	1713 Rhode Island avenue.
PETERS, EUGENE,	458 Pennsylvania avenue.
PETERS, LIEUTENANT G. H., U. S. Navy,	U. S. S. *Minneapolis*.
PETERS, WILLIAM J.,	U. S. Geological Survey.
PHILLIPS, R. H.,	1422 New York avenue.
PHILLIPS, HONORABLE T. W.,	1122 Vermont avenue.
PICKERING, PROFESSOR E. C.,	Harvard Observatory, Cambridge, Mass.
PICKING, CAPTAIN HENRY F., U. S. Navy,	Navy Department.
PIERCE, JOSIAH, JUNIOR,	1325 Massachusetts avenue.
PILLING, J. W.,	1301 Massachusetts avenue.
PLATT, HONORABLE O. H.,	U. S. Senate.
PLEASANTON, GENERAL A., U. S. Army,	1301 F street.
POLLOK, ANTHONY,	620 F street.
POND, MRS E. J.,	420 C street S. E.
POOLE, MAJOR DE W. C., U. S. Army,	2030 P street.
PORTER, MINOTT E.,	Hydrographic Office, Navy Department.
POWELL, MAJOR C. F., U. S. Army,	District building.
POWELL, MRS DIANA KEARNEY,	1734 K street.
POWELL, MAJOR J. W.,	910 M street.
POWELL, PROFESSOR W. B.,	Franklin school.

Powers, Miss Lydia M., 1439 Chapin street.

Prang, Louis, 646 Washington street, Boston, Mass.

Pratt, J. F., U. S. Coast and Geodetic Survey.

Prentiss, D. W., M. D., 1101 Fourteenth street.

Procter, Honorable John R., Civil Service Commission.

Putnam, George R., U. S. Coast and Geodetic Survey.

Pyle, Fred. B., Washington Loan and Trust building.

Pyle, Walter L., M. D., The Albany.

Raber, Miss Katherine, 1914 Third street.

Rand, Charles F., M. D., 1228 Fifteenth street.

Rand, Paymaster Stephen, U. S. Navy, Navy Yard.

Rankin, President J. E., Howard University.

Rankin, John M., Atlantic building.

Raymond, Edward S., Washington Loan and Trust building.

Reed, Lieutenant B. L., U. S. Revenue Marine, Life Saving Service, Treasury Department.

Reed, Miss Temperance P., 1616 Rhode Island avenue.

Reese, Miss Ella, Brookland, D. C.

Reily, Philip K., 2321 Pennsylvania avenue.

Reventlow, Count F., E. E. and M. P., 1409 Twentieth street.

Reyburn, Robert, M. D., 714 Thirteenth street.

Reynolds, General J. J., U. S. Army, 1601 S street.

Richardson, C. W., M. D., 1102 L street.

Richardson, F. A., 1308 Vermont avenue.

Richardson, J. J., M. D., 1017 Fourteenth street.

Richmond, Charles W., 1307 T street.

Richter, Miss Clara M., 330 A street S. E.

Ricketts, W. W., Civil Service Commission.

Riley, Owen, Post Office Department.

Rittenhouse, Major B. F., U. S. Army, 1705 M street.

Ritter, Homer P., U. S. Coast and Geodetic Survey.

Rizer, Colonel H. C., U. S. Geological Survey.

Roberts, A. C., Hydrographic Office, Navy Department.

Roberts, W. F., 1421 G street.

Robertson, Mrs Gay, 1123 Seventeenth street.

Robinson, Honorable H. A., Agricultural Department.

Rochester, General W. B., U. S. Army, 1320 Eighteenth street.

Rock, Miles, C. E., 1447 Staughton street.

Rockhill, Honorable W. W., Department of State.

Romero, Señor Don M., E. E. and M. P., 1413 I street.

Roome, Miss Lillian K., 1345 Princeton street.

Ross, Honorable John W., The Varnum.

Rotch, A. Lawrence, Readville, Mass.

Russell, Captain A. H., U. S. Army, U. S. Arsenal, Rock Island, Ill.

Russell, E. E., 904 S street.

Sanders, Henry P., 1504 Twenty-first street.

Sands, Miss Marie, 1222 Connecticut avenue.

Sanger, Major J. P., U. S. Army, War Department.

Sargent, Professor C. S., Arnold Arboretum, Jamaica Plain, Mass.

Sawyer, Mrs C. B., Globe House.

Sawyer, Mrs N. C., Brattleboro, Vt.

Scaife, Walter B., 143 North avenue, Allegheny, Pa.

Schley, Captain W. S., U. S. Navy, Commanding U. S. F. S. *New York.*

Schmidt, Ferdinand, 1337 Wallach place.

Schmidt, Fred A., 504 Ninth street.

Schoepf, W. Kesley, C. E., Eckington, D. C.

Schouler, Commander John, U. S. Navy, U. S. F. S. *New York.*

de Schweinitz, Dr. E. A., Agricultural Department.

Scidmore, Miss Eliza Ruhama, The Shoreham.

Scott, Miss Fannie T., 2017 O street.

Scott, S. Mathewson, 488 St Nicholas avenue, New York.

Scott, W. O. N., 1711 Connecticut avenue.

Seaman, Professor William H., 1424 Eleventh street.

Seavey, Miss J. M., Internal Revenue Office, Treasury Department.

Sedgley, Miss Isabel, 1779 Massachusetts avenue.

Shaler, Professor N. S., 25 Quincy street, Cambridge, Mass.

Shattuck, George B., Johns Hopkins University, Baltimore, Md.

Shaw, George Clymer, 511 C street S. E.

Shaw, John W., M. D., 908 Fifteenth street.

Shedd, Mrs S. S., Takoma Park, D. C.

Sherman, Honorable John, U. S. Senate.

Shidy, Leland P., U. S. Coast and Geodetic Survey.

Shir-Cliff, William H., 56 R street N. E.

Shock, Chief Engineer W. H., U. S. Navy,
1404 Fifteenth street.

Shoemaker, Captain C. F., U. S. Revenue Marine,
Treasury Department.

Sidwell, Thomas W.,
1811 I street.

Sigsbee, Commander Charles D., U. S. Navy,
Hydrographic Office, Navy Department.

Sinclair, C. H.,
U. S. Coast and Geodetic Survey, El Paso, Tex.

Sinclair, J. C.,
718 Arch street, Philadelphia, Pa.

Sites, C. M. Lacey,
1315 Clifton street.

Small, J. H., Jr,
Fourteenth and G streets.

Smith, General C. H., U. S. Army,
1728 Q street.

Smith, Mrs E. L.,
232 Third street.

Smith, George Lambert,
1209 K street.

Smith, Lincoln A.,
1631 Massachusetts avenue.

Smith, Middleton,
1616 Nineteenth street.

Smith, General William, U. S. Army,
1606 K street.

Somers, Mrs E. J.,
1100 M street.

Sommer, E. J.,
U. S. Coast and Geodetic Survey.

Sothoron, James T., M. D.,
1917 I street.

Southerland, Lieutenant W. H. H., U. S. Navy,
1923 N street.

Spear, General Ellis,
1003 F street.

Spencer, Miss Mary A.,
336 Second street N. E.

Spofford, A. R.,
Library of Congress.

Spring-Rice, Cecil A.,
British Embassy.

Squire, Honorable Watson C.,
U. S. Senate.

Stanley-Brown, Joseph,
1318 Massachusetts avenue.

STAPLES, W. R., General Land Office.

STAVELY, ALBERT L., M. D., Garfield Hospital.

STEAD, ROBERT, 1230 Seventeenth street.

STEEVER, CAPTAIN E. Z., U. S. Army, 1429 New York avenue.

STEIGER, GEORGE, U. S. Geological Survey.

STEIN, ROBERT, U. S. Geological Survey.

STELLWAGEN, EDWARD J., 1214 F street.

STERNBERG, SURGEON GENERAL GEORGE M., U. S. Army, War Department.

STERRETT, DR J. MACBRIDE, Columbian University.

STEVENS, HONORABLE D. W., Japanese Legation.

STEVENS, F. C., 1415 G street.

STEVENS, HONORABLE M. T., North Andover, Mass.

STEVENSON, HONORABLE A. E., The Normandie.

STEVENSON, MRS M. C., 1510 H street.

STOKES, DR H. N., U. S. Geological Survey.

STONE, LIEUTENANT C. A., U. S. Navy, 1821 M street.

STONE, I. S., M. D., 1449 Rhode Island avenue.

STONER, MISS LILLIAN, 1918 I street.

STRATTON, J. A., Civil Service Commission.

STRIDER, MRS L. C., 1450 Rhode Island avenue.

STRONG, MR JUSTICE W.,* 1411 H street.

STUDDS, COLIN, Baltimore and Potomac depot.

STURTEVANT, MRS A. L., Howard avenue, Mt Pleasant.

---

* Died August 19, 1895.

SUMMERS, MILO C.,
War Department.

SUTTON, FRANK,
U. S. Geological Survey.

SWANN, MRS THOMAS,
1415 I street.

SWARTZELL, G. W. F.,
916 F street.

SWEAT, L. D. M.,
The Normandie.

TAINTER, CHARLES S.,
1360 E street.

TANNER, COMMANDER Z. L., U. S. Navy,
U. S. Fish Commission.

TARBELL, MISS ADA M.,
919 I street.

TAYLOR, DANIEL F.,
918 F street.

TAYLOR, H. W.,
100 Fifth street N. E.

THAYER, JUDGE RUFUS H.,
930 F street.

THOM, WM. TAYLOR,
1100 M street.

THOMAS, LIEUTENANT CHAUNCEY, U. S. Navy,
Hydrographic Office, Navy Department.

THOMAS, FRANCIS, M. D.,
Ednor, Montgomery county, Md.

THOMAS, MISS M. VON E.,
1309 N street.

THOMAS, MRS R. R. D.,
206 S street N. E.

THOMPSON, PROFESSOR A. H.,
U. S. Geological Survey.

THOMPSON, MAJOR GILBERT,
U. S. Geological Survey.

THOMPSON, J. B.,
1756 Corcoran street.

THOMPSON, JOHN W.,
National Metropolitan Bank.

THOMPSON, MISS M. IDA,
1419 I street.

THURSTON, HONORABLE L. A.,
Honolulu, Hawaiian Islands.

TILTON, LIEUTENANT PALMER, U. S. Army,
1643 Thirteenth street.

TILTON, R. N.,
220 Second street N. E.

Tisdel, Willard P., 1323 Thirteenth street.

Torbert, J. B., 420 Ninth street.

Townsend, Mrs J. C., 1433 Staughton street.

Truesdell, Honorable George, District building.

Turner, H. W., U. S. Geological Survey.

Tweedale, John, War Department.

Tweedy, Frank, U. S. Geological Survey.

Upton, Lieutenant Fred E., U. S. Navy, Bureau of Education.

Urquhart, Charles F., U. S. Geological Survey.

Van Dyke, W. M., 1111 N street.

Van Hise, Professor C. R., University of Wisconsin, Madison, Wis.

Van Hook, Miss Antoinette, 1616 Nineteenth street.

Vasey, Mrs George, 1307 Riggs street.

Vaughan, T. Wayland, U. S. Geological Survey.

Vilas, Honorable William F., The Arno.

Vinal, W. Irving, 1106 East Capitol street.

Vincent, General T. M., U. S. Army, War Department.

Waddey, John A., Hydrographic Office, Navy Department.

Wagner, F. H., Civil Service Commission.

Wainwright, Dallas B., 1409 Chapin street.

Waite, Miss Mary F., 1616 Rhode Island avenue.

Walcott, Charles D., U. S. Geological Survey.

Wales, George R., Civil Service Commission.

Walker Albert M., 1000 New Hampshire avenue.

WALKER, ADMIRAL J. G., U. S. Navy, 1202 Eighteenth street.

WALKER, HONORABLE J. H., The Shoreham.

WALL, COLONEL WILLIAM, St Cloud Hotel, New York, N. Y.

WALLACE, MRS E. E., 739 East Capitol street.

WALLACE, MRS E. R., 1321 Massachusetts avenue.

WALLACE, WILLIAM J., 1107 E street.

WALTON, MISS FLORENCE, 106 Fourth street S. E.

WANAMAKER, FRED, Civil Service Commission.

WANAMAKER, HONORABLE JOHN, Philadelphia, Pa.

WARD, MISS ELIZA T., 5 Grant place.

WARD, MRS FANNIE B., 1537 Eighth street.

WARD, H. P., The Hamilton.

WARD, ROBERT DE C., Harvard University, Cambridge, Mass.

WARDER, MRS R. B., Howard University.

WARMAN, P. C., U. S. Geological Survey.

WARNER, B. H., 2100 Massachusetts avenue.

WARREN, MISS M. B., 19 Second street, Troy, N. Y.

WASHBURN, W. S., Civil Service Commission.

WASHINGTON, COLONEL L. Q., 1105 Ninth street.

WATKINS, J. ELFRETH, Care of Secretary National Geographic Society, 1515 H street.

WEBB, H. RANDALL, 727 Nineteenth street.

WEBB, W. H., 415 Fifth avenue, New York, N. Y.

WEBSTER, MAJOR WILLIAM H., Civil Service Commission.

WEIR, JOHN B., The Clarendon.

WELD, GEORGE F.,
Albemarle and Chesapeake Canal Company, Norfolk, Va

WELKER, P. A.,
U. S. Coast and Geodetic Survey, 2348 Lawrence avenue, Toledo, O.

WELLMAN, WALTER,
1336 Massachusetts avenue.

WELLS, E. HAZARD,
Office of The Cincinnati Post, Cincinnati, O.

WEST, CAPTAIN F., U. S. Army,
Fort Myer, Va.

WESTCOTT, MISS EDITH C.,
1339 L street.

WHITE, MEDICAL INSPECTOR C. H., U. S. Navy,
Naval Laboratory, Brooklyn, N. Y.

WHITE, DAVID,
143 North Carolina avenue.

WHITE, MISS ELIZABETH WALKER,
Lawrence, Mass.

WHITE, GEORGE H. B.,
National Metropolitan Bank.

WHITE, PROFESSOR I. C.,
Morgantown, W. Va.

WHITNEY, JOSEPH N.,
1403 H street.

WHITTEMORE, W. C.,
1526 New Hampshire avenue.

WHITTLESEY, GEORGE P.,
1430 Staughton street.

WIGHT, E. B.,
1333 F street.

WIGHT, JOHN B.,
1410 G street.

WIGHT, LLOYD B.,
25 Grant place.

WILBUR, MISS F. ISABEL,
1719 Fifteenth street.

WILDE, COMMANDER G. F. F., U. S. Navy,
Light-house Board, Treasury Department.

WILDER, GENERAL J. T.,
Johnson City, Tenn.

WILKES, MISS JANE,
814 Connecticut avenue.

WILKINS, HONORABLE BERIAH,
Editor Washington Post.

WILKINSON, A. G., M. D.,
1526 K street.

WILLENBÜCHER, WILLIAM C.,
428 New Jersey avenue S. E.

WILLIAMS, CHARLES A., 1301 Eighteenth street.

WILLIAMS, MAJOR J. M., U. S. Army, 1842 Thirteenth street.

WILLIAMS, MAJOR L. P., P. O. box 227.

WILLIAMSON, MISS HAIDEE, 1805 Nineteenth street.

WILLIS, BAILEY, U. S. Geological Survey.

WILLIS, F. I., War Department.

WILLITS, HONORABLE EDWIN, Washington Loan and Trust building.

WILSON, MISS ALISAN, The Bancroft.

WILSON, MAJOR C. I., U. S. Army, War Department.

WILSON, H. M., U. S. Geological Survey.

WILSON, COLONEL J. M., U. S. Army, War Department.

WILSON, JOSEPH F., 1315 Clifton street.

WILSON, MISS LIZZIE, 1116 Fifteenth street.

WILSON, DR THOMAS, 1218 Connecticut avenue

WINSLOW, PROFESSOR ARTHUR, Roe building, Fifth and Pine streets, St Louis, Mo.

WINSTON, ISAAC, 1325 Corcoran street.

WINTER, JOHN T., M. D., 1528 Ninth street.

WINTERHALTER, LIEUTENANT A. G., U. S. Navy, U. S. S. *Bennington*.

WISE, CAPTAIN W. C., U. S. Navy, 1014 Seventeenth street.

WITMER, A. H., M. D., Government Hospital for the Insane.

WOOD, LIEUTENANT A. N., U. S. Navy, Navy Department.

WOODWARD, S. W., Wyoming avenue.

WOODWORTH, MILTON, 1424 S street.

WOOLWORTH, JAMES, Sandusky, Ohio.

Wooster, W. M., M. D.,	1228 Fourteenth street.
Worthington, A. S.,	2015 Massachusetts avenue.
Wright, John J.,	1525 O street.
Wright, Moses H.,	53 Trowbridge street, Cambridge, Mass.
Wright, Mrs S. B.,	1525 O street.
Wyman, Walter, M. D.,	Marine Hospital.
Young, F. A.,	U. S. Coast and Geodetic Survey.
Young, John R.,	1314 B street S. W.
Yrigoyen, Dr Don J. M.,	Peruvian Legation.

CORRESPONDING MEMBERS

Abbe, Cleveland, Junior, 2017 I street.

Adams, Professor Frank D., McGill University, Montreal, Canada.

Adams, F. G., Kansas Historical Society, Topeka, Kan.

Ahern, Lieutenant George P., U. S. Army, Fort Missoula, Mont.

Anderson, Surgeon Frank, U. S. Navy, U. S. S. *Amphitrite.*

Anderson, Mary L., P. O. box 977, Salt Lake City, Utah.

Andrews, C. L., P. O. box 106, Fremont, Wash.

Atkins, Thomas B., Maritime Canal Company, 54 Broad street, New York, N. Y.

Austin, Professor E. P., 100 South Eighth West street, Salt Lake City, Utah.

Ayers, H. B., Carlton, Minn.

Babb, Cyrus K., 12 Somerset street, Boston, Mass.

Baber, Miss Zonia, 6757 Lafayette avenue, Englewood, Ill.

Badley, Mrs Mary S., Windsor, Mo.

Bagg, R. M., Junior, Johns Hopkins University, Baltimore, Md.

Baker, David, Sparrow Point, Md.

Baker, Lucius, P. O. drawer 2596, Fresno, Cal.

Bancroft, Dr C. F. P., Phillips Academy, Andover, Mass.

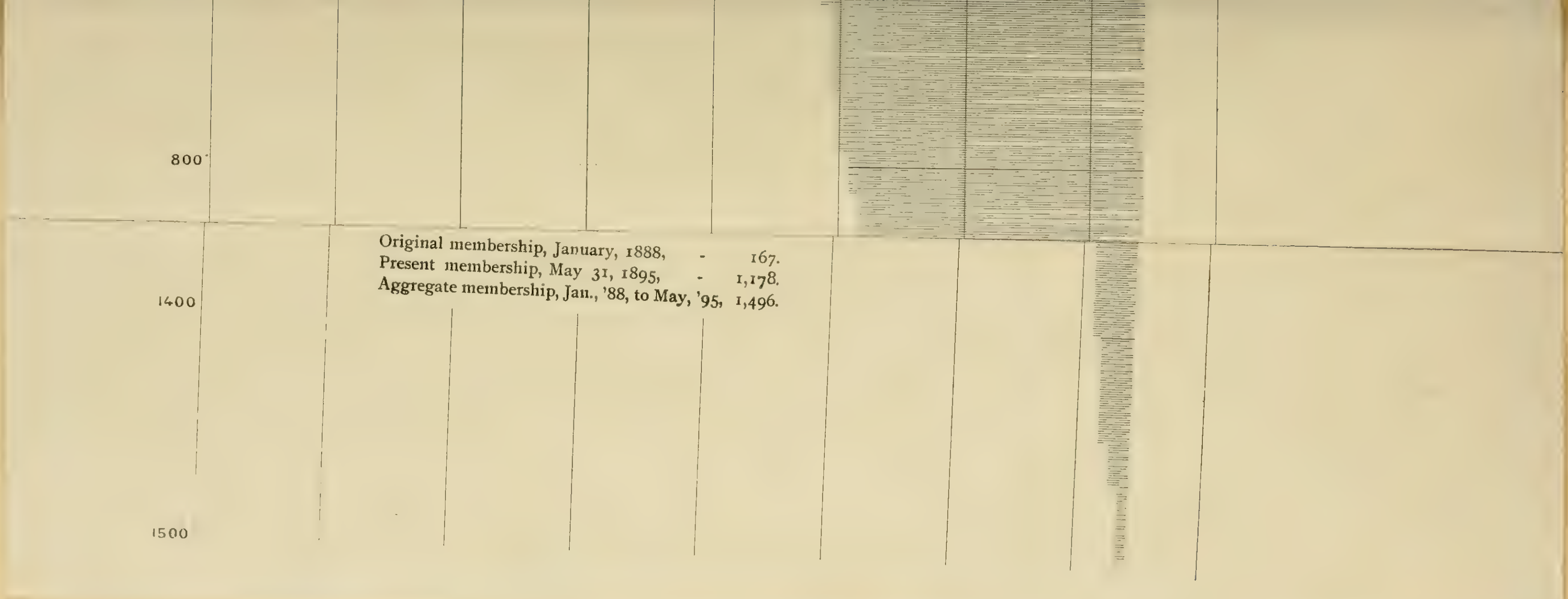
Bannister, Charles K., Ogden, Utah.

Barnard, Charles, Ventura, Cal.

Barroll, Lieutenant H. H., U. S. Navy, Homestead Steel Works, Munhall, Pa.

Barton, George H., Massachusetts Institute of Technology, Boston, Mass.

Bascom, Dr Florence, Ohio State University, Columbus, Ohio.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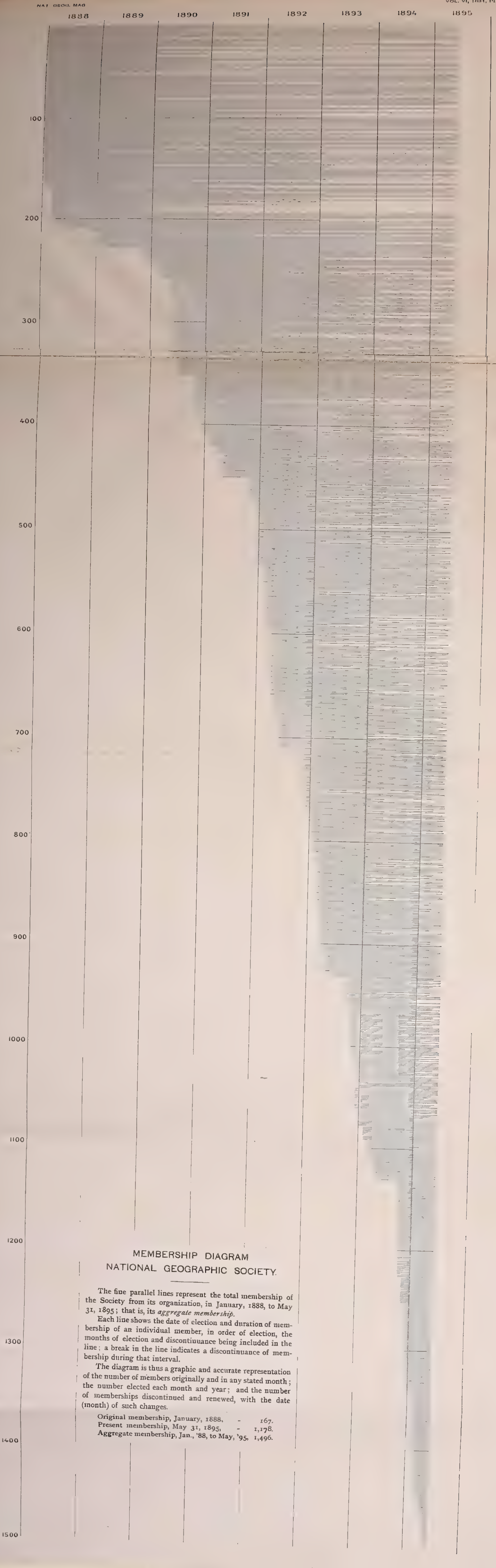
Original membership, January, 1888, - 167.
Present membership, May 31, 1895, - 1,178.
Aggregate membership, Jan., '88, to May, '95, 1,496.



MEMBERSHIP DIAGRAM
NATIONAL GEOGRAPHIC SOCIETY.

The fine parallel lines represent the total membership of the Society from its organization, in January, 1888, to May 31, 1895; that is, its *aggregate membership.*

Each line shows the date of election and duration of membership of an individual member, in order of election, the months of election and discontinuance being included in the line; a break in the line indicates a discontinuance of membership during that interval.

The diagram is thus a graphic and accurate representation of the number of members originally and in any stated month; the number elected each month and year; and the number of memberships discontinued and renewed, with the date (month) of such changes.

Original membership, January, 1888, - 167.
Present membership, May 31, 1895, - 1,178.
Aggregate membership, Jan., '88, to May, '95, 1,496.

Batchelder, C. F., M. D., 7 Kirkland street, Cambridge, Mass.

Bayley, Dr W. S., Colby University, Waterville, Me.

Baylis, Jerome Z., Case School of Applied Science, Cleveland, Ohio.

Beardslee, Admiral L. A., U. S. Navy, Commanding U. S. Naval Force, Pacific Station.

Bernadou, Lieutenant J. B., U. S. Navy, Torpedo Station, Newport, R. I.

Berthoud, Edward L., P. O. box 45, Golden, Colo.

Bixby, Major W. H., U. S. Army, Post Office building, Philadelphia, Pa.

Bower, R. A., 166 Adams street, Chicago, Ill.

Brigham, Professor A. P., Colgate University, Hamilton, N. Y.

Broadhead, Professor G. C., Columbia, Mo.

Brown, Will Q., Riddles, Ore.

Bulkley, Fred G., Aspen, Colo.

Burr, J. H. Ten Eyck, Cazenovia, N. Y.

Cantwell, Lieutenant J. C., U. S. Revenue Marine, 1818 Sacramento street, San Francisco, Cal.

Carleton, P. J., Rockport, Me.

Carroll, Captain James, Juneau, Alaska.

Cary, Austin, Agricultural Department.

Chamberlin, Professor T. C., University of Chicago, Chicago, Ill.

Chenery, Lieutenant Commander L., U. S. Navy, University Club, New York, N. Y.

Chester, Commander C. M., U. S. Navy, Navy Yard, Brooklyn, N. Y.

Clapp, George H., 116 Water street, Pittsburg, Pa.

Clark, Dr W. B., Johns Hopkins University, Baltimore, Md.

Claypole, Professor E. W., Buchtel College, Akron, Ohio.

Clendenin, Professor W. W., Louisiana State Experiment Station, Baton Rouge, La.

Collie, Professor G. L., Beloit College, Beloit, Wis.

Comstock, Professor T. B., University of Arizona, Tucson, Ariz.

Conger, Charles T., University of Chicago, Chicago, Ill.

Conley, Miss M. J., Ventura, Cal.

Cook, Frederick A., M. D., 15 Hart street, Brooklyn, N. Y.

Cook, Fred W., 415 Power building, Helena, Mont.

Cooley, Miss Grace E., Wellesley College, Wellesley, Mass.

Cragin, Professor F. W., Colorado College, Colorado Springs, Colo.

Crimmins, Martin L., University of Virginia, Charlottesville, Va.

Crouter, A. L. E., "Mount Airy," Philadelphia, Pa.

Culbertson, Emma B., M. D., 33 Newbury street, Boston, Mass

Culver, Professor G. E., Stevens Point, Wis.

Cunningham, John M., Cosmos Club, San Francisco, Cal.

Curtis, G. Carroll, 68 Thayer Hall, Cambridge, Mass.

Daly, Reginald A., 60 Perkins Hall, Cambridge, Mass.

Davidson, Professor George, San Francisco, Cal.

Davis, Arthur P., U. S. Geological Survey, P. O. box 788, Denver, Colo.

Davis, W. T., American Bank building, Kansas City, Mo.

Davis, Walter W., 515 Main street, Kansas City, Mo.

Deming, Miss C. E., State Normal School, Providence, R. I.

Denny, Arthur A., 1328 Front street, Seattle, Wash.

Dodge, R. E., Teachers' College, 120th street west, New York, N. Y.

Dolley, Charles S., M. D., 3707 Woodland avenue, Philadelphia, Pa.

Dorr, R. E. Apthorp, Mail and Express, 203 Broadway, New York, N. Y.

DREWRY, W. S.,
Department of Land and Works, Victoria, British Columbia.

DRYER, CHARLES R., M. D.,
Fort Wayne, Ind.

DUMBLE, PROFESSOR E. T.,
State Geological Survey, Austin, Tex.

EASTMAN, CHARLES R.,
297 Laurel avenue, Saint Paul, Minn.

EDSON, HONORABLE OBED,
Sinclairville, N. Y.

EMERSON, DR B. K.,
Amherst, Mass.

EVANS, SAMUEL G.,
211 Main street, Evansville, Ind.

EYERMAN, JOHN,
"Oakhurst," Easton, Pa.

FAIRCHILD, PROFESSOR H. LE ROY,
University of Rochester, Rochester, N. Y.

FAIRCHILD, JOHN F.,
Bank building, Mount Vernon, N. Y.

FENNEMAN, N. M.,
State Normal School, Greeley, Colo.

FORBES, W. H.,
233 Chestnut avenue, Jamaica Plain, Mass.

FRANK, GEORGE W., JUNIOR,
Kearney, Neb.

GANE, H. S.,
Johns Hopkins University, Baltimore, Md.

GANONG, PROFESSOR W. F.,
119 Oxford street, Cambridge, Mass.

GARDNER, JOHN L., 2d,
22 Congress street, Boston, Mass.

GARRETT, H. G.,
Orlando, Fla.

GOODE, J. PAUL,
Moorhead, Minn.

GORMAN, M. W.,
75 North Fourteenth street, Portland, Ore.

GOUCHER, DR J. F.,
Woman's College, Baltimore, Md.

GRANT, ULYSSES S.,
State Geological Survey, Minneapolis, Minn.

GREENE, ROGER S., JUNIOR,
Seattle, Wash.

GREGORY, E. J.,
Fort Collins, Colo.

GRIMSLEY, G. P.,
87 Hubbard avenue, Columbus, Ohio.

GRINNELL, GEORGE B., M. D.,
318 Broadway, New York, N. Y.

GRISWOLD, L. S.,
238 Boston street, Dorchester, Mass.

GROEGER, G. G.,
310 Chamber of Commerce building, Chicago, Ill.

GULLIVER, F. P.,
1686 Cambridge street, Cambridge, Mass.

HAGADORN, LIEUTENANT C. B., U. S. Army,
Springfield, Mass.

HARRIS, DR T. W.,
Harvard University, Cambridge, Mass.

HARRISON, THOMAS F.,
221 West Forty-fifth street, New York, N. Y.

HARVEY, F. H.,
Galt, Sacramento county, Cal.

HASKELL, E. E.,
U. S. Engineer's office, Sault de Sainte Marie, Mich.

HASTINGS, JOHN B.,
Boise, Idaho.

HAWLEY, LIEUTENANT COMMANDER J. M., U. S. Navy,
U. S. S. *Detroit.*

HAYDEN, JOHN ELLERTON VASSALL,
Milton, Mass.

HAYES, PROFESSOR ELLEN,
Wellesley College, Wellesley, Mass.

HAYNES, F. JAY,
392 Jackson street, Saint Paul, Minn.

HENSHAW, H. W.,
Chico, Cal.

HILL, HARRY C.,
P. O. box 1040, Salt Lake City, Utah.

HILLS, VICTOR G.,
P. O. box D, Cripple Creek, Colo.

HITCHCOCK, PROFESSOR C. H.,
Dartmouth College, Hanover, N. H.

HOBBS, DR W. H.,
University of Wisconsin, Madison, Wis.

HODGIN, CYRUS W.,
Earlham College, Richmond, Ind.

HOLDEN, LUTHER L.,
9 Saint John street, Jamaica Plain, Mass.

HOLMES, PROFESSOR J. A.,
University of North Carolina, Chapel Hill, N. C.

HOOPER, CAPTAIN C. L., U. S. Revenue Marine,
320 East Sola street, Santa Barbara, Cal.

HORE, CAPTAIN E. C.,
Care of Thomas Pratt, Bridge street, Sydney, N. S. W.

HOWE, EDWARD G.,
304 Columbia avenue, Champaign, Ill.

HOWE, FRANK D.,
Care of Secretary National Geographic Society, 1515 H street.

HOWISON, CAPTAIN H. L., U. S. Navy,
Navy Yard, Mare Island, Cal.

HOXIE, CAPTAIN R. L., U. S. Army,
P. O. box 1240, Pittsburg, Pa.

HUBBARD, W. H.,
904 "The Rookery," Chicago, Ill.

HUBERICH, CHARLES H.,
P. O. box 640, San Antonio, Tex.

HURD, ARTHUR W., M. D.,
Buffalo State Hospital, Buffalo, N. Y.

IDDINGS, PROFESSOR J. P.,
University of Chicago, Chicago, Ill.

VAN INGEN, GILBERT,
Vassar College, Poughkeepsie, N. Y.

JACOBS, JOSEPH,
Los Angeles, Cal.

JAGGER, T. A., JUNIOR,
Care of Drexel Harjes et Cie, Paris, France.

JEWETT, W. P.,
180 East Third street, Saint Paul, Minn.

JOHNSON, MRS MARY D.,
Sitka, Alaska.

KELLEY, W. D.,
619 Havemeyer building, New York, N. Y.

KEMP, PROFESSOR J. F.,
Columbia College, New York, N. Y.

KEMP, JAMES S.,
395 Union street, Brooklyn, N. Y.

KENNAN, K. K.,
Manhattan, Mont.

KENNEDY, GILBERT F.,
19 Rutland street, Cambridge, Mass.

KERR, H. S.,
Manti, Utah.

KERR, MARK B.,
402 Front street, San Francisco, Cal.

KERR, W. H.,
Ilchester, Md.

KING, W. F.,
Department of the Interior, Ottawa, Canada.

KLOTZ, DR OTTO J.,
437 Albert street, Ottawa, Canada.

KOEHLER, S. R.,
Museum of Fine Arts, Back Bay P. O., Boston, Mass.

Kümmel, Henry B., University of Chicago, Chicago, Ill.

Lamb, Miss Lavinia, 579 Broadway, Saint Paul, Minn.

Lambert, M. B., 326 Clinton street, Brooklyn, N. Y.

Leonard, A. G., Iowa Geological Survey, Des Moines, Iowa.

Leverett, Frank, Denmark, Iowa.

Lewis, Jesse, Warrensburg, Mo.

Lewis, J. V., Chapel Hill, N. C.

Libbey, Professor William, Junior, 20 Bayard avenue, Princeton, N. J.

Liddell, Henry, M. D., Care of Secretary National Geographic Society, 1515 H street.

Lloyd, Francis E., Pacific University, Forest Grove, Ore.

Loomis, Henry B., Seattle, Wash.

Luce, Joseph, E. M., 29 South Sixth East street, Salt Lake City, Utah.

Macfarlane, Professor A., University of Texas, Austin, Texas.

MacKaye, James M., Shirley, Mass.

Mackinder, H. J., 1 Bradmore road, Oxford, England.

Maher, James A., P. O. box 35, Johnson City, Tenn.

Malone, Miss M. J., Hyattsville, Md.

Marbut, Curtis F., Care of Secretary National Geographic Society, 1515 H street.

Marcy, Professor Oliver, 703 Chicago avenue, Evanston, Ill.

Marks, A. J., M. D., 419 Madison street, Toledo, Ohio.

Mason, Mrs A. Livingston, "Halidon Hall," Newport, R. I.

McArthur, J. J., Topographical Survey, Ottawa, Canada.

McCracken, R. H., P. O. box 495, San Antonio, Tex.

McCurdy, George G., Care Professor E. E. Salisbury, New Haven, Conn.

McDowell, William O.,
Lincoln Park, Newark, N. J.

McLaughlin, Major Frank,
Oroville, Cal.

Mell, Professor P. H.,
Auburn, Ala.

Mendenhall, Dr T. C.,
Polytechnic Institute, Worcester, Mass.

Merrill, Charles A.,
Holden, Mass.

Merrill, F. J. H.,
State Museum, Albany, N. Y.

Merrill, Professor J. A.,
Warrensburg, Mo.

Miller, Charles C.,
509 Ross street, Hamilton, Ohio.

Monjeau, Cleophas,
Middletown, Ohio.

Montgomery, Professor J. H.,
Allegheny College, Meadville, Penn.

Morris, Miss L. W.,
617 Milan street, Shreveport, La.

Nitze, H. B. C.,
1505 Edmondson avenue, Baltimore, Md.

Nixon, J. H., M. D.,
314 Saint Louis street, Springfield, Mo.

Nordhoff, Charles,
Coronado, Cal.

Norman-Neruda, L.,
Devonshire Club, Saint James street, London, England.

O'Brian, J. T.,
Kearney, Neb.

Oppenheim, Mrs Ansel,
277 Summit avenue, Saint Paul, Minn.

Osborn, Lieutenant A. P., U. S. Navy,
Commanding Coast Survey Steamer *Gedney*.

Osborne, Dr George L.,
State Normal School, Warrensburg, Mo.

Otis, Hamilton,
Cazadero, Cal.

Owen, W. O.,
Laramie, Wyo.

Parker, Colonel Francis W.,
6640 Honore street, Englewood, Ill.

Parmelee, H. P.,
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Pavlow, Professor Alex. W.,
Sadowaja, Great Spassky Perlouak, Haus Lebedeff No 3, Moscow, Russia.

Peale, Dr A. C., 1909 Chestnut street, Philadelphia, Pa.

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Poore, Howard W., Worcester Academy, Worcester, Mass.

Power, George C., P. O. box E, Ventura, Cal.

Powers, Fred Percy, 32 Broadway, New York, N. Y.

Price, Joseph M., 56 West Seventy-first street, New York, N. Y.

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Prince, Honorable L. Bradford, Santa Fe, N. M.

Read, Motte A., Laguna P. O., Tex.

Reclus, Professor Elisée, 17 rue du Lac, Brussels, Belgium.

Reid, Professor Harry Fielding, Johns Hopkins University, Baltimore, Md.

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Ricksecker, Eugene, P. O. box 289, Seattle, Wash.

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Robinson, Miss F. Page, Forest Glen, Md.

Rockwood, Professor C. G., Junior, 34 Bayard avenue, Princeton, N. J.

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Care of Union National Bank, Denver, Colo.

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Point Street Grammar School, Providence, R. I.

SCHAAP, C. H.,
P. O. box 32, Sitka, Alaska.

SCHOBINGER, JOHN J.,
Morgan park, Cook county, Ill.

SCHRADER, F. G.,
68 Thayer hall, Cambridge, Mass.

SCHRYVER, MISS A. A.,
Teachers' College, 120th street west, New York, N. Y.

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Topographic Survey of Canada, Ottawa, Canada.

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State Geological Survey, Trenton, N. J.

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U. S. Naval Academy, Annapolis, Md.

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27 Mellen street, Cambridge, Mass.

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Massachusetts Institute of Technology, Boston, Mass.

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Alabama Polytechnic Institute, Auburn, Ala.

STOCKTON, COMMANDER C. H., U. S. Navy,
30 Kay street, Newport, R. I.

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ULRICH, J. C., P. O. box 1291, Denver, Colo.

UPHAM, WARREN, 109 Oakdale avenue, Cleveland, Ohio.

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WADHAMS, LIEUTENANT COMMANDER A. V., U. S. Navy, Care of Navy Pay Office, San Francisco, Cal.

WALKER, E. D., 605 Union street, Schenectady, N. Y.

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WARD, L. B., Taylor's Hotel, Jersey City, N. J.

WARREN, WILLIAM M., 329 Broadway, Cambridgeport, Mass.

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WELLS, WILLIAM H., 274 Ashland avenue, Chicago, Ill.

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WILLIAMS, WILLIAM, University Club, New York, N. Y.

WINCHELL, HORACE V., 1306 Southeast Seventh street, Minneapolis, Minn.

WINCHELL, PROFESSOR N. H., 120 State street, Minneapolis, Minn.

WOODWARD, PROFESSOR R. S., Columbia College, New York, N. Y.

WOODWORTH, J. B., 7 Rutland square, Cambridge, Mass.

WORTHINGTON, ERASTUS, JUNIOR, 637 Exchange building, Boston, Mass.

WRIGHT, PROFESSOR G. FREDERICK, 11 Elm street, Oberlin, Ohio.

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Corresponding members	274
Total membership, May 31, 1895	1,178

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THE

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GEOGRAPHIC PROGRESS OF CIVILIZATION

ANNUAL ADDRESS BY THE PRESIDENT

HONORARLE GARDINER G. HUBBARD

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Annual Address by the President

HONORABLE GARDINER G. HUBBARD

(*Presented before the Society February 2, 1894*)

If parallels of latitude were drawn around the earth about fifteen degrees north and fifteen degrees south of Washington, the land within these parallels would include all the countries of the world that have been highly civilized and distinguished for art and science. No great people, except the Scandinavians and Scotch, who, from their climate, belong to the same region, ever existed outside these limits; no great men have ever lived, no great poems have ever been written, no literary or scientific work ever produced, in other parts of the globe. In the far north are found savages and barbarians, the Mongols, Lapps, Eskimos, Finns and other equally barbarous tribes; in the south the Polynesians in Oceanica, the Hottentots and Bushmen in southern Africa, the Patagonians and Terra del Fuegans in South America. The nearer man lives to the polar regions the greater his inferiority in intellect, the greater his barbarism.

Now, changing our starting point, if two other parallels are drawn, one fifteen degrees north and another fifteen degrees south of the equator, the country within these parallels would contain the richest and most abundantly watered lands, producing the greatest varieties of vegetal and animal life, the largest variety of the most beautiful birds and flowers, the most ferocious animals; both animal and vegetal life carried to the highest perfection, save only in the case of man, for whose development a different zone has been required.

When we look at the geographic distribution of man and observe that from the Arctic seas to the Antarctic ocean the world is inhabited by men of differing race, color, character and civilization, we naturally ask, Are the Mongolian, the Polynesian, the Negro, the Indian, and the Caucasian descended from one or from many progenitors? We believe that there are facts sufficient to show that man may have originated in one place and migrated thence over the world. We have evidence of the the life of man during the Ice age in caves among the foothills of the mountains of France, where the bones of men and the remains of their food, nuts and roots, with the bones of the cave bear, the woolly-haired rhinoceros, and other extinct animals have been found. As years rolled on and men multiplied, they were compelled to wander in search of food: some to colder climates, where they dug holes in the earth in imitation of caves and covered them with the branches of trees and leaves; others emigrated to southeastern Europe and thence to western Asia, where finding neither caves nor trees, they built huts of stone and mud, and wandering still further into China they made houses of bamboo; still others migrated to the torrid zone and lived in the woods, the trees their only shelter. Wherever men wandered they were governed in the construction of their habitations and in their food by the climate, the materials at hand, and the vegetation.

Some early men found their way to the sea-coast, where mollusks and fish served them for food. From the extent of the shell mounds in our country and the kitchen-middens of Scandinavia, these places must have been inhabited for many hundreds and some say thousands of years. In Europe the forests and running streams furnished game and fish, and there man lived by hunting and fishing. In eastern and central Asia the country is open, destitute of trees and running water, the land of the wild horse, goat and cow; by slow degrees these animals were domesticated, and the nomads became shepherds. The tribe remained the same, roaming from place to place in quest of game and fish or of pasture, without any permanent abiding place or connection with the soil; even a small tribe required a large tract of land, for a square mile supported only one man, while in England the population is 265 and in portions of India over 400 to the square mile. The flocks and herds increased, and gradually came the idea of personal property. After man ceased to be a nomad and became a tiller of the soil and began to sow and reap, then came the idea of property in real estate, belonging not to the individual but to the tribe.

In all countries similar weapons and instruments were used in the chase and for warfare and in the construction of habitations. Stones, everywhere found, were early shaped into darts and lances and then into arrow-heads and axes. This was the Stone age. Copper mines have been found in Egypt and near Lake Superior, abandoned long before the beginning of history; copper from these and other mines was the first metal used because found in its native state; then tin, and with the invention of bronze a further advance toward civilization. This was the Bronze age. Every new invention or discovery made the next stage more rapid; yet it was long after the Bronze age before iron was used.

Even now in the different parts of the world men are passing through these various stages. In Kamchatka the natives live in caves of rocks and cover the openings with skins; they have no domestic animals, not even the dog; their weapons are bones and pointed stones. In Terra del Fuego the natives live on sea mussels, fish, rats and wild geese. In central Africa the Dwarfs possess no domestic animal but poultry, and some of the tribes live almost entirely on roots, berries and nuts. These people belong to the Stone age. Other tribes of Africa have passed from savagery to barbarism, the first stage of progress, and make vessels of copper and bronze. The equatorial Indians of South America subsist almost entirely on the fruit of the banana and the palm tree, and by hunting and fishing. The Mandans of Dakota lived in mud houses. I have seen similar huts among the Tatars of Asia. In Russia the agricultural land generally belongs to the commune, or mir, as the commune is called. Every year the property is allotted to the families of the mir according to their size.

In the earliest ages government was unknown; with the family came the first idea of government, the head of the family having despotic power over all its members; then several families formed the clan, and as the clan grew came the tribe, the association of clans.

The earliest civilizations of which we have any knowledge are those of Egypt, Babylon, and China, and though the monuments of those civilizations are from 5,000 to 6,000 years old, and perhaps much older, they show that centuries of civilization must have antedated their erection; for the Sphinx and the Pyramid of Cheops, the earliest monuments of Egypt, have never been surpassed. The manners and customs of the Egyptians and Chinese were almost identical, though their architecture was of entirely different type, depending on the material convenient for use—in Egypt, stone; in China, bamboo and wood. The syllabic symbols of the Chinese are the counterparts of the hieroglyphic writings of Egypt. The civilization of other nations, save perhaps that of the Indians of this continent, was derived from and dependent in a greater or less degree on that of Babylon and Egypt.

China.

At some early period Mongolian tribes must have passed the Pamir, descended the plateau of Tibet into the rich valleys of eastern China, dispossessed the aborigines of their lands, and extirpated, absorbed or forced them into inaccessible fastnesses. The physical geography of China influenced and tended to form the character of its inhabitants. On the north are the deserts of Mongolia and Gobi, beyond these Siberia, until recently even more desolate than the Mongolian desert; on the east the ocean; on the south China sea and the Himalaya mountains; on the south and west the highest and most extensive plateau in the world, Tibet, and behind it a long chain of mountains crossed only by passes from 14,000 to 20,000 feet in altitude. These well-nigh impassable barriers cut off the Chinese from communication with the world, and for ages they remained entirely unknown to Europeans, whom they regarded as outside barbarians.

The great rivers of China have afforded an unsurpassed system of inter-communication, and to this the empire owes the homogeneous character of its population, and largely also its long-continued political unity. The Chinese very early passed from the nomadic to the agricultural state, and for a long period must have made great progress in art and science; but in some remote age this progress was stopped, and since then they have neither advanced nor retrograded. The Chinese invented gunpowder, the mariners' compass, and the printing-press. They made silk goods and ceramics long before they were known to the western world; but they used gunpowder only for fire-works, and even with the compass they never ventured so far from the land as the Phenecians without it. They had the printing-press long before Europe, but their literature is greatly inferior to that of the Greeks and Romans, who used only the papyrus and skins or parchment for their writings. Their fields of bituminous and anthracite coal are unsurpassed in extent, but though coal has been used for ages in their houses, it has never to any considerable extent been used for other purposes. Their form of government, the patriarchal, which contributed to stay development, is founded on the conception of the state as an enlarged family, and of the family as the state in miniature. As the father possesses absolute control over his own family, so the emperor possesses despotic power over the lives and property of all the families. The Chinese have neither freedom of mind nor liberty of body. They are an impersonal people with little conscious individuality. Their civilization, begun so early, has remained stationary for thousands of years.

Arabia.

From China we pass to another country no less peculiar in its physical features, but entirely dissimilar. In a territory nearly two-thirds surrounded by water we should not expect to find one of the arid tracts of the world, where rain falls only once in three or four years; in a country on a parallel of latitude only a little south of Florida, with a mean altitude of 3,000 feet, we do not expect to find the zone of maximum heat, and still less do we expect to find ice and snow for three months of the year on mountains only 7,000 to 8,000 feet in height. All of these contrasts are found in Arabia. A range of mountains follows the coast line around the whole of Arabia, and except on Red sea and on a few small streams and oases Arabia is dry, hot and barren, the land of the shepherd. The largest cities are Mecca and Medina, near Red sea, to which annually thousands of pilgrims resort; for it is a sacred obligation on every Mohammedan to visit Mecca before he dies. Arabia has been peopled from the earliest times, and the bedouin, the inhabitants of the larger portion of its territory, have never passed beyond the nomad state. The bedouin have always cherished the poet and have a rich literature of poetry and romance, and in every tent of Arabia may be heard the recital of the stories of the "Arabian Nights." The Arab sheik with his tribe roams from place to place seeking pasture for his horses and herds. Thus, without contact of man with man, without schools or education, progress in trade or commerce is impossible.

The Arabs as Mohammedans ruled the whole territory from Caspian sea to the Indian ocean, and from the western border of India through northern Africa to the Atlantic; they crossed the straits of Gibralter and, as Moors, conquered the greater part of Spain and southern Gaul, where their further progress was stopped by Charles Martel at Tours in the year 732. Wherever they came in contact with other races they accomplished much in science, especially in astronomy, but little in art. Even now, through their religion and institutions, they give the law to one-eighth part of the human race, while their language is one of the most extensively spoken in the world. To the Arabs we owe probably our first knowledge of astronomy and the Arabic numerals, brought to us from India through Arabia.

Egypt.

China may have been inhabited before Egypt, but it is the latter country that has influenced the civilization of the world.

As Egypt has neither game nor fruits for food, nor broad plains for cattle to roam, it could not have been inhabited at an early period nor by a nomadic race. Its inhabitants must have come from the east and not from the south, from Asia and not from Nubia, for they are of the Asiatic and not the Negro type.

The climate is warm but not enervating; the soil, though rich, produces no large trees—indeed the willow seems to have been the only tree that grew spontaneously on the river banks,—while the indigenous plants were unsuitable for food. It is inclosed by deserts on the east and west, and beyond the valley by two low mountain ranges called by Arabian writers "The Wings of the Nile," on the south by the mountains of Nubia, on the north by a broad band of marsh land and shallow lakes extending along the coast that held the people back from the sea, while the want of timber suitable for ships prevented them from becoming a maritime nation. Herodotus says, "Egypt is the gift of the Nile." Its valley is so level that it is enriched by each inundation of the Nile throughout its entire length of 600 miles and breadth of from 12 to 15 miles, a little regular labor thus securing large returns. The houses were built of dried mud, as there are neither trees nor stone, and adobe houses answered in a country where rain seldom falls. The pyramids were built of stone brought from several hundred miles up the Nile. The king was the first soldier and the high-priest, the representative of the gods before the nation. The pyramids were constructed by the descendants of those who had even then long occupied the land—the ancestors of the present fellahin. Egypt was conquered by the Hyksos or shepherd kings, by Cambyses, Alexander, and others in turn; foreign rulers usurped the throne, but the people remained unchanged. If a mummy should awake from his sleep of three thousand years he would today see the same sky above him, the same river overflowing its bank, the same deserts; the same people living in similar houses, cultivating the ground with the same kind of plow, irrigating with the same shadoof—a people as changeless as the sky, the river and the desert.

Architecture has never reached such vast proportions elsewhere, but art, swathed in bands like the mummies, was forced into the same cold rigidity and remained unchanged as the monuments erected by despotic sovereigns under a sky as unchangeable as themselves.

To the Egyptians we owe the development of agriculture and architecture.

Mesópotamia.

Mesopotamia, or "The land between the rivers" (Euphrates and Tigris), was formerly called Assyria and Babylonia. Assyria occupied the upper portion, 500 miles long and from 100 to 300 miles wide, a well watered, rich country. Its capital was Nineveh.

The lower part of the valley, Babylonia, was the seat of the earliest civilization. It was 400 miles long and about 100 miles wide, a rainless country watered by the overflow of the Euphrates and the Tigris from April to June, formerly irrigated by numerous canals connecting the Tigris and Euphrates.

East of Mesopotamia were the mountains and deserts of Scythia, early inhabited by nomad tribes without permanent or fixed habitations. As they increased they required more land for their herds, and the overflowing population was forced into the plains of Mesopotamia, where they began the cultivation of the valley. Mesopotamia was successively ruled by Babylonian, Assyrian, Chaldean, Syrian, Median, and Persian monarchs. The kings were the religious as well as the secular heads, despots of the most absolute kind, ruling over a nation of slaves. They built a vast number of great cities. As there were no stones in the lower valley the buildings were constructed of sun-dried brick, and although there was stone in Assyria, brick was generally used as in Babylon.

In Nineveh and Babylon the architecture of the palaces and city walls surpassed in variety, beauty, and taste that of Egypt. Hieroglyphics were gradually superseded by cuneiform characters, running from left to right, in which many books and instruments were written. As early as the twentieth century B. C. their annals were engraved on stone, and every great city had its library of baked bricks or tablets, stamped in minute characters, arranged in order and numbered, so that the student had only to give the number of the tablet and receive it from the librarian. But notwithstanding their architecture, their libraries and luxury, the people were intellectually and morally barbarous. Mesopotamia, unlike Egypt, was not protected by deserts from incursions. The nomads of Scythia, tempted by the wealth and luxury of the inhabitants of the plains, again and again left their flocks and poured into the valley, and though often repulsed, finally overthrew the empire and destroyed the irrigating canals; the land was then covered with sand, and Mesopotamia has become a desert waste.

To the inhabitants of Babylonia and Assyria we owe the development of trade and commerce by the caravan.

Syria.

Between Mesopotamia and Arabia lies Syria, a small country remarkable for its physical features and its wonderful history. In the east a great desert with beautiful oases, where were Palmyra, Baalbec and Damascus; west of these oases the mountains of Moab and Gilead; beyond the mountains in the valley of the Jordan, with the lake of Gallilee at the north and the Dead sea at the south, Palestine, the land of the Jews. Beyond the Jordan lay Lebanon and Anti-lebanon; on the sea-coast the land of Tyre and Sidon.

By its position, Syria was the great battle-field of Africa and Asia. Bordering on the Mediterranean, it has been the means of transmitting the civilizing influences of the east to the west, and generations later that of the west to the east.

The great plateau of Syria stops suddenly at some distance from the Mediterranean and encircles on a large curve a belt of coast land, sometimes expanding into large plains cut up by rocky spurs into narrow valleys opening into the sea and inhabited by the Phenecians. Good harbors and timber from the mountains of Lebanon and the outlook on the sea invited the inhabitants to launch on the Mediterranean their vessels theretofore confined to the rivers of Mesopotamia.

The Phenecians, like many other people in modern times, began their mercantile career by plundering the neighboring coasts and villages. They rapidly increased in number, and soon wealthy cities sprang up on the sea-coast, each city with its adjacent territory governed by its king. The Phenecians sent out colonies, east to the Persian gulf and Red sea; west to Greece, Carthage, Sicily, Italy, and Spain. They sailed through the straits of Gibralter northward and southward into the Atlantic and became merchants and traders, exchanging their manufactures of glass and Tyrian dyes for the goods and precious stones of the east, the wheat and grain of Carthage, the gold and silver of Spain, the tin and copper of Great Britain.

The country was frequently conquered by Assyria, Babylon, and Egypt without affecting its prosperity; but when Greece became a maritime power the Phenecians were driven from the eastern Mediterranean, and later the Romans drove them from the western Mediterranean, each state thus protecting its own trade and commerce.

To Phenecia we owe the development of navigation and commerce, the alphabet and, probably, weights and measures.

Persia and India.

Three thousand five hundred years ago the Aryans, emigrating from the cradle lands of their race, passed through Syria into

Persia and later into India, in each country driving the native races before them and occupying the most favored parts of the land.

The geographic features of Persia and India are dissimilar, affording an opportunity to notice the effect produced on the same race by differences in the physical geography of the two countries. Persia formerly included Afghanistan and Beloochistan, and was called the Iranian plateau. It is environed with mountains, so that one-half the drainage is inland. Mountain chains cross it in every direction; it is dry and hot in summer, cold in winter, with great salt deserts and rich fertile valleys of limited extent; it is the land of the rose and the nightingale.

The Persians are naturally brave, warlike, independent and unconquered, but under a despotic government a part of the people have lost much of their independence and have become great traders. This despotism is, however, principally confined to the cities and towns, for the larger proportion of the population are nomads, subject only to their chiefs, and remain free and independent. The area of the Iranian plateau is about two-thirds that of India; the population of the one is 13,000,000; of the other, 287,000,000.

The vedas, hymns which the Aryans sang three thousand years ago on the banks of the Indus in northern India, give us our earliest knowledge of India. They show that when they were written the Aryans were a people of robust rudeness and manly freedom, in character entirely unlike the Hindus of to-day, more like the nomad Persians.

The Aryans found one of the richest countries in the world, generally well watered and easily cultivated: in the north, a temperate and healthful climate, the region of the Himalayas and their foot-hills; in northern-central India, the warm, rich valleys of the Indus and Ganges. Further southward low mountains cross the country from east to west, and from these mountains rich plains with an equatorial climate extend to southern India and Ceylon. The Aryans conquered India, driving the aborigines into the mountains and jungles and the Dravidians into the southern parts of India, where they retain their habits and customs. Though the same race conquered and settled Persia and India, it would be difficult to find two nations now more unlike: the Persians restless, strong, brave and independent; the Hindus small in stature, weak in body, highly imaginative, with little independence or even love of liberty, easily enslaved, and passive under bondage.

Into this country, considerably over a thousand years ago, the Mohammedans came and settled among the earlier inhabitants; and now Brahmins, Mohammedans, Sudras, Dravidians and aborigines live together in all parts of India without anything in common—they never intermarry, their religious and domestic life and all their interests are in opposition; this diversion of interests preventing them from uniting against foreign invaders or domestic tyrants. England, therefore, with an army of 220,300 (British, 71,171; native, 149,129) rules the 287,000,000 people of India. There is scarcely a country in the world containing so great a diversity of tribes and races as India, where we find every stage of civilization, from the philosophic Hindu down to the most degraded savage.

The arts of India were more original and varied than those of Rome; her forms of civilization present an ever-changing variety, such as are nowhere else to be found. Greece and Rome are dead, but India is a living entity and a complete cosmos in itself. Within the life of the present generation England has introduced great reforms, abolished inhuman customs, diffused education, and built railroads in many directions, tending to overthrow caste and gradually change the character of the people.

Greece.

From Persia we turn to Europe and to Greece, the country with which Asia had for many centuries close connection. As the geographic situation of Phenecia gave commerce to the world, so the position of Greece, a short distance west of Phenecia, gave a further and greater advance to civilization.

Greece, the smallest of the three peninsulas of Europe, is the most bountifully endowed by nature. In variety of physical features it excels the countries of Europe, as Europe excels the other continents. Into its small territory are gathered all the peculiarities of the continent to which it belongs—mountains, valleys, rivers, a lovely climate and fine scenery, seas with deep gulfs studded with islands, the largest extent of sea-coast in proportion to its territory of any country. Its mountain ranges opening to the sea inclose fertile valleys, which naturally led to the formation of autonomous communities, in which each developed its own political, social and artistic life independently of all others. No other country possessed within such narrow limits so many different characteristics of humanity with such varied tastes, pursuits, and amusements. Fond of liberty, bold and adventurous, never acting together unless driven by the necessity of an alliance against a common foe, there were yet bonds of unity in the poems of Homer, in their religion, in their temples, and especially in their games.

The gulfs of Corinth and Egina, now connected by a canal, divide Greece into parts, each antagonistic to the other: on the one side were the Dorians, represented by Sparta; on the other the Ionians, represented by Athens; the one an oligarchy, the other a democracy; in the one tyranny of the state, in the other freedom of the family; in the one contempt for labor, in the other work honorable alike for all; war and hunting the sole occupation of the Spartans, commerce, the arts and sciences the pursuit of the Athenians. The government of Athens was at first democratic, a government of the people by families and tribes. Its life-and-death struggle with the Persians compelled the Athenians to build a navy and assume the leadership of Greece, and to change the form of government. If Greece had been defeated, her whole civilization would have been crushed by eastern despotism and neither her artistic nor her spiritual life would have been possible. Greece was the home of individual freedom and democracy, of great philosophers, poets, architects, sculptors, and painters. Though Greece and Athens fell, it was only to spread their influence and learning far and wide.

To Greece we owe the separation of church and state—for it is the earliest nation of which we have any knowledge where the king and priest were not united in the same person,—the development of philosophy, literature and art, and the ideas of democracy and the personality of man.

Rome.

The geographic position of Italy, a neighbor of Greece, bordering on Gaul and not far from Spain, dividing the Mediterranean into two distinct parts, was admirably adapted to make her capital in the middle of Italy—Rome—the center of the ancient world, its mistress.

Rome had the genius of government; her rule was not that of a race, for she united a hundred different races in the state, The east and the west contributed to her greatness. The provinces which became tributary to her enjoyed, in healthfulness and fertility of soil, in variety of vegetal and mineral products, and in natural facilities for transportation and distribution of exchangeable commodities, advantages that have not been possessed in equal degree by any territory of like extent in the Old World or the New. From Mesopotamia came cotton and silk and from India precious stones; from Arabia the Blest came spices; grain came from Egypt and Sicily, elephants, lions and tigers for her colosseum and circus from Africa, gold and silver from Spain, iron, copper and tin from England, gladiators from Gaul and Germany. Even the harvests of Egypt and the wealth of Asia could not forever supply the demands of the Roman emperor and support in idleness and luxury the people of Rome. Some of the countries from which Rome had long drawn its supplies became exhausted of their fertility and so diminished in productiveness as to be no longer capable of affording sustenance even to their own inhabitants, while others refused to be still longer subject to the despotic rule of Rome. Lands which from their abundance sustained a population scarcely inferior to that of the whole Christian world of the present day became entirely unproductive or at least capable of supporting only the few tribes which wander over their deserts. While this exhaustion of the national resources was going on the Gauls and Germans, taught the art of war by their conflicts with the Romans, once and yet again crossed the Alps and carried war into the heart of Italy. The Goths, Huns and Vandals, with hordes from the far-distant deserts of Tartary and Mongolia, poured through the fastnesses of the Alps, and Rome fell.

To Rome we owe the idea of universal dominion, the merging of all nations into one, and the civil law.

We have now finished our review of the nations of the Old World, and have shown that all nations pass through similar stages of progress from savagery to a more or less advanced state of barbarism, and that beyond these stages nations have rarely if ever progressed without a change in their surroundings or contact with other peoples. Certain nations like Egypt, Arabia, and China had an early development, and since then have been persistent, but have made no progress, while other highly civilized nations, like the Babylonians, Assyrians, Phenicians, Grecians and Romans, have had their times of development, progress and decay. In these nations, excepting Greece, civilization was confined to the rulers and the noble families, while the people were sunk in the deepest degradation and without true civilization.

We turn now to modern nations, from Asia to Europe, Africa, and America.

Scandinavia.

After the fall of Rome the first revival of civilization seems to have come from the far north, "The land of the midnight sun."

A slight knowledge of the geography of Europe will show why Scandinavia, the home of the vikings, was the first to awake from the lethargy of the dark ages. Though it lies far away in the northernmost part of Europe, yet the winds and waves from the Gulf stream bathe its shores and give it a more equable climate than that of New England. Whoever looks at the map of Norway and sees its gulfs, bays, numerous fiords, and fine harbors probably exceeding in number those of all the other countries of Europe, will see what gave her the vikings, a race of seamen, and why her population, when they found no room on their own shores, sailed for other lands and occupations. They early became pirates and freebooters, then founded colonies on the coasts of North sea, in France, on the coasts of Italy and Sicily, in England, the Orkney islands, Iceland, and Greenland. In the geographic position of their country and in their habits they somewhat resemble the inhabitants of Tyre and Sidon.

Italy.

Though Scandinavia opened a new era for commerce and for a time was all-powerful on the ocean, yet the northmen did little for the development of a higher civilization. For progress in the arts and sciences, we must return to the shores of the Mediterranean.

Italy, situated in the middle of the Mediterranean, the peninsula of Europe which extends furthest southward, rich in its valleys and fine harbors, the land of the vine and fig-tree, is the only country which has had a renaissance. The ships of Venice and Genoa became the carriers of Europe, exchanging the products of the Orient for the goods and wares of Europe; and when Constantinople fell and the church of the east was overthrown, Rome a second time became the capital of the world, the church was separated from the state, and the pope became the spiritual head of the world.

The practical and reasoning mind of the north could not long bear this rule. The discovery of America, the invention of the printing-press, and the personality and independence of northern Europe produced Luther and the Reformation, broke up the old regime, and brought in a new life to Europe.

Spain.

From Italy the wave of civilization which rolled over the peninsulas of the Mediterranean at last reached Iberia—the Spain and Portugal of today. The greater part of this peninsula is an elevated plateau, dry and hot in summer, cold in winter, its southern and western coasts only having the climate and products of Greece and southern Italy. The difference of climate and the admixture with more southern races has given to the Spaniards and Portuguese a different complexion, temperament and character from the inhabitants of northern Europe. The sea-coast and harbors of Portugal invited its people to send out ships on voyages of discovery and trade along the coast of Africa.

The peace which followed the war of Ferdinand and Isabella with the Moors left a multitude of restless spirits ready for any rash undertaking; and for them the discovery of America opened a wide field of adventure and led to the conquest of the New World and the Orient. Gold and silver poured into Spain, the labor of slaves was substituted for that of the freeman, and Spain became the first nation of the world, extending her empire over central Europe and the Netherlands; but wealth, luxury, and the religious despotism which reached highest development in the Inquisition led to her conflict with Great Britain and finally to her fall.

Great Britain.

Great Britain, protected by her insular position from foreign invasion, with a mild climate, abundant rainfall, fertile soil, good harbors, and vast mineral wealth, is most favorably situated for a great nation; yet for many generations before the discovery of America the Britons made little progress in population, wealth or civilization.

Later, Hawkins, Drake and others saw that the African slave trade was very profitable; so with the aid of Elizabeth they built ships, captured negroes in Africa, and carried them to the West Indies, where they were sold as slaves. Their followers became buccaneers and pirates, finding that occupation still more profitable. Leaders and seamen were thus trained for the war with Spain, which resulted in the destruction of the Armada and made England a maritime power. She founded colonies in North America, captured islands in the West Indies and Pacific, and subsequently acquired India, Cape Colony and the Gold coast in Africa, with all of Australia and New Zealand. England became a great commercial and mercantile nation, a mother of nations; coal and iron mines were opened, the steam engine and steam ships were invented; she became a manufacturing nation, the carrier and banker of the world, and her wealth and prosperity increased and still continue to grow.

Africa.

Over against Greece and Italy and in sight of the Iberian peninsula is Africa, the eldest of the continents, the birth-place of European civilization.

In its physical aspect, its population and its civilization, Africa is unlike the other continents. It is a huge peninsula, with few bays and gulfs, scarcely any islands, without good harbors or rivers navigable from the ocean into the interior. It has only one-fourth as much sea-coast in proportion to its area as Europe, and only one-third as much as America. It is the only continent in which the largest part of its territory lies within the tropics. As the earth here spontaneously furnishes food for the sustenance of man, and as only scanty clothing is required, all inducements to either mental or manual labor are wanting.

In all the continents we find traces of inhabitants of a different race from those now peopling them, but in no other country are the movements of different races so well marked as in Africa. The Arabs who now inhabit the northern part of Africa drove the former occupants, the Bantus, toward central Africa; they in their turn dispossessed the Negro, while the Negro dispossessed the Dwarfs and their kinfolk the Bushmen and the Hottentots, who were probably the aborigines. The Dwarfs retreated to the thick woods of the interior, the Bushmen and the Hottentots to the extreme southern lands of Africa.

Cape Colony, in the southern part of Africa, in a mountainous region with salubrious climate and considerable fertile soil, was settled by the Dutch in 1652, only thirty years subsequent to the landing of the Pilgrims at Plymouth. For over one hundred years the English have held it, but the population today is only 1,530,000, of whom but 370,000 are whites and 1,160,000 Africans. It should have been a fit home for the white race, but they have not flourished there.

Contrast Cape Colony with the Argentine republic, on the same parallel of latitude and with a similar climate. The immigration into that state within the last ten years has been over 1,200,000; in 1869 the population was 1,877,000; in 1891, 5,200,000.

Natal, formally occupied by a small number of boers, was seized by the British in 1843, when it had only a few inhabitants. It possesses great advantages of soil, a semi-tropical but agreeable and healthful climate; the land rising in plateaus from the coast affords several varieties of temperature. Emigrants at different times have poured into the Colony, yet although fifty years have elapsed since its settlement by the British, Natal has only 46,000 Europeans out of a population of over 540,000. Great numbers of Negroes, refugees from the neighboring Zulu country, have settled in Natal, attracted by the good government of the English.

Algeria, in the north temperate zone, has a climate like that of Spain, Italy, and Greece. It was conquered by the French and has been held by them for over sixty years. France has sent many colonists to Algeria, but the increase in the European population has been very slow, and for a long time the deaths exceeded the births. The population in 1893 was estimated at 4,124,000, including about 267,000 French and 215,000 other Europeans. The French have had little better success in northern Africa than the English in the south.

Within the last fifteen years the nations of Europe have made a few settlements in different parts of Africa, the results of which cannot be foretold.

America.

The physical geography of America is essentially different from that of the old world, very largely by reason of the fact that in the one the mountains run north and south, in the other east and west. It has less ocean front to the square mile than Europe, more than either Asia or Africa.

When America was discovered its north temperate region was occupied by numerous tribes of Indians, living by hunting and fishing, almost always at war with one another. South of Ohio river the land was more easily tilled, and the tribes that inhabited it, unlike the aborigines of New England and New York, cultivated a little ground and were less savage. Still further southward, in Georgia, Alabama, and Mississippi, the Cherokees, Chocktaws, and Natches had an organized government with fixed places of residence and tribal rights. They relied for their support more on agriculture than on the chase and fishing. The Pueblos, in New Mexico and Arizona, inhabiting the cliff dwellings, had advanced to a still higher state of civilization. Among the Pueblos, as well as among the more highly civilized tribes of Central America, were other tribes living in the same territory, much more savage than their neighbors, and in some cases even more savage than the Indians of New England. Still further southward, in Central America, in a warmer zone, tempered by its high mountains, was a higher civilization than in the north. Unfortunately, we know little either of this people or of the Incas of Peru. On the Pacific coast of North America, in a territory 50 miles wide and 1,000 miles long, were a vast number of different races and languages. In South America there was a greater variety of race and language than in North America east of the Sierra Nevada.

In South America is the richest valley of the torrid or temperate zone, watered by the Orinoco and the Amazon. A rich soil, with a moist and hot climate and an abundance of rain, produces a most luxuriant vegetation. Mr Buckle says: "Here, where physical resources are the most powerful, where the soil is watered by the noblest rivers, the coast studded by the finest harbors, the profusion of nature has hindered social progress and opposed that accumulation of wealth without which progress is impossible." Fortunately, most valuable timber, the rubber tree, quinine, and tapioca yield abundant harvests without the labor of planting and watching from seed time to harvest, and by quick gains for light work offer inducements to the laborer to acquire habits of industry. The inhabitants of this region are a mixed race of Spaniards, Indians, and Negroes, numbering about 37,000,000, of which 21 percent are white, 35 percent Indians, 40 percent mixed, and 6 percent Negroes. In all these countries, even those where there are few whites, the pure Indian is steadily giving away to the mixed blood, apparently the product of natural selection. It would seem from this that the climate and country are better adapted to the increase of mixed blood than either the Spanish or the Indian.

Central America and South America were settled by the Latin race, North America by the French and English. The French early founded settlements on the Saint Lawrence, and have ever since occupied the larger portion of its valley, though their population has never spread outside of this territory and portions of New England. They are a hardy, frugal, and industrious race, living in a cold, unfruitful country; all their strength and resources are expended in obtaining a scanty livelihood, leaving them without opportunity to develop the artistic taste and culture natural to the French race.

The United States owes its rapid growth and prosperity largely to the valley of the Mississippi. This great valley slopes from the east and west and toward the south, and has the largest extent of rich arable land in the temperate zone. West of the Missouri are great plains, and further westward among the Rockies great parks and plateaus, with short summers and long winters, so dry that neither heat nor cold are unpleasant. Here also are great mineral veins, bearing gold and silver, lead and copper, iron and coal, with rapid streams, fit country for the miner, the manufacturer, and the herdsman. In the far west, where there are only from five to fifteen inches of rainfall, numerous irrigating ditches have been made, and by means of the storm water collected in reservoirs the desert has been made to yield most abundant harvests.

The English and their descendants have never mingled with the Indians, but have driven them from their homes, following the example of every other nation of the Old World in occupying the territory of the aborigines. As soon as the rich plains and fertile prairies of the Ohio and Mississippi valleys were explored, thousands and tens of thousands of emigrants from the Old and New World flocked into a region where they could obtain homesteads for the asking. This emigration benefited both continents, for the population and wealth of the Old World has rapidly increased since emigration began, and never in the history of the world has so much wealth been created as by the settlement and cultivation of these valleys.

Athough the blood of many nations is mingled in the United States, we find the same peculiarities prevailing along the same parallels of latitude today that existed in the Old World and in the colonies when the country was settled. The people of the north are more practical and more inventive than the people of the south. In the northern states, in 1891, one patent was issued to each 3,257 of the population, in the southern states one to every 11,181 of the population; in Connecticut one to every 965, in Mississippi one to every 23,447.

Slavery was early introduced into the United States, but its increase was very slow until the cotton-gin was invented, when the raising of cotton became profitable and the slave population necessary to the cultivation rapidly increased. It is impossible to ascertain how many Negroes were imported into the United States between 1619, when the first cargo was landed at Jamestown, and 1808, when the trade ceased. By a count made prior to the Revolution the number of slaves was a little over 500,000. The first census, in 1792, showed 757,000 colored, most of whom were slaves. In 1861 there were 4,440,000, of which 488,000 were free. Since the abolition of slavery the blacks have concentrated upon lands at once both hot and moist, in the middle of the Gulf states, and have increased more rapidly than the whites in the states of South Carolina, Georgia, Alabama, Mississippi and Louisiana. The negroes have increased 70 percent, the whites 60 percent.

Table showing the relative Increase of Negroes in the Gulf States.

	1860.	1870.	1880.	1890.
Negroes	2,104,000	2,245,000	3,064,000	3,528,000
Whites	2,120,000	2,195,000	2,805,000	3,377,000
	4,224,000	4,440,000	5,869,000	6,905,000

Jamaica and San Domingo.

A healthy climate, fertile soil, good harbors, and luxuriant vegetation, or even a large and prosperous white population, are not sufficient to ensure progress in civilization. Jamaica, the

Queen of the Antilles, is one of the loveliest islands of the West Indies, with a tropical climate on the coast, in the interior high mountains with a temperate climate, a sea breeze by day and a land breeze by night stronger than are found elsewhere.

In slavery times the sugar and coffee properties made the planters of Jamaica the richest men of England, and the white population steadily increased, while the deaths among the slaves exceeded the births, and the number was kept up only by the average annual importation of 9,000 slaves. The abolition of slavery caused the failure of the planters, the decrease of the white population, the abandonment of the greater part of the plantations and properties, and the rapid increase of the blacks. In 1861 there were 13,816 whites, 81,074 mixed, 346,376 blacks; total, 441,266. The proportion was one white man to six mixed or mulattoes and twenty-four blacks; today it is one white man to four mixed and sixty blacks, the total population being 639,491.

San Domingo is even more beautiful than Jamaica. It has a healthful climate, high mountains, beautiful scenery, fine harbors, a fertile soil which repays with three harvests a year the labor of the husbandman. The first European settlements in America were on this island, four hundred years ago. As the Indian proved incapable of enduring the hard labor imposed by the Spaniards, Las Casas introduced Negroes to save the life of the Indian. His efforts were unsuccessful, for the Indians, numbering it is said 2,000,000 when the Spaniards landed, have all perished. The white man ruled for nearly three hundred years; vast fortunes were made; the returns from slave labor were so great that the carrying trade employed 1,400 vessels with crews of 50,000 men.

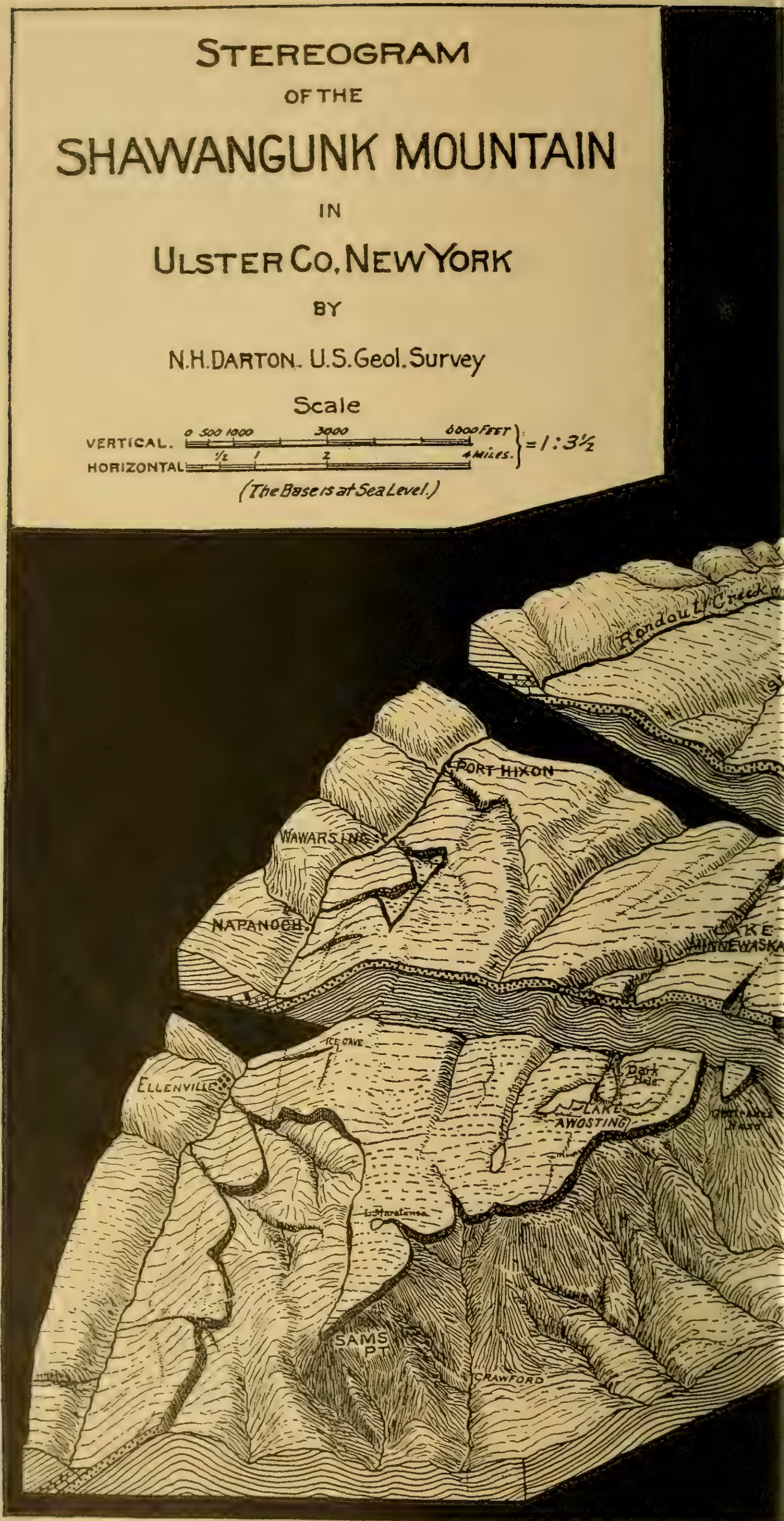
About one hundred years ago the blacks of Haiti threw off the French yoke, murdered the white men, and established what they called a republic. San Domingo subsequently threw off the Spanish yoke and declared itself free and independent. The Spaniards were killed as the French had been. The white man perished even as the Indian perished, and all trade and prosperity passed away. Since then both states have sunk into the deepest barbarism, and the people, three-fourths black and one-fourth mixed blood, are daily becoming more savage. Fetichism and cannibalism are here combined, and the people have fallen lower in the scale of civilization than the Negroes of Africa.

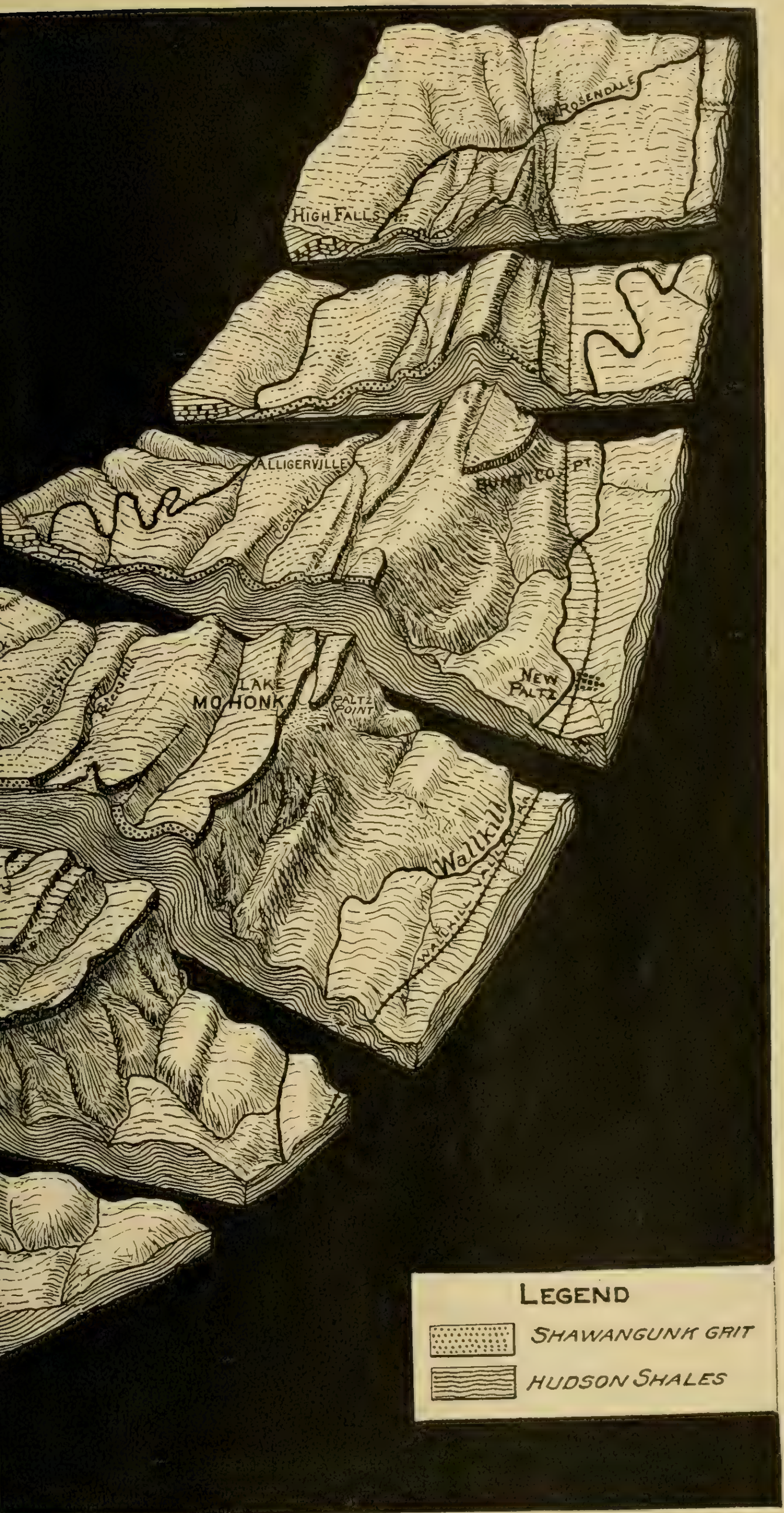
The most favored places in the world for climate, fertility of soil, and ease of access are, first, the West Indies; next the islands of Oceanica. Surpassing these in fertility and equaling them in salubrity of climate is the valley of the Amazon. These regions are now inhabited by the Negro, the Polynesian, and the Indian. The Negro in the equatorial regions, unless held as a slave, supplants the white man; the Polynesian and Indian both fade before the civilization of the white man. In the valley of the Amazon a mixed race of whites and Indians seems persistent, and the white element by a kind of natural selection predominates.

A late writer says that these regions must be given up to inferior races; to this conclusion we cannot agree. In the progress of civilization man with his inventions and discoveries, by the applied power of steam and electricity, has practically annihilated time and space. In the early history of man he was controlled by and subject to his environment, which shaped his life and formed his character; now he in turn controls his environment. In our homes we temper the summer heat and make an equatorial climate in winter; we daily provide our tables with all the products of each season of the year and every clime; we have begun even to understand and combat the microbes of the tropical regions that have brought sickness and death in their train.

We have followed the progress of civilization from the rising to the setting sun; we have witnessed its decay in one country, followed by the rise of a higher civilization in another; we have seen it cross the Atlantic to the New World where it has spread, ever widening and deepening its scope, until it has leavened the whole mass of humanity.

We began with the proposition that in all the ages of the past civilization has been confined to the favored regions lying in the temperate zone; but with ever increasing knowledge there seems to be no reason to doubt that man will eventually bring under subjection all the adverse conditions of physical life and become the master of his environment, until the whole earth, even those regions heretofore supposed to be entirely unfit for habitation, shall own his power and become the abode of the highest intelligence and greatest civilization.


STEREOGRAM
OF THE
SHAWANGUNK MOUNTAIN
IN
ULSTER CO, NEW YORK
BY
N.H.DARTON. U.S.Geol.Survey
Scale
VERTICAL. 0 500 1000 3000 6000 FEET
HORIZONTAL ½ 1 2 4 MILES.
= 1 : 3½
(The Base is at Sea Level.)
Rondout Creek
PORT HIXON
WAWARSING
NAPANOCH
LAKE MINNEWASKA
ICE CAVE
ELLENVILLE
Dark Hole
LAKE AWOSTING
SAMS PT
CRAWFORD


ROSENDALE
HIGH FALLS
ALLIGERVILLE
NEW PALTZ
LAKE MOHONK
PALTZ POINT
Wallkill
LEGEND
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SHAWANGUNK MOUNTAIN*

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Shawangunk† mountain is a prominent range lying between Hudson river and the southern Catskills, in Ulster county, New York. To the eastward it rises from the Wallkill valley in steep inclines, surmounted by a high escarpment; to the westward it slopes to the Rondout valley. Along its axis it rises gradually south of Rosendale, and finally attains an elevation of 2,200 feet and a width of five miles. It continues to the southward, with somewhat decreased height and width, through New Jersey and Pennsylvania, where it is known as Kittatinny mountain, and gives rise to the Delaware, Lehigh and Susquehanna water-gaps.

The well known summer resorts of lake Mohonk and lake Minnewaska are on the summit of Shawangunk mountain, in Ulster county, so that the region has become familiar to a large number of visitors. Unfortunately, however, no description of its geology has ever been published and the meagre references in the report of Mather‡ throw but little light on the subject.

During the autumns of the past two years I have had occasion to spend a few days on the mountain to determine the salient

* Published by permission of Professor James Hall, State Geologist, in advance of the Annual Report of the Geological Survey of New York.

† Pronounced "Shongum," according to the residents of the region.

‡ Geology of New York, Report on the First Geological District, 1843.

features of its geology in Ulster county, and they were found to be of great interest. In this article there is presented a brief summary of the results of my observations, but in a report on the geology of Ulster county, now in preparation, there will be a somewhat more detailed description of the region.

The structure of Shawangunk mountain in Ulster county is a particularly interesting illustration of close relation of rock texture to topography, for the presence of the mountain and its form are directly dependent on the structure of a relatively thin sheet of hard rock. In the accompanying stereogram (plate 1) an attempt has been made to represent its physiographic character, and the structure is shown in the cross-section at the ends of blocks into which the supposed model is divided. The mountain consists of a widely extended sheet of Shawangunk grit lying on soft Hudson shales. This sheet lies in a gently westward-dipping monocline which is corrugated by a series of gentle longitudinal flexures. To the westward it dips beneath shales and limestones of the succeeding formations in the Rondout valley; to the eastward it terminates in long lines of high precipices which surmount steep slopes of Hudson shales. Its anticlinals give rise to high ridges and wide plateaus; its synclinals constitute in greater part the intervening depressions. In several portions of the mountain the grit has been eroded off the crests of the anticlinals and the underlying slates are bared. This is the case in a wide area southeast of Ellenville, in a long strip extending from near lake Mohonk nearly to Rosendale, in a small area east of Wawarsing, and in the top of the mountain north of lake Minnewaska. Mather has suggested that the great cliffs of the region are due to faults, but I find this is not the case. Only one fault was found, and this was a small overthrust in the Rosendale region. There are many slight faults of a few inches or feet, but they appear to be entirely in the grit.

The surface of Shawangunk mountain is nearly everywhere very rugged, and cliffs and rocky slopes abound. These consist of snow-white grits, more or less mantled with dark lichens, and are remarkably picturesque. There are many cataracts, several beautiful rock-bound lakes, and widely extended views of the Catskills to the westward and the Hudson valley to the eastward. The ruggedness is due to the exceptional hardness of the grits, the softness of the underlying shales, and a tendency to vertical jointing which gives rise to cliffs and clefts.

There are low lines of cliffs all over the surface of the mountain, especially to the southward, but along the eastern face, where the grit is being continually undermined by erosion of the slate, they are of great prominence, in some cases having a nearly vertical height of two hundred feet and extending continuously for many miles. The "points" are projections or promontories of the eastern edge of the grit beyond the general crest line, due to a less degree of recession. Buntico point, Paltz point, Gertrude nose and Sams point are the most prominent of these, but there are many others of minor importance. The cliffs on the surface of the ranges are of various heights and lengths, and rise along joint cracks. They face in various directions, but a north-and-south trend is predominant. They are usually in irregular, discontinuous steps on the slopes and face each other and enclose depressions of various sizes on the plateaus.

The lakes for which the mountain is famous lie in basins of moderate depth and are all near the top of the range. They are nearly surrounded by cliffs of Shawangunk grit of greater or less height, which add greatly to their beauty. The grit is mainly a messive white or gray quartzite or conglomerate, averaging 250 to 300 feet thick. The proportion of pebbles is large but variable, many beds being fine. The pebbles and grains are quartz, and the matrix is siliceous. The conglomerate is the famous Esopus millstone, and has been largely quarried for two centuries.

The relations of the Shawangunk grit to the Hudson shale in the Shawangunk mountain region is one of slight but persistent unconformity. The coarse grit lies directly on the eroded surface of the shales. This erosion has truncated low arches of the slate, but has channelled its surface only slightly. Exposures of the relations are everywhere abundant. One of the best instances is along the road from Minnewaska to New Paltz, two miles south of lake Mohonk. Here along the mountain slope a very low arch of the grit is seen surmounting a truncated arch of shales of materially steeper dip. Diversity of dip is seen at every locality, varying from very slight to 10°, but several points were observed where it was hardly perceptible.

The corrugations in the general monocline of the mountain are a series of anticlinals and synclinals which traverse the range diagonally from north-northeast to south-southwest and begin in succession from northeast to southwest, their axes rising gradually to the southward. Beginning at the northern end of the range the principal feature is the anticlinal which brings up the cement between Rosendale and Whiteport. South of Rondout creek, opposite Rosendale, the upward pitch of this flexure increases rapidly, and the Shawangunk grit soon rises into a ridge of considerable altitude. In a short distance from the creek the grits are eroded from the crown of the arch, and to the southward the underlying shales constitute a series of high but rounded hills extending along the center of the mountain. The occurrence of these high hills of soft rock is a striking feature, and they give a unique character to this portion of the mountain. Their presence is due to the former protection of the arch of Shawangunk grit by which they were originally covered. The grit in the flanks of this arch extends down the slopes of the mountain, where it dips beneath overlying formations in the valley on the western side and extends nearly or quite to the base on the eastern side. One mile and a half south of Rosendale the range has the structure shown in the first section on the stereogram. It will be seen that the sheet of grit lying along the eastern slope of the mountain is considerably corrugated. This corrugation consists in the main of a western limb dipping more or less steeply eastward, and a shallow synclinal. In one portion of the ridge, there is a very abrupt anticlinal crumple in this synclinal which extends but a short distance in either direction and then flattens out into the general flexure. There is also a fault which extends from the Rosendale cement region. It gives rise to a sharp ridge which continues to the first road across the mountain, beyond which it dies out. Along the eastern face of the northeastern range of the mountain the dips are in greater part gently to the westward. Along the railroad they are 20°, and this is the average for some distance. On the first road across the mountain the dips are 60°, but this steep dip soon gives place to inclinations of not over 10°, and toward the southern end of the ridge the synclinal dies out, leaving a gentle dip eastward. This grit area lying along the eastern slope of the mountain terminates abruptly southward in a fine line of cliffs which, owing to the upward pitch of the bed in this direction, are of great elevation. This is Buntico point, one of the most prominent topographic features in the region. Its character is shown in the stereogram.

South of Buntico point the eastern crest and summit of Shawan-

LAKE MOHONK LOOKING SOUTHWARD.

gunk mountain consists of a great mass of Hudson shales, which are being rapidly and deeply eroded. They extend southward nearly to lake Mohonk, where the crest of the anticlinal is occupied by grit for some distance. The grit in the western limb of the anticlinal on the northern end of the mountain lies part way down the western slope and does not attain the prominence that it has in the area terminating in Buntico point. It constitutes a monoclinal ridge, with a line of cliffs along its eastern edge, above which the hills of Hudson shales rise several hundred feet. To the westward the Shawangunk grit dips beneath overlying formations in the synclinal valley of Coxingkill. On the opposite side of this valley, at High Falls, there rises one of the principal anticlinals of Shawangunk mountain, which soon brings up Shawangunk grit in the low ridge on which the village is built. This ridge gradually increases in width and altitude southward, and near the line of the third section on the stereogram its crest is nearly as high as the ridge eastward, from which it is separated by the synclinal valley of the Coxingkill.

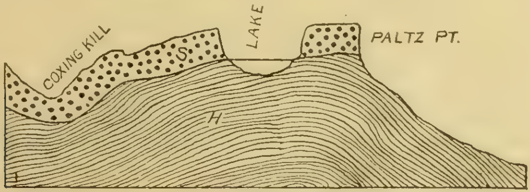

FIGURE 1.—*Cross-Section of eastern Ridges of Shawangunk Mountain through Lake Mohonk, looking northward (S, Shawangunk Grit; H, Hudson Shale). Vertical scale exaggerated.*

South of Alligerville the mountain widens rapidly as flexure after flexure brings up the Shawangunk grit from the northwestward. The western ridge rises gradually on the upward pitch of the axis of the flexure, and finally becomes the highest part of the mountain east of Ellenville. Southwest of lake Mohonk there are five of these flexures, together with various small undulations, with a creek in each synclinal. Lake Minnewaska is in the crown of the anticlinal which rises at High Falls, and lake Awosting is on the western slope of the same flexure.

These lakes are all situated near the eastern side of the mountain and about 150 feet below the crest. They are similar in relation and originated under almost the same conditions. Lake Mohonk occupies a north-and-south cleft in the crown of the anticlinal which rises at Rosendale. The structure of lake Mohonk is shown in figure 1.

The lake basin is in Hudson shales, but it is bordered on the east and west by high cliffs of Shawangunk grit. To the south there is a gap in the front of the mountain through which the shales extend to the lake. The top of these shales is a few feet above the surface of the lake at its southeastern end, but the pitch carries them a few feet below the water surface toward the north and west.

On plate 2 are shown some features of lake Mohonk.

This view is looking to the southward and out of the gap in the eastern front of the mountain through which the Hudson shales extend to the lake. On the left is Paltz point, and to the right, in the distance, is Cope point, a projection of the southern extension of the eastern front of the mountain.

East of the lake there is a thick mass of grit, which lies along the crest of the anticlinal. It begins a short distance northward and is terminated by very abrupt cliffs in Paltz point, near the southern end of the lake. The character and relations of this "point" are represented in the stereogram.

At the head of the lake and the base of the southern end of the mass of grit in Paltz point the Hudson shales constitute a small plateau which surmounts the long eastern slope of the mountain. There is no cross-drainage way at the base of the cliffs and the reason for the abrupt termination of this point is obscure.

The grit dips gently west-northwestward along the western side of Paltz point and very slightly eastward in its easternmost part. Northeast of the lake the dip is at a low angle to the westward, but there are several slight undulations. There is everywhere a pronounced pitch northwestward. Owing to the westerly dip the grits in the Paltz point ridge are somewhat lower just north of the lake than elsewhere. It will be seen from these statements that the lake lies slightly west of the center of the arch of the anticlinal, and all the dips along its shores are northwestward, although at very low angles. The degree of dip rapidly increases down the western slope of the mountain into the synclinal valley of Coxingkill.

The outlet of lake Mohonk is to the northward by a branch of Coxingkill. This branch flows through a slight depression separating the Paltz point range from the main mountain mass, and then obliquely down the flank of the anticlinal.

South of Paltz point the eastern front of the mountain presents a nearly unbroken line of high cliffs for many miles along or near the crest of the anticline. The nature of a portion of this escarpment is shown in plate 3

Two miles south of lake Mohonk there is a slight depression in the crest line through which the road to lake Minnewaska passes, and there are several other depressions of less amount. Millbrook mountain is the culminating feature of this portion of the range, beyond which its front is somewhat more irregular in contour.

Lake Minnewaska is similar to lake Mohonk in appearance, but it is somewhat larger. It was not ascertained whether its basin extends into the Hudson shales, for there is a continuous rim of grit surrounding it. As a very great thickness of grit is exposed above the water level in this vicinity, it seems probable that the bottom of the lake is in or very near the shales. This probability is increased somewhat by the presence of the steep

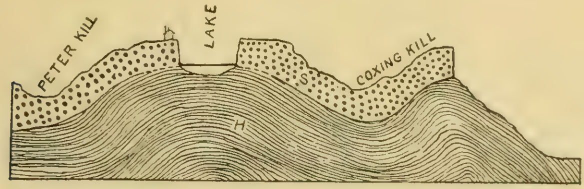

FIGURE 2.—*Cross-Section of the eastern Ridges of Shawangunk Mountain through Lake Minnewaska, looking northward* (*S, Shawangunk grit; H, Hudson shales*).

cliffs and the width of the valley or cleft in which the lake lies. In figure 2 there are shown the principal structural features at this locality.

The cliffs which extend along the eastern side of the lake are very high and precipitous. As at lake Mohonk, the rocks are greatly fissured and are traversed by many deep wide clefts. The dips are gently anticlinal about the lake, which is on the axis of the flexure, but they increase in amount to the east and west. The lake empties to the southward through a wide gap, into the synclinal valley of the Coxingkill, and it may be regarded as the headwaters of this stream.

A mile northeast of the lake the anticlinal on which the lake is situated is crossed by the road to Port Hixon, and in the vicinity of the road the grit has been removed from the crown of the arch for some distance. The road crosses the ridge in a gap on the Hudson shales, and the edges of the grit give rise to high cliffs on either side. Down the slope aways, the grit outcrops on the flank of the arch, but the slate extends along the upper slopes of the mountain for some distance, especially on the east side. The occurrence of the slate in this inlying area is a very striking feature, and the reason for the removal of the grit at this locality is not clear.

South of lake Minnewaska the front of the ridge trends southwestward some distance, and the Coxingkill anticlinal and the anticlinal next west, pass out to the south. There is a prominent "point" in this vicinity known as Gertrude nose, which is due to a deep incision in the front of the mountain made by a small branch of the Wallkill. This stream heads on the plateau south of the lake, passes over the edge of the grit in a series of falls, and has cut a deep gorge into the Hudson shales below.

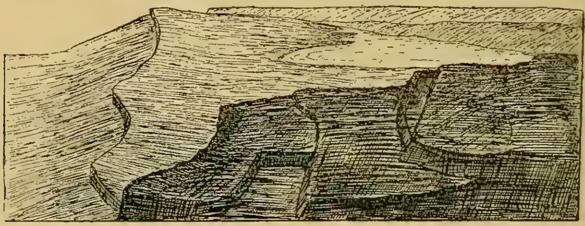

FIGURE 3.—*Lake Awosting from the East-northeast, Sams Point in the Distance.*

Lake Awosting is the largest lake of the series, and has a length of about a mile. It is surrounded in greater part by low cliffs and rocky slopes, but near its eastern end there is a line of very high cliffs which extend in from the crest of the mountain eastward and constitutes a high, west-sloping plateau northeast of the lake. In figure 3 there is given a view of this lake based on kodac photographs.

The basin of the lake does not appear to be in Hudson shales, although possibly they underlie its deeper portions. The grit dips gently westward along the lake and this dip continues over a wide area of surrounding region. On the west there is a long slope to the main Peterkill valley, which extends from a low cliff along the lake. The outlet of the lake is by a fork of the

EASTERN FACE OF SHAWANGUNK MOUNTAIN LOOKING SOUTHEASTWARD.

Peterkill which flows along the west-sloping grits for half a mile, and then in high falls over the grit into the kill. East of the confluence there is a narrow depression known as Dark hole, which extends southeastward up the slope of the mountain. It is rimmed by moderately high cliffs of west-dipping grit and was cut by a stream which empties into the Peterkill. On the southern side of Dark hole is the high plateau of which the eastern front constitutes the cliffs at the southeastern end of lake Awosting.

The Peterkill valley from beginning to end extends along the western flank of the anticlinal on which lake Minnewaska is situated, and has a cliff of west-dipping grit on its western side and slopes of grit on its eastern side. Four miles below lake Awosting the kill passes over Awosting falls and then over a series of cascades, aggregating in all a fall of over 240 feet approximately. In Awosting falls there is a clear fall of sixty-odd feet. They are a mile north of lake Minnewaska. In the gorge below the several falls there are high cliffs of grit for some distance, but owing to considerable pitch northward or down stream and a thickness of grit somewhat over 200 feet, the kill has not cut through to the Hudson shales.

South of lake Awosting there are two small, shallow ponds on the summit of the mountain. Mud pond, at the head of Fly brook, the principal fork of the Peterkill, is one, and lake Maratanza is the other. Lake Maratanza empties eastward by a branch of the Wallkill which pitches over the edge of the grit on the crest of the mountain, in a great fall into a deep gulf of Hudson shales. The locality is known as Verkeerder falls.

Between Gertrude nose and Sams point the crest of the mountain is very high, but for some distance the edge of the grit is broken into great terraces and there is a sloping bench of Hudson shales of some width at the base. Several branches of Wallkill drainage head in the crest of the mountain in this region and pass over the edge of the grit in falls of which the above-mentioned Verkeerder falls are the most noteworthy.

In this region the mountain narrows and some of the flexures pass out to the southward. This narrowing is due to recession of the edge of the sheet of the Shawangunk grit, which is closely related to the upward pitch of the flexures. This pitch increases the height of the mountain southward, but with increased height there is a corresponding increase of erosion in the soft underlying shales, which beyond certain limits causes rapid recession. This is illustrated by Sams point, where the maximum altitude of 2,240 feet is attained. The "point" is a narrowing extension of the grit along the axis of a very flat synclinal, which finally terminates in a high narrow cliff presented southward. From the wide anticlinal area to the west the grit has been eroded and the Hudson shales occupy the surface in a group of very high hills. These hills are surrounded by cliffs of the grit which on the eastern side rise somewhat above their summits, on the northern are about even with their higher summits, and on the western lie along their flanks. Originally the grit area in this region and southward was as wide as it is now at lake Mohonk, but owing to the greater height to which the northern pitch of the flexures carried the grit, it was here more rapidly and widely undermined and removed. It is the grit on the western limb of the anticlinal that lies on the western flanks of the shale hills, constituting a monoclinal ridge of considerable prominence which extends from Ellenville far southward into Pennsylvania. This monoclinal mountain consists of a single-crested ridge of the Shawangunk grit, with a long slope up the dip from the valley westward, which terminates in an east-facing cliff of grit surmounting long rolling slopes of shale on the eastern side of the mountain. Its structure near the southern edge of Ulster county is shown in the bottom section on the stereogram, and this is typical for the greater part of its course. In the valley westward there is a succession of formations overlying the grit, as shown on the left of the sections in plate 1. They are the Clinton red shales, Salina water lime, Helderberg limestone, Oriskany sandstone, Esopus shales, Onondaga limestones, and a great mass of Devonian shales and sandstones which extend into the Catskills. The dips along the western slope of the mountain are low north of Wawarsing, but they rapidly increase southward to an average of about 60° in the vicinity of Ellenville. In this region of steep dips the streams flowing down the steep western slope have cut deep gorges, which extend through the grit into the underlying shales. The two streams south of Ellenville are exaggerated examples of this, and they have been largely instrumental in baring the Hudson shales on the anticlinal area behind Sams point. The two streams just north of Ellenville also cut into the shales, but they are very small and have only formed narrow gorges. Opposite Napanoch is a small creek which has cut a deep gorge into the shales, and in the higher part of the slope has bared the grit from an area of considerable size, which is surrounded by high cliffs. The stream opposite Wawarsing has cut a gorge and removed an area of the grit on the upper slopes of the mountain, but does not cut through to the shale. The head of this depression extends into the head of the depression opposite Napanoch, and both are surmounted on the east by a continuous line of high cliffs. The stream which flows out of the mountain at Port Hixon is larger than the others and has cut a deep, wide gorge; but owing to the lower dip of the grit it does not appear to have cut through to the shales to any great extent. No shales were observed in place in the depression, but a small amount of shale débris was noticed at one point. Everywhere along the steep slopes there are clefts in the grit, some of which appear to extend down to the shales. One of these is the "Ice cave," a locality which is widely famous in the region. It is high in the slope, about two miles east-northeast of Ellenville. Ice and snow remain in it in greater or less amount, and in some seasons they are preserved entirely through the summer and autumn. In the vicinity there is also an old copper mine from which large supplies of fine quartz crystals were obtained some years ago. The top of the mountain southwest of Wawarsing is a wide plateau which is traversed by the valley of Stony creek. Its surface is very irregular and low cliffs of the bare grit abound.

The grit in the higher portion of Shawagunk mountain nearly everywhere presents a basined surface. These basins are depressed an inch or two below the general level and are of various sizes and shapes. They usually contain pools of water and some sand and pebble detritus. They are mostly smooth and even polished and are distributed all over the mountain, but particularly on the western slope. With the polishing are associated lines of glacial scorings and striation which are conspicuous at nearly every locality. Julien* has recorded the direction of some of these striæ and scorings. The general direction is southwestward and the average depth is between one-sixteenth and one-eighth of an inch. In the vicinity of Sams point the most abundant scratches trend south 46° west and south 29° west.

* New York Academy of Sciences, Trans., vol. iii, pp. 22–29.

A few were observed somewhat more to the westward in direction, one-fourth inch in depth.

In the vicinity of lake Mohonk, about the hotel and on the northwestern slope, south 10° west is the general direction; on the southeastern side of the mountain and on the road to Alligerville, it is south 40° east; and at Sky Top, south 18° east. At lake Minnewaska the trend is south 10° west. There is but little foreign glacial drift on the summit of the range, so far as observed, but there is considerable in the adjoining valleys.

The origin and history of the lakes are not entirely clear, but they appear to be due to glacial agencies. The principal feature has been a local deepening and widening of a preëxistent valley, aided, at least in the case of lake Mohonk, by the presence of shales at the point now occupied by the lake. They do not appear to be due in great measure to damming by glacial or other débris or to dislocation.

Owing to its prominence the mountain has been long exposed to erosion. Originally the grit was overlain by a great mass of limestones and shales and the rocks of the Catskills, but these were removed far down into the Rondout valley at an early period. During the glacial epoch there was great erosion and the removal of great masses of the grit, which is now found in drift far to the southward. To the glaciation, too, probably is due the abruptness of Paltz point and other features of that sort. The grit also originally extended far to the eastward, but, owing to long-continued undermining by the removal of the soft, underlying shales, its front has receded to its present position. This recession is still actively in progress, and every year there fall great masses from the front of the mountain. One of the regions of weakness is Paltz point, for its base is exposed to erosion on several sides, and it will eventually disappear. Probably before it is gone the streams heading near its southern end will cut back through the shales at the head of lake Mohonk, and this beautiful body of water will be tapped. Of course this is all very remote, so far as human history goes, and artificial means will stay its progress in some measure, but it will all be accomplished in the near future, geologically speaking. Lakes Minnewaska and Awosting lie so far back from the front of the mountain that they will survive lake Mohonk by a very long time.

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THE

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WEATHER MAKING, ANCIENT AND MODERN

MARK W. HARRINGTON

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WEATHER MAKING, ANCIENT AND MODERN

BY

MARK W. HARRINGTON

The subject of ancient and modern weather making is a very large one—too large to be treated with entire generality. I shall discuss it rather from the American standpoint, and shall use cases in the Old World simply for the purpose of illustration and for completeness.

Three distinct sorts of weather-making have been employed. The first depends on superstitious and religious methods; then follows on this the degradation of these religious ideas into folk-lore remnants, which have a curious persistency in civilized countries. Both these are psychic. Opposed to them is the third method, mainly American and intensely practical, with which some history and literature are connected.

I. Superstitious and Religious Methods.

*RAIN MAKING AND STOPPING.**

Many Indian tribes have attempted to produce rainy or dry weather, according to requirements. Among these may be mentioned the Mandan, the Muskingum, the Moqui, the Natchez,

* These cases of weather-making among the North American Indians were collected for me by Dr Fuller Walker, of the Weather Bureau, who searched through the literature available in Washington.

Zuñi, Choctaws, and others. For this purpose pipes were smoked, tobacco was burned, prayers and incantations were offered, arrows were discharged toward the clouds, charms were used, and various other methods were employed. Classifying by tribes the processes employed, we turn first to the Iroquois.

Mrs E. A. Smith, in her "Myths of the Iroquois," says:

> In a dry season, the horizon being filled with distant thunder-heads, it was customary to burn what is called by the Indians real tobacco as an offering to bring rain.
>
> On occasions of this nature the people were notified by swift-footed heralds that the children, or sons, of Thunder were in the horizon, and that tobacco must be burned in order to get some rain. *

As to the Muskingum, Heckewelder, in his "Account of the Indians of Pennsylvania" (Philadelphia, 1819, page 229), says:

> There are jugglers, generally old men and women, who get their living by pretending to bring down rain when wanted, and to impart good luck to bad hunters. In the summer of 1799 a most uncommon drought happened in the Muskingum country (Ohio). An old man was applied to by the women to bring down rain, and, after various ceremonies, declared that they should have rain enough. The sky had been clear for nearly five weeks, and was equally clear when the Indian made this declaration; but about four o'clock in the afternoon the horizon became overcast, and, without any thunder or wind, it began to rain, and continued to do so until the ground became thoroughly soaked.

Heckewelder adds that "Experience had doubtless taught the juggler to observe that certain signs in the sky and in the water were the forerunners of rain."

Among the Natchez, according to Father Charlevoix,† jugglers not only pretended to cure the sick, but also professed to procure rain and seasons favorable for the fruits of the earth. Their incantations were often directed to the dispersion of clouds and the expulsion of evil spirits from the bodies of the afflicted.

In the third report of the Bureau of Ethnology it is stated by J. Owen Dorsey that "When the first thunder is heard in the spring of the year the Elk people [among the Omaha Indians] call to their servants, the Bear people, who proceed to the sacred tent of the Elk gens. When the Bear people arrive one of them opens the sacred bag and, after removing the sacred pipe, hands it to one of the Elk men, with some of the tobacco from the elk

* 2d Ann. Rep. Bureau of Ethnology for 1880–'81 (1883), p. 72.

† Voyage to North America, Dublin, 1776, vol. ii, p. 203.

bladder. Before the pipe is smoked it is held toward the sky, and the thunder god is addressed. * * * 'At the conclusion of this ceremony the rain always ceases, and the Bear people return to their homes.'"*

Catlin, in his "Life among the Indians" (page 78), says that he found that the Mandan had "rain-makers" and also "rain-stoppers," who were respected medicine men "From the astonishing facts of their having made it rain in an extraordinary drought, and for having stopped it raining when the rain was continuing to an inconvenient length." He adds:

For this purpose, in a very dry time, the medicine men assembled in the medicine lodge, and sitting around a fire in the center, from day to day smoking and praying to the Great Spirit for rain, while a requisite number of young men volunteered to make it rain. Each one of these, by ballot, takes his turn to mount to the top of the wigwam at sunrise in the morning, with his bow and arrows in his hand and shield on his arm, talking to the clouds and asking for rain, or ranting and threatening the clouds with his bow, commanding it to rain. After several days of unsuccessful attempts have passed off in this way with a clear sky, some one more lucky than the rest happens to take his stand on a day on which a black cloud will be seen moving up. When he sees the rain actually falling he lets his arrow fly, and pointing says: "There! my friends, you have seen my arrow go. There is a hole in that cloud. We shall soon have rain enough." When he comes down he is a medicine man. The doctors give him a feast and a great ceremony and the doctor's rattle. When the doctors commence rain-making they never fail to succeed, for they keep up the ceremony until the rain begins to fall. Those who have once succeeded in making it rain, in the presence of the whole village, never undertake it a second time. They would rather give other young men a chance.

A similar account of the Mandan ceremony is given by Mr John Frost, in his book "The Indians of North America" (New York, 1845, page 109). He says:

It was in a time of great drought that I once arrived at the Mandan village on the upper Missouri. The young and the old were crying out that they should have no green corn. After a day or two the sky grew a little cloudy in the west, when the medicine men assembled together in great haste to make it rain. The tops of the wigwams were soon crowded. In the mystery lodge a fire was kindled, around which sat the rain-makers, burning sweet-smelling herbs, smoking the medicine pipe and calling on the Great Spirit to open the door of the skies to let out the

* "Omaha Sociology," op. cit., 1884, p. 227.

rain. At last one of the rain-makers came out of the mystery lodge and stood on the top of it with a spear in his hand, which he brandished about in a commanding and threatening manner, lifting it up as though he were about to hurl it at the heavens. He talked loud of the power of his medicine, holding up his medicine bag in one hand and his spear in the other; but it was of no use, and he came down in disgrace. For several days the same ceremony continued, until a rain-maker, with a head-dress of the skins of birds, ascended the top of the mystery lodge, with a bow in his hand and a quiver at his back. He made a long speech, for the sky was growing dark, and it required no great knowledge of the weather to foretell rain. He shot arrows to the sunrise and sundown points of the heavens, and also to the north and south, in honor of the Great Spirit, who could send rain from all parts of the sky. A fifth arrow he retained until it was almost certain that rain was at hand. Then, sending up the shaft from his bow with all his might, to make a hole in the dark cloud over his head, he cried aloud for the waters to pour down at his bidding and to drench him to the skin. He was brandishing his bow in one hand and his medicine in the other, when the rain came down in torrents.

Among the Blackfeet Indians, according to W. P. Clark in his "Indian Sign Language" (Philadelphia, 1885, page 72):

The medicine man has a separate lodge, which faces the east. He fasts and dances to the sun, blowing his whistle. He is painted in different colors, and he must have no water, and only after dark can he eat, and then only the inner bark of the cotton-wood tree. A picture of the sun is painted on his forehead, the moon, ursa major, etc, on his body. The dance continues for four days, and should this medicine man drink it is sure to cause rain, and if it [does not] rains no other evidence of his weakness is wanted or taken. He is deposed as high priest at once.

Mr W. Noble of Indian territory says that "The Choctaws, during a severe drought, will fasten a fish to one of their number, who then goes into the water and remains there every day for two weeks in order to cause it to rain." He adds that "In wet weather, if they wish the rain to cease, they go to a sand bank, put sand in a pan, and dry it over a fire."

Among the Moqui, according to Schoolcraft:

There is a charm used for calling down rain. It consists of a small quantity of wild honey wrapped up in the inner fold of the husk of the maize. To produce the effect desired it is necessary to take a piece of the shuck which contained the wild honey, chew it and spit it upon the ground which needs the rain. *

* "History," etc, vol. iii, p. 208.

Captain J. G. Bourke, in his "Snake Dance of the Moqui" (page 120) says:

> There was painted on the east wall a symbolical design, or "prayer," representing three rows of clouds in red and blue, from which depended long narrow black and white stripes, typical of rain, while from right and left issued long red and blue snakes, emblematic of lightning. This was a prayer to the god of clouds to send refreshing rains upon the Moqui crops. * * * Yellow was used in all prayers for pumpkins, green for corn, and red for peaches.

Among the Zuñi, according to Stevenson, medicine sticks were supposed to influence rain. These little sticks are found hidden beneath the rafters of nearly every house in Zuñi.*

Passing a little further from home we find, in Acosta's "History of the Indies,"† some accounts of rain producing and weather making among the Peruvian natives. According to him a Peruvian king in his lifetime caused a figure to be made wherein he was represented, which they called Huaugue, which signifies brother. They carried this image to the wars and in procession for rain or fair weather, making sundry feasts and sacrifices to it. They also pursued other methods. "In matters of importance they offered up alpacas, hanging the beast by the right fore-leg, turning his eyes to the sun, speaking certain words according to the quality of the sacrifice they slew; for if it were of color their words were addressed to the god of thunder and lightning, that they might want no water" (page 341). If they wanted water, to procure rain they set a black sheep tied in the middle of a plain, pouring much chica about it, and giving it nothing to eat until it rained (page 376). This is practiced (says Acosta, 1571–1588), at this day in many places in the month of October.

OTHER WEATHER MAKING.

What precedes relates to rain making or stopping. A somewhat similar series of facts occur among the American Indians concerning other elements of the weather, but their energies in this direction seem to be expended chiefly in the control of the winds.

It appears that the Kansas gens of the Omaha are Wind people, and to them is especially entrusted the control of the

* 2d Ann. Rep. Bureau of Ethnology, p. 371.
† Hakluyt Society edition, vol. ii, pp. 312–313.

wind. Mr J. Owen Dorsey says the Kanze (Kansa or Kaw) gens of the Omaha tribe, being Wind people, "flap their blankets to start a breeze."* He adds that when there is a blizzard the other Kansa tribe of Indian territory beg the members of the Wind gens to interpose, saying, "O grandfather, I wish good weather. Cause one of your children to be decorated." Then the youngest son of a Kanze man, say one about four feet high, is chosen for the purpose, and painted with red paint. The youth rolls over and over in the snow, reddening it for some distance all around him. This is supposed to stop the blizzard.

The following account is from a book entitled "The Fourteen Ioway Indians" (London, 1844), and relates to raising wind:

> A packet ship, with Indians on board, was becalmed for several days near the English coast. It was decided to call upon the medicine man to try the efficacy of his magical powers with the endeavor to raise the wind. After the usual ceremony of a mystery feast, and various invocations to the spirit of the wind and ocean, both were conciliated by the sacrifice of many plugs of tobacco thrown into the sea; and in a little time the wind began to blow, the sails were filled, and the vessel soon wafted into port.

The Indians also have many associations with thunder. Madam Lucy Elliot Keeler, in a paper recently contributed to the "American Agriculturist" for December, 1892, says:

> The Dakotas used to have a company of men who claimed the exclusive power and privilege of fighting the thunder. Whenever a storm which they wished to avert threatened, the thunder fighters would take their bows and arrows, their magic drum, and a sort of whistle made of the wing-bone of a war eagle, and, thus armed, run out and fire at the rising cloud, whooping, yelling, whistling and beating their drum to frighten it down again. One afternoon a heavy black cloud came up, and they repaired to the top of a hill, where they brought all their magic artillery into play against it; but the undaunted thunder darted out a bright flash which struck one of the party dead as he was in the very act of shaking his long-pointed lance against it. After that they decided that no human power could quell the thunder.

In the "Pawnee Hero Stories and Folk-tales," published by George Bird Grinnell, we find the following:

> An old Pawnee Indian said: "Up north, where we worshipped at the time of the first thunder, we never had cyclones. Down here [Indian territory], now that this worship has been given up, we have them."

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* 3rd Ann. Rep. Bureau of Ethnology, p. 241.

The Indians in some cases have ideas of controlling the weather more generally, and Dablin, in his "Relation of the Voyages, Discoveries and Death of Father James Marquette,"* writing in 1671–1675, says:

> It now only remains for me to speak of the calumet, than which there is nothing among the Indians [*i. e.*, the Illinois] more mysterious or more esteemed. * * * They esteem it particularly because they regard it as the calumet of the sun, and, in fact, they present it to him to smoke when they wish to obtain calm or rain or fair weather.

Even the control of fog has been attempted, as shown by the following quotation from Dorsey's account of the Turtle subgens of the Omaha: †

> In the time of a fog the men of this subgens drew the figure of a turtle on the ground with its face to the south. On the head, tail, middle of the back and on each leg were placed small pieces of a (red) breech-cloth with some tobacco. This they imagined would make the fog disappear very soon.

But it is not only the pagan Indians who have tried their hand at weather-making. Their christianized descendants have also tried to control these operations of nature. In the transition times between paganism and Christianity occurred some events which throw a curious and instructive side-light on this question, and two of these I will now give.

Mr Parkman says that while the Jesuits labored with the Hurons a severe drougth came upon the fields. The sorcerers put forth their utmost power, and from the tops of the houses yelled incessant invocations to the spirits. All was in vain. A renowned "rain-maker," seeing his reputation tottering under his repeated failures, bethought him of accusing the Jesuits, and gave out that the red color of the cross which stood before their house scared away the bird of thunder and caused him to fly another way. On this a clamor arose. The popular ire turned against the priests, and the obnoxious cross was condemned to be cut down. The Jesuits said: "If the red color of the cross frightens the bird of thunder, paint it white." This was done, but the clouds still kept aloof. The Jesuits followed up their advantage. "Your spirits cannot help you. Now ask the aid of Him who made the world." Heavy rains occurring soon

* Hist. Coll. of Louisiana, part iv, 1852, pp. 34–35.

† 3d Ann. Rep. Bureau of Ethnology, p. 240.

after, it is said that many Indians believed in the white man's Great Spirit and presented themselves to the priests for baptism (Alice Elliot Keeler).

A somewhat similar story is told of Peru by Acosta. It appears that the Santa Cruz Indians became Christians because of the success of a renegade soldier in making rain. This soldier, seeing the native Indians "In a great extremity for water, and that to procure rain they used many superstitious ceremonies, according to their usual manner," said to them that if they would do as he said they should presently have rain, which they willingly offered to perform. "Then the soldier made a great cross, which he placed on a high and eminent place, commanding them to worship it and to demand water, which they did. A wonderful thing to see, there presently fell such an abundance of rain, as the Indians took so great devotion to the holy cross as they fled unto it in all their necessities, and obtained all they demanded, so as they broke down their idols."*

The quotation from Acosta indicates the attitude of the Indians of middle latitudes on this subject. This attitude, as is well known to those familiar with the Latin-American countries, is preserved unchanged among their descendants. Interesting illustrations of it can be picked up any day even as far north as Arizona and New Mexico, and every traveller in Latin-America has several at his disposal. As the quintessence of them all I present a clipping from the *New York Tribune* to which my attention was called by Dr T. C. Mendenhall. *Se non é vero é ben trovato.* The extract runs as follows:

In the department of Castañas there had been no rain for nearly a year, and the people were brought to such a pass that they were actually dying of thirst, to say nothing of the total destruction of all crops and other agricultural industries.

"El Pueblo Católico," of New San Salvador, prints a number of resolutions promulgated by the principal alcalde of the town and department of Castañas. They are as follows:

"Considering that the Supreme Creator has not behaved well in this province, as in the whole of last year only one shower of rain fell; that in this summer, notwithstanding all the processions, prayers and praises, it has not rained at all, and consequently the crops of Castañas, on which depend the prosperity of the whole department, are entirely ruined, it is decreed:

"Article 1. If within the peremptory period of eight days from the

* Op. cit., vol. ii, p. 524.

date of this decree rain does not fall abundantly, no one will go to mass or say prayers.

"Article 2. If the drougth continues eight days more, the churches and chapels shall be burned, and missals, rosaries, and other objects of devotion will be destroyed.

"Article 3. If, finally, in a third period of eight days it shall not rain, all the priests, friars, nuns, and saints, male and female, will be beheaded. And for the present permission is given for the commission of all sorts of sin, in order that the Supreme Creator may understand with whom he has to deal."

The most remarkable feature of this affair is the fact that four days after these resolutions were passed the heaviest rainfall known for years was precipitated on the burning community.

II. Folk-lore Remnants.*

Among the many curious remnants of folk-lore which we find in connection with the subject of weather making none is more curious than the idea that birds "call for rain." Whenever this expression is used the evident intention is, as is well known to those who are familiar with this mode of speech, to express the idea that they demand the rain, and that rain is likely to follow because of this demand. For instance, the call of the robin, heard so frequently, is interpreted to mean, "Bring out your skillet, bring out your skillet, the rain will fill it." In popular estimation this is a "call for rain." This association with our American robin is very general. In Maine and Massachusetts they are said to "sing for rain" (Miss F. D. Bergen). The American quail is also said to "call for rain," and its cry is interpreted to be, "More wet, more wet" (Dr Robert Fletcher). The call of the loon is given the same meaning in so widely separated localities as Cape Breton, the state of Washington, and Florida (Mr C. A. Smith). The same power is attributed, generally in the Old World, to many other birds, as ducks, geese, crows and ravens. From Pennsylvania (William Schrock) comes the quaint conception expressed in the following rhyme:

The goose and the gander
Begin to meander;
The matter is plain,
They are dancing for rain.

* This series of associations of natural objects with weather-making, in the sense of a weather fetich—a weather maker, not simply a weather forecaster—is taken from the collections of weather proverbs made by the Signal Service and Weather Bureau.

But the birds are not only effective in making rain; they can exert still greater influence. The kildee, or killdeer plover, is said, in Maryland, to call up the wind by his cry of "kildee, kildee!" while to kill him would cause a violent storm (Dr Fletcher). The Kiowa of Indian territory attribute to the killdeer the bringing of spring (James Mooney, Washington).

Another popular association between animals and rain is the idea that by certain treatment of some animals definite results in the way of rain-making can be obtained. For instance, on Santee river, in South Carolina, it is believed that if you catch an alligator, tie him to a tree, and whip him to death it will be certain to bring rain (Dr W. W. Anderson). This seems to be a fragment of negro folk-lore. In Massachusetts it is said that if you see or step on a frog it is a sure sign of rain, while in Maine they say, "Kill a frog and it will rain before morning" (Miss F. D. Bergen). This association of rain with the toad is general over the United States. Still another folk-lore remnant of the same sort relates to snakes. It is a curious fact that among many races the snake is supposed to have some relations with the weather. Mr James Mooney says, "The belief in a connection between rain and snakes is quite general among Indian tribes. The snake dance is intended to bring rain. The Indians of Indian territory turn a dead snake on its back to bring rain." It is a piece of negro folk-lore that hanging a dead snake on a tree will bring rain in a few hours. Further northward it runs "Hang up a snake skin and it will bring rain." This refers to the cast-off skin. In northern Illinois the expression is, "Hang up a snake's cast-off skin on the crab-apple tree and it will bring rain." The snake has played a very important part in weather making, and to it has been attributed many other magical powers.

An interesting series of superstitions with reference to weather making are those which are common to sailors, who have a well known half-serious belief that one can raise wind by whistling. In Newfoundland they say, "Stick a knife in the mainmast and whistle, and it must produce wind." In Newfoundland, also, they have an idea that if a vessel is becalmed wind can be produced by throwing overboard a half-penny. Another notion, common also to the same sailors, is that if you put the end of the sheet overboard it will produce wind, and that if you hit it three times across the thwarts it will stop the rain. Mr

Kinahan, illustrating the sincerity of the belief in the power of whistling in raising wind, says: "In a dead calm you may whistle for wind, except in a dangerous place. Crossing from Skibbereen to Clear island, county Cork, a friend of mine was very nearly getting into a row for inadvertently whistling." This belief is very general. In California sailors say that one may whistle softly for a breeze, but that it is dangerous to indulge in loud or thoughtless whistling, as it may bring a gale. Here the skipper scratches the mizzen-mast for a fair wind.

Sailors profess great confidence in the ability of the cat to raise the wind, and are accustomed to say that the cat carries the wind in her tail. Cats have the general reputation of being very weather-wise. On shipboard especially, it is considered imprudent to provoke a cat, because she is assumed to have a certain share in the arrangement of the weather. Imprudence of this sort appears, however, to have no terrors for the Soudanese in western Java, for, when rain is needed, they form in procession with gongs and clappers, take their cats to the nearest streams, where the animals are sprinkled and bathed.*

Many sailors also have a very curious notion that hen's eggs on board ship produce contrary winds, and on the occurrence of such winds they are likely to insist that the eggs must be thrown overboard.

Another of these folk-lore remnants of sailors is the idea that there is a distinct relation between the albatross and wind. This superstition has been embalmed in most attractive form by Coleridge in his "Lay of the Ancient Mariner." One stanza runs as follows:

> For all averred I had killed the bird
> That made the breeze to blow.
> Oh, wretch! said they, the bird to slay
> That made the breeze to blow.

In addition to the above folk-lore remnants there are some methods which are purely magical. The earliest reference to this sort which I have found is the case of Sópater. He is said to have caused a horrible famine in Asia Minor by "chaining the winds." He was put to death by Constantine—probably for this reason, as this crime was forbidden by the laws of the Twelve Tables as well as later in the Theodosian code.

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* Forbes: Eastern Archipelago, p. 75.

The association of weather making with the witches in Finland is familiar. Steele, in his "Medieval Lore," from Bartholomew Anglicus (about 1260), referring to the people in Finland, says:

> The men * * * occupy themselves with witchcraft, and so to men that sail by their coasts, and also to men that abide with them for default of wind; they prefer wind to sailing, and so they sell wind. They used to make a clue [skein] of thread, and they make divers knots to be knit therein, and then they command to draw out of the clue to three knots, more or less, as they will have the wind more soft or strong; and for their misbelief fiends move the air and arise strong tempests, or soft, as they draweth of the clue more or less knots; and sometimes they move the wind so strongly that the wretches that believe in such doings are drowned by the rightful doom of God.

The elder bush is especially associated with weather making. The witches were thought to make bad weather by stirring water with branches of the elder.

Still another remnant of ancient superstition is, according to Aubrey (1696), to the effect that "On Malvern hills, in Worcestershire, and thereabouts, when they farm their corn and want wind they cry 'Youle! youle! youle!' to invite it, which word, no doubt, is a corruption of Æolus, the god of the winds" (Dr R. Fletcher).

III. Physical Methods.

WEATHER MAKERS.

What precedes relates to purely psychic methods of controlling the weather or the elements. The collection which it presents has been made in no spirit of disrespect, but solely in that of the collection and scientific comparison of facts. I have great respect for all sincere religious belief and great interest in folklore remnants—fragments of what have once been great psychic structures—ruins about the tombs of the ancients. What follows is intensely *fin-de-siècle* and treats of the paradoxer in a well-developed stage. The paradoxer deserves a respect to be measured by the sufficiency of his information and the correctness of his logic. He is a possible benefactor of the world, a potential great man. Galileo was a paradoxer—very unwelcome to the Aristotelians of his time. Kepler was a rank paradoxer to his contemporaries, and Newton was a paradoxer to the Cartesians of his day.

Time will not be spent on rash paradoxers in the field of weather making. We shall only consider those who have some such guarantee as a patent, an appropriation, or genuine learning. As an illustration of the rash paradoxers I will simply mention two, one the man who proposed to destroy blizzards by a line of coal-stoves along our northern boundary from Red river to the continental divide, and the other a man who proposed to ameliorate the weather of New England and the Canadian provinces by damming the strait of Belleisle.

WEATHER MAKING.

We pass first to the treatment for tornadoes. M Weyher has made laboratory tornadoes of a mild and gentle character, but they contain no suggestion as to how to treat this pathologic phenomenon of the weather.

A treatment has been suggested which is heroic and may possibly be effective. It is, however, a local application, and the chief difficulty is to have it ready when and where wanted. The method proposed is that of a great explosion in the tornado itself. Many plans have been suggested, and two patents have been granted. I will consider the first, that of Mr J. B. Atwater, of Chicago (number 370,845, 1887). A strong box with a double bottom is firmly supported on a pole erected at a suitable point, probably a mile or so southwest of the village to be protected. The upper bottom is fixed and the space above it is filled with an explosive and firmly closed. In holes in the upper bottom are inserted fulminating caps and these project below its lower surface. The lower bottom slides up and down. Then, if a high wind drives the lower bottom against the upper with such force as to flash the caps, the explosion follows, and the tornado (if present) suffers the effects which a tornado will suffer when a powerful explosion occurs in its immediate vicinity.

What these effects will be we do not yet know. It is said, with enough repetition to make it fairly worthy of credence, that a cannon fired into a waterspout destroys the latter. If such a disturbance destroys the gentler waterspout, it may be worth while to try a larger one on the more intense tornado. Perhaps it will be effective; we can be more positive when it has been tried.

Many other schemes have been proposed for the control of the elements of the weather. Most of them have an objectionable side, notably in rain making, which can be pointed out here as well as elsewhere. It is this: The phenomenon to be produced cannot probably be controlled as to area covered, and may occur where it is not wanted. If we are clothing merchants and I carry over too large a stock of winter clothing into late spring, I may order a cold wave to help me reduce my stock. But you may have exhausted your winter stock and wish to have warm weather to start your summer stock. My cold wave affects your trade seriously; I may be sued for damages. Such a state of things is said to have actually happened in Kansas, where a rain maker was refused payment by his employer because of failure of contract, and was sued by a neighbor of the employer because his crops were washed out of the ground. Should the weather maker prosper he will often find himself very much embarrassed until our law makers have caught up with our advance in the arts, and the volume of the statute books has been materially enlarged.

RAIN MAKING.

We come now to the subject of rain making, which has attracted more attention, been more tried, and has more history than any other one method of weather making. It has attained the dignity of at least two patents and two congressional appropriations. A bibliography of the subject is appended, containing 64 titles, two of which refer to books devoted to this subject, respectively by Power and Gathman.

First Method.—To clear the way for the American history we may note here as method number one a French method reported in the *Comptes Rendus* for October 23, 1893. M Baudouin sent a note to the French Academy of Sciences in which he wrote that in Algeria, earlier in that year, he used a kite to obtain electric connection with a cloud at the height of about 4,000 feet. As soon as this connection was made a few drops of rain fell and a local fog formed. These disappeared on breaking the connection, presumably by withdrawing the kite from the cloud. M Baudouin had obtained some rain in Algeria in 1876 by the same method. I know of no other experiments in this direction, nor do they involve anything in opposition to knowledge already acquired. It is a fair field for experiment, and it is remarkable that M Baudouin's experiments have not attracted more attention in the United States.

Second Method.—A second proposed method of obtaining rain is by means of great fires. With this proposal the name of a Pennsylvania meteorologist, James P. Espy, is inseparably connected. In 1841 he published a "Philosophy of Storms," in which he enlarged on this idea previously propounded by him in occasional articles dating from 1838. The idea was not new, for Dobrizhoffer, a Jesuit missionary in South America, in his "Account of the Abipones" (first published in 1784), says that these Indians produce rain by setting fire to the plains. Indeed the idea has been and is generally entertained and in the west has crystallized into the weather proverb, "A very large prairie fire will cause rain." To show something of the character of testimony on which Espy relied we shall quote the story of George Mackay as given in a letter to Espy and printed by him in his "Fourth Meteorological Report" (pages 32–34). Mr Mackay says:

In 1845 I was engaged in the public survey on the Atlantic coast of Florida. Some time in April (the time of the dry season there, which lasts up to June) I was running a township line between latitudes 26° and 27°, about five miles from the sea. The weather was oppressively warm that day. There was not air enough stirring to move an aspen leaf. We found our line must pass through a saw-grass pond, containing about five hundred acres. In ponds of this description the green grass at the top shoots up from five to six feet in height, and when the region has not been for some years swept clear by fires the dead and dry growths of preceding seasons accumulate under the latest growth, and are often found there from two to four feet in depth. They are exceedingly inflammable. When lighted in dry weather they burn with frightful rapidity and violence. Whenever, in our explorations, we came upon a place of this description we could only pass our line by cutting away the lofty fresh grass and wading (or rather wallowing) through the mud and the under rubbish. On the day in question we determined, as it was so hot, that, to save ourselves trouble, we would burn our way through. I had then no thought of your theory. In order to prevent the flames from running over the woods, through which we were obliged to pass, we communicated them at once to both sides of the spot we desired to open, that they might converge and combine in its center and not scatter laterally. In a very few minutes an awful blaze swept over the entire surface which we had marked out for our purpose. We then crossed our line. Ere we had proceeded over forty chains a delightful breeze sprang up and cooled the atmosphere, and presently a refreshing shower sparkled in the bright rays of the sun. All this excited no further observation than that it had not rained there before for a long time. I myself did not observe any smoke nor the formation of any cloud.

Our work went on for some days without a repetition of our short cut at pioneering, some objection having been made when another burning was proposed, because the first one had rendered it difficult, after crossing the lines, to distinguish the white men from the negroes. At length, however, the pleasant breezes ceased, which had made the weather for a while endurable, and the still air and intense heat returned, and with them constant murmurs from the men, especially the negroes, whose duty it was to cut lines and mark trees. We were now on the confines of a saw-grass pond, and a much more formidable one than any we had yet encountered. Being surrounded by a cypress swamp, we concluded that it had never yet been burned. My assistant, Captain Alexander Mackay, who was standing by my side, mentioned his having, in our late conflagration, observed the formation of a cloud at the apex of the smoke. He added that it had frequently since brought to his mind some account which he had read of Professor's Espy's theory. He suggested that there could not be a better opportunity than this to put the theory to the test, and, being fond of a joke, he said he would like to astonish the superstitious negroes and to make them believe that he could call together the clouds and bring down rain. So we determined to make the experiment.

When our party were all gathered at the halting place complaints of the extreme heat went round and all unanimously agreed that a more confined and oppressive day had never been known to them. To these complaints the usual wishes for "a little breath of air" and "a few drops of rain" succeeded. "Cut through this pond," exclaimed the captain, "and I will bring you more than a few drops of rain; I'll give you a plentiful shower and a breeze, too, that shall wake you up. Come, boys, cut away, and when you've done you shall wash off the dust in a cold bath from the skies!" They stared up and around; not a cloud as large as a man's hand was to be seen, and they looked back at the captain with a good-natured grin of incredulity. "Ho, ho! ha, ha! Captain make cloud out o' nuffin'; he, he! Captain bring water all dis way from de sea? Ho, ho! ha, ha! he, he!" Whereupon the Captain affected to be very indignant. To hasten his victory I ordered the grass to be set on fire. The flames soared forthwith above the tallest trees; a dense volume of smoke mounted upward spirally; the grass soon disappeared; we crossed over. As the smoky column broke and the cloud began to form the Captain traced a large circle in the sand around him, and placed himself in its center, making fantastic figures and forming cabalistic phrases out of broken French. Still was the cloud unnoticed. All eyes were riveted upon the Captain, who stood gazing at the earth and shaping outlines of devils there. At this juncture came a roll of distant thunder. Every glance instantly turned upward; a cloud was spreading there; the thunders increased; the lightnings flashed more vividly; the knees of the negroes shook together with alarm. Already was the rain descending, and in torrents, though the clear sky could be seen in all directions under the cloud. The Captain meanwhile maintained his mystical attitude and continued his wild and extraordinary evolutions. Some of the whites, who were in the secret of the hoax, fell upon their knees, and were imitated by the negroes, whose fears augmenting as the storm grew fiercer, with clasped hands, fastened upon the Captain a stare of awe and deprecation. In short, the scene presented a more complete triumph of philosophy over ignorance than I could have supposed it possible to have been produced anywhere in the nineteenth century, and most especially anywhere in our enlightened Republic.

We often fired the saw-grass marshes afterward; and whenever there was no wind stirring, we were sure to get a shower; and I say with perfect confidence that we never had a shower in April or May at any other time. Sometimes when there was a breeze, it would carry the smoke toward the horizon, where there would seem to be a fall of rain.

Espy dwelt on this theory with great devotion, and in 1845 published a special letter addressed "To the Friends of Science" in which he proposed a plan for practical rain production. As the paper in question is now very rare and his plan possesses some features of interest, I quote it here:

Let masses of timber to the amount of forty acres for every twenty miles be prepared and fired simultaneously every seven days in the summer, on the west of the United States, in a line of six or seven hundred miles long from north to south; then the following results seem highly probable, but not certain until the experiment is made: A rain of great length north and south will commence near or on the line of fires; this rain will travel eastward; it will not break up till it reaches far into the Atlantic ocean; it will rain over the whole country east of the place of beginning; it will rain only a short time in any one place; it will not rain again until the next seventh day; it will rain enough and not too much in any one place; it will not be attended with violent wind, neither on land nor on the Atlantic ocean; there will be no hail nor tornadoes at the time of the general rain nor intermediate; there will be no destructive floods, nor will the waters ever become very low; there will be no more oppressive heats nor injurious colds; the farmers and mariners will always know before the rains when they will commence and when they will terminate; all epidemic diseases originating from floods and subsequent droughts will cease; the proceeds of agriculture will be greatly increased, and the health and happiness of the citizens will be much promoted. These, I say, are the *probable*—not certain—results of the plan proposed—a plan which could be carried into operation for a sum which would not amount to half a cent a year to each individual in the United States; a plan which, if successful, would benefit in a high degree not merely the landsman, but every mariner that plies the Atlantic. If this scheme should appear too gigantic to commence with, let the trial be first made along the Alleghany mountains; and let forty acres of four ten-acre lots be fired every seven days through the summer in each of the counties of McKean, Clearfield, Cambria, and Somerset, in Pennsylvania; Alleghany, in Maryland; and Hardy, Pendleton, Bath, Alleghany, and Montgomery, in Virginia. The ten-acre lots should be, as nearly as convenient, from one to four miles apart, in the form of a square, so that the up-moving column of air which shall be formed over them may have a wide base, and thus may ascend to a considerable height before it may be leaned out of the perpendicular by any wind which may exist at the time.

Espy's theory was practically the modern convective theory of storms, and to this most worthy student of science is due the credit of calling effective attention to the part which the condensation of aqueous vapor plays in the mechanism of storms.

Third Method.—Another proposed method of making rain artificially is that of L. Gathman, of Chicago, patented in 1891 (number 462,795). His method is to "Suddenly chill the atmosphere by rapid evaporation, and it is also advisable to produce a heavy concussion in connection with the cooling in order to set the different air-currents in motion. It is obvious that sudden and rapid evaporation in the upper regions of the atmosphere could be accomplished in various ways by the evaporation of various highly compressed gases; but the evaporation consequent upon the release of liquefied carbonic acid gas is thought to be the most efficient." He proceeds:

In accordance, therefore, with my invention, liquefied carbonic acid gas is liberated in the upper regions of the atmosphere and will, of course, instantly evaporate and spread out in a sheet of vapor of an extremely low temperature and produce a cloud. The surrounding atmosphere will be chilled by its proximity to the cold vapor and the moisture in the atmosphere will be condensed thereby. The condensation takes place in large quantities and with great rapidity, so that a cloud is formed that will precipitate a rainfall upon the earth.

The liquefied carbonic acid gas can be confined in a suitable shell or casing, said casing also to contain an explosive—gunpowder, dynamite, etc—which is thrown or shot into the upper regions of the atmosphere and there exploded by a time-fuse. A balloon, moreover, could be employed to elevate the shell or casing containing the liquefied carbonic acid gas, and the explosion to liberate the gas could be made by an electric current controlled by persons upon the earth.

Mr Gathman also published a little book in which were reproduced, with approval, Professor Newcomb's article entitled, "Can We Make it Rain?" and Professor Houston's "Artificial Rain-making." In this book we learn that Mr Gathman has been occupied with the use of condensed carbon anhydride to cool heavy guns, and was led to his theory by the results of his experiments with ordnance. He also experimented on his method of rain-making, and says (page 38):

In making some experiments last year, a shell filled with liquefied carbonic acid gas was exploded at a height of 600 feet; a cloud was produced in the clear sky at once, and, floating along on a current of air, was visible for miles. This experiment was made in July, 1890, and since that time I have made sufficient other experiments to satisfy myself that I can produce rain whenever necessary, or at will. Experiments made in my astronomical observatory, at a height of only seventy-five feet, have proven that by the evaporation of liquefied carbonic acid gas a rain shower on a small scale can be produced with but a small quantity of the gas. When completed arrangements have been made, the experiments mentioned will be seen to be but a step to the practical illustration on a grand scale.

It appears that in Gathman's method the explosion plays a very subordinate part; but in the method to follow the explosion is the main, if not the only thing.

Fourth Method.—The concussion theory is probably an old one, though it is not correct to refer it to Plutarch, as is sometimes done. In his life of Marius, referring to the battle with the Teutons near Aix, in July, 102 B. C., Plutarch says: "Extraordinary rains pretty generally fall after great battles; whether it be that some divine power thus washes and cleanses the polluted earth with showers from above, or that moist and heavy evaporations steaming forth from the blood and corruption thicken the air, which naturally is subject to alteration from the smallest causes."* Here are two distinct suggestions for rain-making, but not that of concussion.

The first elaborate treatment of the concussion theory appears to have been by Edward Powers, civil engineer, who published in 1890 a book on the relations of battles to rainfall. The first edition was printed in Chicago in 1871, but most of the edition was destroyed by the great fire in that city, which also destroyed the stereotype plates. The latest issue seen by me contains an inset of 15 pages devoted to a criticism of Professor Newcomb's article already mentioned. The aim of this book is to prove that great battles or heavy cannonading are usually soon followed by rainfall. A fair criticism of the book is that such phenomena are not invariably followed by rain. The coincidences could be explained by the fact that in the season of mili-

*Plutarch's Lives, Clough's revision, Am. Book Exchange edition, 1881, pp. 390–391.

tary operations rain is usually falling somewhere in eastern United States; that in fact it is not clear but that the rain is a pure coincidence. The argument is not conclusive. Indeed, it is only fair to say that under the conditions involved it could not be made conclusive. Mr Powers, however, did not despond, but used his utmost endeavors to bring the matter to a test. For this purpose he persuaded Senator Farwell, in 1874, to present a petition to Congress asking that the theory be tried. This, with a previous petition to which he refers, seems to have been without response on the part of Congress.

Later, and apparently independently, the matter was taken up by General Daniel Ruggles, of Fredericksburg, Virginia, who obtained a patent in 1880 (number 230,067) on making rain by explosions in the clouds. His claim runs:

> The nature of my invention consists in sending one or more balloons into the cloud-realms, said balloon or balloons carrying torpedoes and cartridges charged with explosives, and there to explode or detonate them by magneto-electric or electric force through metallic wire, textile cordage, or by the fuse, or by mechanical force, in order to precipitate rainfall by concussion or vibration of the atmosphere.

General Ruggles succeeded in bringing the matter before Congress, but did not succeed in getting an appropriation. His plan was much discussed in the newspapers at the time, but does not seem to have reached the experimental stage.

Senator Farwell, however, continued his interest in the matter, and in 1890 finally succeeded in obtaining an appropriation, first of $2,000, then of $7,000, for carrying on the experiments, some of which he had already had made at his own expense. The appropriation assigned the conduct of the experiments to the Department of Agriculture, and the Secretary selected R. G. Dyrenforth for the work. The experiments were carried on in the vicinity of Washington and in Texas. A report from Mr Dyrenforth was published by Congress in 1892. At the next session of Congress another appropriation of $10,000 was made for this purpose, of which the sum of $4,913.59 was expended, as before, under Dyrenforth's direction, the remainder having been covered back into the Treasury.

Mr Dyrenforth's methods were highly ingenious. He used a variety of explosives, on the ground and in the air, by great single explosions and by volleys. He introduced many novelties, among them that of exploding the gas in the balloon itself when high in the air. His conclusions, as stated by himself in his first report, were (page 59):

First. That when a moist cloud is present, which, if undisturbed, would pass away without precipitating its moisture, the jarring of the cloud by concussions will cause the particles of moisture in suspension to agglomerate and fall in greater or less quantity, according to the degree of moistness of the air in and beneath the cloud.

Second. That by taking advantage of those periods which frequently occur in droughts, and in most if not in all sections of the United States where precipitation is insufficient for vegetation, and during which atmospheric conditions favor rainfall, without there being actual rain, precipitation may be caused by concussion.

Third. That under the most unfavorable conditions for precipitation, conditions which need never be taken in operations to produce rain, storm conditions may be generated and rain be induced, there being, however, a wasteful expenditure of both time and material in overcoming unfavorable conditions.

His second report has not been published, but I infer that his second series of observations were believed by him to confirm the results of the first.

Mr Dyrenforth generally omitted one check which he might well have employed, and which I personally urged him to employ. Experiments of this sort, made in the free air, with the accompanying conditions not under control, should be accompanied with every possible check; and one self-evident and very necessary one is the observation of a physicist familiar with the meteorologic side of physics. Such an expert (Mr G. E. Curtis) accompanied the party in its first experiments. His report (except the bare meteorologic record made during the experiments) does not accompany Dyrenforth's document. It was presented, however, to the Philosophical Society of Washington, and was printed elsewhere. Mr Curtis says, substantially, that an explosion in a cloud brings down a few scattering drops of rain, and this may happen even with an explosion on the ground, if heavy. Otherwise he says there was no rain-making. It is but fair to say that with Mr Dyrenforth's report are given the reports of his assistants, Mr John T. Ellis, Lieutenant S. A. Dyer, and Mr Eugene Fairchild, and they were stronger in the expression of a belief that rain was successfully made than is Mr Dyrenforth; and there are also many favorable quotations from spectators.

Professor A. Macfarlane, of the University of Texas, was present as an uninvited guest during the elaborate experiments near San Antonio on Friday, November 25, 1892, beginning at 4 p m. The sky was from time to time overcast, and the natural conditions were not unfavorable for rain. Many explosions were made without rain until late in the evening, from which point I will take up the story in Professor Macfarlane's own words, as given in a letter to the *New York World* December 4, 1892:

At 10.15 a balloon was sent up and was lost in the darkness; when it exploded a very large area of light was seen, as if the explosion had occurred inside a cloud. There was no fall of rain at the camp, and nobody was stationed below the spot where the balloon exploded.

I consider this the only experiment that was worth making, yet no care was taken to observe whether rain did fall. It is conceivable that the explosion of a twelve-foot balloon inside a cloud ready to precipitate may jar the particles so as to quicken the dropping of the rain. This was the idea of Ruggles. But to test whether some rain can be drawn down in this manner from a rain-cloud does not suit the ideas of cranks who wish to get a large something out of an absolute nothing.

At 10.45 a mist became just perceptible. The General issued an order to get ready the rain-gauge. The boys hurried up a balloon, which was nearly ready, but it had no effect on that mist.

At 11.40 the mist ceased and the stars appeared in places nearly overhead. The General apparently felt that things were going against him, for he suggested to the Doctor to put a small piece of dynamite in the shells, and also to try the effect of an explosion down at the Springs.

At 12.30 a 12-foot balloon went well into the cloud, but no rain effect.

At 1 o'clock, the time when operations were to be suspended for the night, it was fair, with some stars visible, and the boys were preparing one more balloon. Colonel King remarked that it would be necessary to keep up the operations for forty-eight hours. I retired to a room in the hotel, from which I could see the operations.

At 1.30 I heard a slight shout from the balloon boys, and I could hear the rain pattering on the roof. The General, who had also retired to the hotel, threw open the window and called out:

"Hurry up, boys."

After ten minutes the balloon was exploded, and the rain almost immediately diminished so as to be scarcely perceptible. When the explosion occurred I had my head out of the window. The hotel, a frame house, shook considerably, but there was no breaking of glass or any of the effects produced by a powerful explosion on the solid earth.

At 1.50 the General went out to observe, and I heard him say:

"There is a beautiful rain to the north of us and to the west of us."

At 2 the rain had entirely ceased, and the last of the operations consisted of two shells fired in succession at 2.05.

Professor Macfarlane is a competent physicist. He was trained in Edinburgh and has, I believe, no such appreciation of humor as to make him unconsciously color his report. His conclusions were adverse to the rain makers.

Referring in general to the experiments in Texas, one fact has been generally overlooked. The rainfall in western Texas is always small, but it is subject to its maxima and minima, like other regions. Now, there is a rainfall season in July and August in Arizona and New Mexico, and this reaches western Texas. Thirty percent of the annual rainfall descends in these two months along the eastern border of New Mexico and in the western angle of Texas. At El Paso this percentage is forty. This maximum passes gradually eastward and is found in the southeastern part in September. The experiments in the western part of Texas in 1891 were in September, fairly in the time of this maximum. There is another maximum of rainfall in Texas in November. This is in the northeastern part of the state. The second series of rainfall experiments in Texas was in November, 1892, at San Antonio. The maximum here occurs in September, but there is in November an average (for 24 years) of 2.5 inches, or one-twelfth of the annual 30.6 inches. There is a high relative probability of rain naturally in September in the region of the experiments in 1891, and there is an even chance of it in the region of 1892. To test the theory of rain-making in Texas the months might have been better chosen. Yet it is but fair to say that the rainfall in western Texas is very fluctuating, as it comes generally in local storms.

Fifth Method.—There is another method of rain-making which is still a mystery, but which deserves mention because it has been submitted to actual test. I have not been given permission to use names in this case, and will only guarantee that the letter which I quote came from a high official of a railway company and is worthy of the credence which an official business letter of this sort should carry with it. This gentleman, under date of August 22, 1893, wrote to me as follows:

Dear Sir: Your letter, August 10, * * * has been referred to me. In reply thereto, we have no published reports concerning rain-making experiments such as mentioned by you. While these experiments have been made by a couple of employés of this company, we can say but little about them ourselves. These parties claimed to be able to cause rainfall by artificial means, and we have furnished them with materials, together with transportation facilities, more or less all the time since the early part of May, they having experimented in some eighteen or twenty different locations, and in each case we have had more or less rainfall. In nearly every instance we can but feel there is something in their claim. We have had from one-half to three or three and a half inches falls of rain, covering a section of country from twenty-five to ninety miles in length and ten to thirty miles wide, all owing to the direction of the wind, and in some cases at times when there was no moisture in sight or known until they began operations, and then only throughout the section over which their own rainfall extended.

I presume the operators themselves have kept a record of their work, and results of same, at each of the different points where they have been located, and should you desire I will have them make a statement showing what they themselves feel they have accomplished. We have been slow to believe there was anything in this business, but at the same time must admit that they are either very fortunate in reaching the different points where they have experimented just in time to have rain-storms, or they have certainly hit upon the right thing in the way of rain-making.

The process I do not know, but a humorous railway man, personally cognizant of the matter, told me that the operators kept themselves carefully secluded in a freight car with a hole in the roof, and when occasional glimpses were caught of them they seemed to be cooking over a red-hot coal stove. Probably the method employed was that of Frank Melbourne, the Australian, who has most reputation in the west, and who has carefully kept his secret. It is proposed by the company in question to continue the experiments in another field and with competent experts accompanying, and another railroad company is seriously considering the propriety of entering the field.

Conclusions.

Finally, permit me to complete this sketch by some remarks; and, to make them as specific as they can be made, permit me to put them in the form of questions and answers. The answers are my own.

Question. Will a noise make rain? Answer. No; there is no reason in theory or practice to make us think it will.

Q. Will a concussion make rain? A. It will probably jostle the droplets in a cloud and may bring a few together, which may coalesce and become large enough to cause them to fall to the ground—a few scattering drops only.

Q. Will smoke or dust released in great quantities produce rain? A. Floating particles of spongy texture will absorb the moisture hygroscopically. If the air is dry this will make it drier and prevent rain. If the air is very moist and near saturation, any solid particles in the air will facilitate the condensation; witness the experiments of Aitken and Barus. Thus, when other conditions are very favorable, an addition of much dust or smoke to the air might determine a fall of rain.

Q. Will the expansion of carbon anhydride produce rain? A. Mr Gathman says he has tried it and with success. Experiments should be made systematically.

Q. Will electric connection with a cloud aid in rain formation? A. M Baudouin says it does.

Q. Will a conflagration produce rain? A. Quite probably, under favorable circumstances. It acts in the line in which nature acts, according to the best of our knowledge. Condensation is the result of chilling the air. The theory of chilling by mixture, the Huttonian theory, a century old, is now known to be inefficient. The chilling in nature seems to be due either to the ascent of air and its consequent expansion and loss of heat or the chilling of one cloud by having the shadow of a higher cloud fall on it in sunlight. The chilling by ascent is the method evoked in the Espy plan and appears to be by all odds the most effective rain-producer in nature.

Q. If rain can be made, how much will it cost? A. This is truly an American question, and quite appropriate to the *fin-de-siècle*. Mr Powers, who, by the way, says that Mr Dyrenforth did not after all really try *his* experiment, puts the cost of one experiment with government aid at $80,000. Gathman says he can sprinkle the earth at a cost of from $30 to $90 a square mile. Espy proposed to fire the low forest growths at regular intervals at a cost less than five mills per citizen per year. The method of concussion costs the comfort and peace of all within hearing, a cost which a much more certain result would not justify.

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THE

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GEOMORPHOLOGY

OF THE

SOUTHERN APPALACHIANS

C. WILLARD HAYES AND MARIUS R. CAMPBELL

WASHINGTON
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Price 75 cents.

Modeled by E. E. Howell,
Washington, D. C.

RELIEF MAP OF THE

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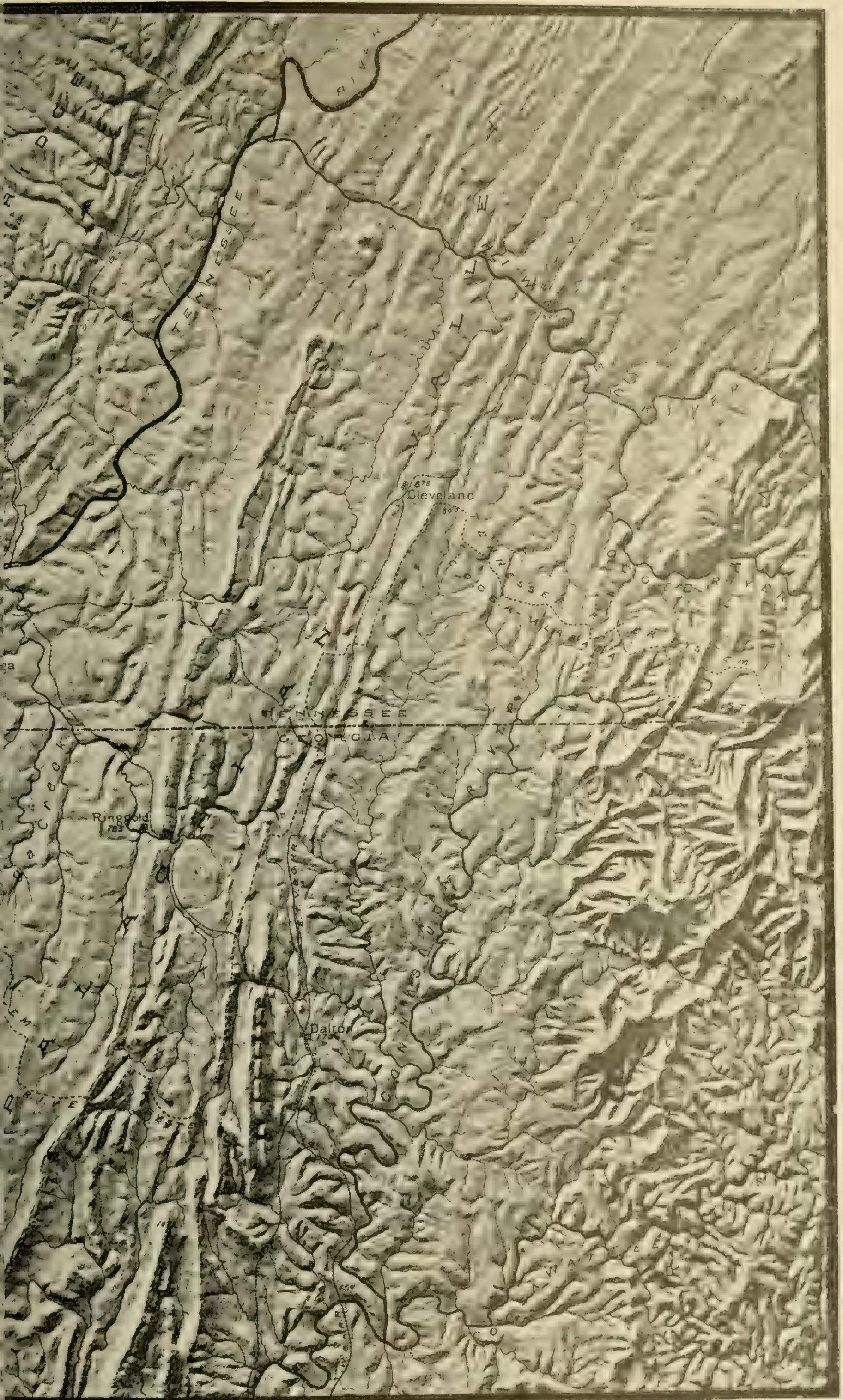
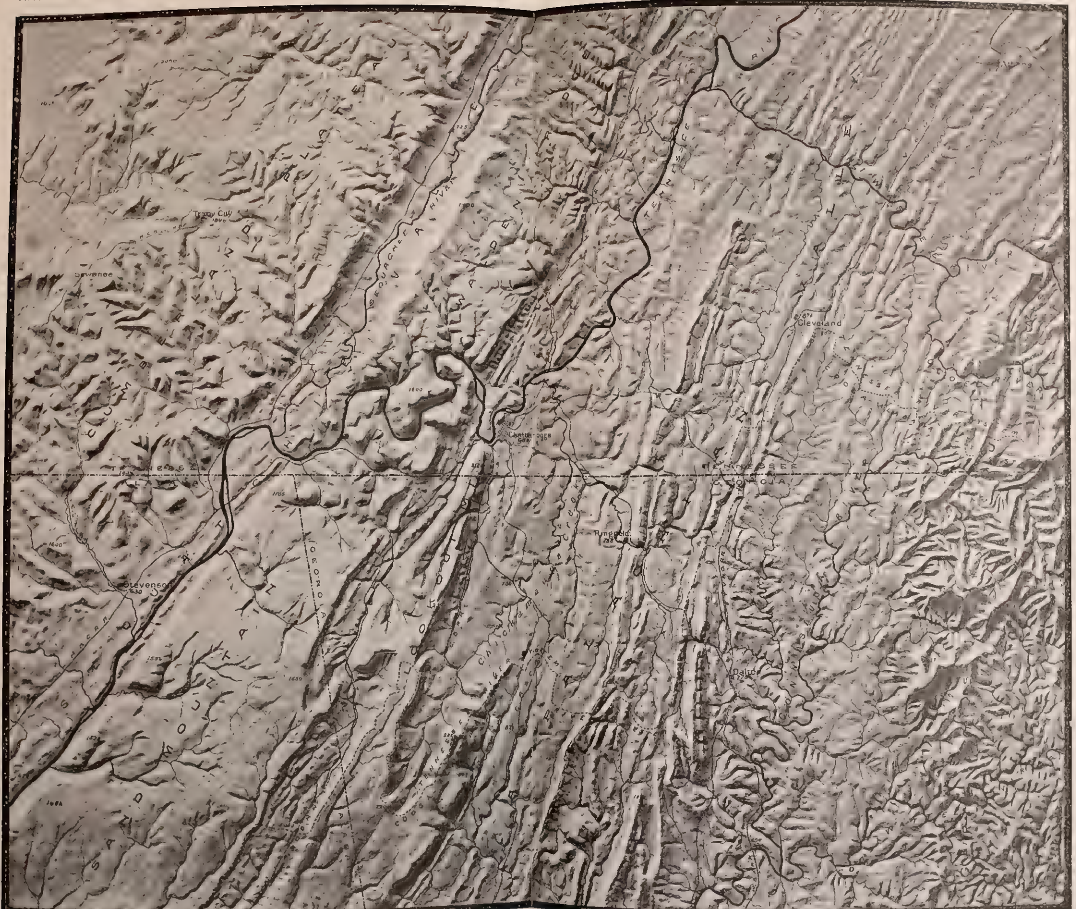


ATTANOOGA DISTRICT.

3 miles = 1 inch.



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RELIEF MAP OF THE CHATTANOOGA DISTRICT.

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BY

CHARLES WILLARD HAYES AND MARIUS R. CAMPBELL

CONTENTS

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INTRODUCTION.

REVIEW OF PREVIOUS WORK.

The post-Paleozoic history of the Appalachian province has, until recent years, been known only in the most general terms. That the region has been a land area since the close of Carboniferous time was known, and it was assumed that, in common with other land areas, it had been repeatedly elevated and depressed, yet the extent and character of these movements, in the interior at least, were not only unknown, but no data were supposed to exist by which they could be measured. Along the margin of the province the subsidences are recorded in the sediments deposited as the sea transgressed upon the land, and in some cases the amount of subsequent uplift is indicated by the recession of overlying deposits. In so far as these oscillations have been determined from sedimentary deposits, each transgression of the sea was regarded as marking a continental depression, and each recession a continental uplift. Within the past few years, however, a complete revolution has been effected in the interpretation of the post-Paleozoic history of this region. Through the work of a few pioneers in this field the number and character of the principal oscillations and their position in geologic time are now fairly well known.

The first systematic application of the new methods of research was made by McGee in the middle Atlantic slope. In 1885, in a paper on the geology of Chesapeake bay,* he pointed out the methods pursued and the importance of utilizing topographic forms resulting from degradation, as well as the complementary sedimentary deposits in interpreting geologic history. In 1888 † he more definitely correlated the principal oscillations with the sedimentary deposits, thus fixing their position in geologic time, and in a subsequent paper ‡ he made the very important generalizations that all elevations have been accompanied by seaward tilting of the land, and that along certain axes the oscillations have reached a maximum amount, while along others both elevation and depression have been at a minimum.

Davis § published the results of his studies on the geomorphology of the middle and north Atlantic slope shortly after the

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* The Geology of the Head of Chesapeake Bay, by W J McGee: Seventh Annual Report U. S. Geological Survey, 1888, pp. 545–646.

† Three Formations of the middle Atlantic Slope, by W J McGee: Am. Jour. Sci., vol. xxxv, 1888.

‡ The Lafayette Formation, by W J McGee: Twelfth Annual Report U. S. Geological Survey, 1891, pp. 353–528.

Geology of Washington and Vicinity, by W J McGee: Compte Rendu de la Congrès Géologique International, 5th Session, Washington, 1891, pp. 219–251.

§ The Rivers and Valleys of Pennsylvania, by W. M. Davis: Nat. Geog. Mag., vol. i, 1889, pp. 183–253.

The geographic Development of northern New Jersey, by W. M. Davis and J. W. Wood: Proc. Boston. Soc. Nat. Hist., vol. xxiv, 1889, pp. 365–423.

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appearance of the first two papers above cited. He has carried his observations somewhat further toward the interior and describes two well marked baselevel peneplains in eastern Pennsylvania, New Jersey and portions of New England, the formation of which, he ascribes to long continued erosion in Cretaceous and Tertiary time. A general seaward tilting of the peneplain is described, but no attempt is made to locate the axes of their deformations. In 1890 Davis published a more comprehensive paper,† bringing in review all previous publications on the baselevels of the Atlantic slope and discussing the probable continuation of the peneplains, found in the northern portion southwestward over the whole of the Appalachian province.

Thus the broad outlines and to some extent the details of post-Paleozoic history of the Atlantic slope and Mississippi embayment have been determined, but for most of the interior the details are still wanting. The present paper is an attempt to supply in some measure this deficiency.

THE PROVINCE DEFINED.

For present purposes the southern Appalachian province is regarded as embracing the region south of the Ohio and Potomac rivers and limited toward the east, south, and west by the Cretaceous and the later formations of the coastal plain and Mississippi embayment. One or both of the present writers are personally familiar with the greater part of this region, and many observations made in connection with the work of the Appalachian division of the United States Geological Survey are here for the first time brought together. The location of the region is exceptionally favorable for the study of its geomorphology. Surrounded on three sides by Mesozoic and later deposits, the relations of land and water which prevailed during post-Paleozoic time are fairly well determined. The character of the sediments serves to establish correlations between them and their corresponding erosion features. The intersection of erosion planes with deposits of known age serves to fix the date of each erosion period within narrow limits. Finally, the absence of glaciation and glacial deposits renders the interpretation of topographic forms and of drainage systems much easier than in regions

† The geologic Dates of Origin of certain topographic Forms on the Atlantic Slope of the United States, by W. M. Davis: Bull. Geol. Soc. Am., vol. ii, 1890, pp. 545–581.

where glaciation has interfered with their normal development or masked their completed form.

THE PROBLEMS AND THE DATA.

Since the southern Appalachian province, as above defined, has stood above sealevel throughout the whole of the period whose history is under consideration, that history must be read in the topographic forms developed during the process of subaerial degradation and in the adjustments of drainage to changing conditions.

The fundamental conception, in the interpretation of the history of a region from its topographic forms, is the *baselevel of erosion.* The formation of a general baselevel peneplain implies the long continuance of certain well defined conditions, so that wherever the presence of such a peneplain can be established the former existence of these conditions may be safely inferred; also it can be formed only near sealevel; hence by contouring the present remnants of a baselevel peneplain the contour at any point represents very nearly the algebraic sum of all changes in altitude which that portion of the plain has suffered.

In the southern Appalachian province the more or less perfectly preserved remnants of two baselevel peneplains have been mapped and their deformations represented by contours; the conditions implied by these baselevels have been inferred; their probable correlations with the contemporaneous sedimentary deposits indicated; and finally the development of the drainage has been traced through a complex series of adjustments upon the repeatedly deformed surface to its present mature location.

Part I—Physiographic Development.

CLASSIFICATION OF TOPOGRAPHIC FEATURES IN THE PROVINCE.

The southern Appalachian province has certain topographic features common throughout its entire extent. They are so modified by local conditions that their identity in different portions of the province would scarcely be recognized by the casual observer, but to the student of geomorphology they stand out as the most prominent feature of the landscape and he reads from them many chapters in the history of the province during post-Paleozoic time. With our present information we are able to classify these topographic forms and to trace with considerable certainty the more prominent features over the greater portion of the province. In some portions lack of data prevents the identification and correlation of these forms, but it is probable that further study will show the same features there as in the better known regions. The identity and practical continuity of certain topographic forms have been clearly proven through the major portion of the southern Appalachian province, and by other writers across Pennsylvania, New Jersey and the greater portion of New England, so that the conditions and agencies which produced them must have prevailed uniformly over wide areas.

In addition to these principal topographic forms, there are many minor features which doubtless record brief and local conditions, but in most cases the data at hand are not sufficient for their determination.

Inferences from the observed topographic forms back to the conditions under which they were produced necessarily involve elements of uncertainty, and the writers are fully aware that some of their conclusions are open to question and may be modified by further study.

The classification of the main topographic features of the province is as follows:

1. Elevations standing above the Cretaceous peneplain.
2. Deformed Cretaceous peneplain.
3. Intermediate erosion slopes.
4. Deformed Tertiary peneplain.
5. Post-Tertiary erosion slopes.

Of these five classes the two baselevel peneplains are most important to the student of geomorphology, for they render it possible to interpret the meaning of the other topographic features and to fix the dates of their origin in geologic time.

ELEVATIONS STANDING ABOVE THE CRETACEOUS PENEPLAIN.

The oldest topographic forms found in the southern Appalachian province are those portions of the land which were not reduced to baselevel during the long period of Cretaceous erosion. These summits may possibly mark the position of a still earlier baselevel peneplain; but if so, the remnants are so few that we are unable to reconstruct the ancient plain. Protected by a favorable location with reference to drainage lines or composed of exceptionally durable rocks, they stood during the formation of the Cretaceous peneplain in low relief above the level surface and still remain as isolated peaks, ridges or mountain groups above the remnants of that plain. The distribution and relations of these remnants will be more easily understood after the Cretaceous peneplain has been described in detail; hence their consideration will be deferred and included under the physiography of the Cretaceous peneplain.

DEFORMED CRETACEOUS PENEPLAIN.

The oldest topographic feature that can be identified with certainty in this region, one which forms the basis upon which all later history has been recorded, is a more or less perfectly preserved baselevel peneplain. The reasons for ascribing its formation to Cretaceous time are given in a subsequent part of this paper and its Cretaceous age may be assumed for the present. Doubtless, at earlier periods the surface of the province had been baseleveled again and again, but subsequent erosion has so modified these earlier forms as to leave them unrecognizable.

Conditions of Development.—The condition under which a plain of erosion will be formed is long-continued stability of baselevel, and as baselevel is usually determined by sealevel, the essential condition is that the relative position of land and sea shall remain unchanged for a period long enough to allow the agents of erosion to carry their work toward completion and reduce the surface of the land to drainage-level, the baselevel of erosion.

During Cretaceous time the condition of stability prevailed in this region for the longest period of which we have any record in its history; for, while it is a popular belief that the normal condition of the earth's crust is one of stability, the reverse is shown to be true of this region. Its history in post-Paleozoic time is a record of almost continuous orogenic movement—extremely slow, it is true, but with sufficient time allowed, capable of producing the greatest deformations with which we are acquainted.

Throughout this period of exceptional quiet, erosion was in progress, reducing the surface toward baselevel—rapidly at first, as the land was high and the slopes steep, but at a rate growing gradually less and less as the gradient of the streams decreased and with it their ability to carry off the waste of the land. As the gradient approached its lowest limit the mineral matter removed from the land was almost wholly in solution. This process continued, reducing to baselevel first the soft and soluble rocks, and then, less perfectly, the harder rocks; the degree to which it was carried depending largely upon their location with reference to the margin of the sea or the larger streams. In this manner the greater portion of the province was reduced to an almost featureless plain. The surface over hard and soft beds alike was smoothed until gentle slopes and low relief replaced the sharp declivities and high elevations which marked the early stages of the process.

Following the period of quiescence above described came one of epeirogenic activity, and the process of baseleveling was brought to an end. The land was elevated and the streams began anew the rapid trenching of its surface; but the land was elevated unequally, and as it arose the surface was warped and twisted. Where the elevation was greatest the erosion was most active and quickly destroyed the symmetry of the surface, in some places producing a deeply cut mountain region, the summits alone marking the position of the former peneplain; where the elevation was slight the surface remained practically unchanged; and all gradations exist between these extremes—on the one hand, where the peneplain is wholly destroyed, and on the other, where it is perfectly preserved.

Although the whole province, as stated above, had been reduced to an almost featureless plain, the character of the underlying rocks modified to a very slight extent the character of that plain. The soft rocks were somewhat more perfectly reduced than the hard rocks. Still the differences were not strongly marked. When, however, the nearly perfect plain was elevated and the activity of the streams was revived, differences in the underlying rocks became all important in determining the degree to which the plain would be preserved. Where the rocks were soft it was rapidly destroyed, and where they were hard it has retained in large measure its original form. Hence the peneplain, although originally quite uniform, now shows great diversity and presents several distinct types, depending jointly on the amount of elevation and the character of the underlying rocks.

Western marginal Type.—In general around the margin of the province this peneplain has been almost entirely obliterated by later erosion. Especially is this true in central Tennessee and Kentucky, where limestone occupied the baseleveled surface or lay beneath a thin capping of sandstone. When erosion was revived upon the peneplain by its elevation the streams quickly sank their channels to the second baselevel and almost completely removed the intervening portions. Hence there are only a few widely separated outliers of the Cumberland plateau whose summits still mark the surface of the peneplain. One of the most typical of these outliers is Short mountain, in central Tennessee, which rises 1,000 feet above the surrounding level plain. It has about the same altitude and is capped by the same hard sandstone as the Cumberland plateau, 20 miles distant. The intervening low plain is underlain by limestone, which, on the removal of the sandstone cap, offered comparatively little resistance to degradation, so that only a combination of favorable accidents has preserved this remnant of the old peneplain once continuous over the whole region.

Plateau Type.—This is very different from the foregoing, chiefly in the degree and manner of its preservation. In the great Appalachian coal basin, south of Cumberland gap, the rocks are comparatively undisturbed. Along certain lines narrow anticlinal folds have developed, leaving broad basins between. The anticlines have been eroded, and the synclinal basins, with their flat lying strata, constitute the mountains or more properly the plateaus of this region. The form of the level topped plateaus has been attributed to the attitude of the strata, especially where the surface is formed by the great Carboniferous conglomerate, as is the case over most of the region; but close study shows that this uniform surface does not always correspond to the geologic structure, but is a more or less perfect plain, regardless of the attitude of the strata. The few low knobs and ridges which rise above this common level are truly monadnocks,* standing out in striking contrast to the uniform surface below. They generally bear no definite relation to the outcrop of the harder beds, but appear to be due rather to the accidents of erosion and remoteness from main drainage lines. These features prevail throughout the coal basin from central Alabama to Kentucky. The plain is well preserved in the southern portion, but becomes more deeply dissected toward the north, until near Cumberland gap there remain only a few narrow remnants of the once continuous surface. The conditions for the study of this plain are nearly ideal in the plateau region, where it was so perfectly

*A term lately used by W. M. Davis to designate those isolated elevations standing above a baseleveled plain as mount Monadnock stands above the surrounding plain.

formed and so excellently preserved. It can be traced continuously from an altitude of 600 feet in central Alabama to 2,000 feet at the Tennessee-Alabama line, and thence holding about the same altitude, with slight irregularities, to Cumberland gap. North of the Kentucky-Tennessee line the identification of this peneplain becomes a much more difficult matter, for elevation has been greater and erosion more rapid. The rocks are generally soft and have been unable to preserve any extent of level surface; hence the plain is almost wholly destroyed. Nevertheless, upon careful study of a wide area, it is seen that along northeast-southwest lines there is a marked uniformity in the altitude of the summits, and on transverse lines an extremely regular increase in their elevation toward the interior. This gentle but regular slope bears apparently no relation to the structure, and there seems no other explanation but to regard this as an almost completely dissected peneplain whose surface is represented approximately by the summits of the isolated knobs. The altitudes of these remnants of the plain vary from 1,300 or 1,400 feet near the mouth of the Big Sandy river to 4,000 feet near the central portion of the Virginia-West Virginia line. Above this inclined peneplain no summits rise until well toward the interior of the region, where their occurrence seems to be due to the same causes which produced monadnocks further southward, viz., unfavorable location with reference to the main drainage lines. This is well exemplified in the Big Black mountain on the state line between Kentucky and Virginia. This irregular mountain mass near Big Stone gap is composed of upper Coal Measures, and has an altitude of 4,100 feet, while Pine mountain, but a few miles northwestward, is finely baseleveled at about 2,500 feet. True, there is a great difference in attitude of the strata in these two mountains, for in Pine mountain the dip is about 30° southeastward, while in Big Black mountain the rocks are horizontal; but the former is made up of 1,200 to 1,400 feet of hard conglomerate, interbedded with shales and sandstones, while the latter is composed of the ordinary shales and sandstones of the upper Coal Measures. Apparently Big Black mountain owes its preservation to the presence of Pine mountain on its northwestern side, which acted as a barrier against erosion from that direction.

Valley Ridge Type.—In the Appalachian valley the type is more uniform throughout the whole extent of the province and consists of the even crested ridges similar to those of Pennsylvania which have been so well described by Davis.* As a rule the ridges of the southern Appalachian valley are remarkably even crested and are unquestionably the remnants of a plain. In many cases, however, more or less wide variations from the type are found. In some instances a continuous but irregular ridge seems to rise quite above the peneplain, while in others the wind gaps have a constant altitude and probably represent the old baselevel, while the intervening portions of the ridge rising 100 to 300 feet higher stand, now as then, as a series of knobs above the general level. On the other hand, some ridges composed of less resistant rocks or occupying more exposed positions have been so reduced by subsequent erosion that no points along their crests reach the altitude of the peneplain. In reconstructing the peneplain from the valley ridges, careful study is required to determine its true position, and in some regions considerable uncertainty attaches to the determination. On the whole, however, the results obtained from the ridges are surprisingly concordant with those obtained in adjacent regions where the plain is better preserved.

Smoky Mountain Type.—This type differs altogether from those previously described and consists almost wholly of baseleveled valleys. They prevail from the vicinity of Roanoke, Virginia, to Cartersville, Georgia, giving rise to some prairie-like country in the heart of the Smoky mountains. It was in these valleys that this peneplain was first recognized. In a paper read before this Society in 1889 Willis described the baseleveled valley of the French Broad river as follows: †

> A broad amphitheater lies in the heart of the North Carolina mountains which form its encircling walls; its length is forty miles from north to south and its width ten to twenty miles. At its southern gate the French Broad river enters; through the northern gate the same river flows out, augmented by the many streams of its extensive watershed.
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> From these water-courses the even arena once arose with gentle slope to the surrounding heights. . . . But that level floor exists no longer. In it the rivers first sunk their channels, their tributaries followed, the gullies by which the waters gathered deepened, and the old plain was thus dissected. It is now only visible from those points of view from

* The Rivers and Valleys of Pennsylvania, by W. M. Davis: Nat. Geog. Mag., vol. i, pp. 183–253.

† Round about Asheville, by Bailey Willis: Nat. Geog. Mag., vol. i, pp. 291–300.

which remnants of its surface fall into a common plane of vision. This is the case whenever the observer stands upon the level of the old arena. He may then sweep with a glance the profile of a geographic condition which has long since passed away.

Again, in speaking of its altitude and probable origin, he says: *

We have recognized that dissected plain, the level of the Asheville amphitheater, now 2,400 feet above the sea. It was a surface produced by subaërial erosion, and as such it is evidence of the fact that the French Broad river and such of its tributaries as drain this area at one time completed their work upon it, reached a baselevel.

This baseleveled condition, as described by Willis on the French Broad, has been found to characterize nearly all the river valleys of the Great Smoky mountains and has been observed by the present writers on the Little Tennessee, Hiwassee and Ocoee rivers of the Tennessee system and on the Coosawattee and Etowah rivers of the Alabama system. The altitudes of the baseleveled valleys vary considerably, but on the whole show a gradual descent southwestward. Thus the altitude of the peneplain is 2,400 feet at Asheville, 2,200 feet on the Little Tennessee, 2,000 feet on the Hiwassee, 1,900 on the Ocoee and 1,600 feet on the Coosawattee. The proportion of the surface which was reduced to baselevel also increases southwestward and in northern Georgia, in place of the baseleveled mountain valleys, most of the surface was reduced and adjacent river basins merge with low divides. Thus the upper basin of the Coosawattee and Etowah present to the eye the characteristic form of broad undulating plains partly enclosed by mountains and from which rise the gentle slopes of island-like monadnocks. In detail these plains are found to be deeply etched by the present streams, which flow in narrow recently-cut gorges several hundred feet below their general level. On the Etowah river and southward this enclosed valley type disappears and the peneplain assumes a different form, which will be described later.

Blue Ridge Type.—The writers are less familiar with the region northward from the French Broad river and the data for reconstructing the Cretaceous peneplain are less abundant. The topographic maps, however, show quite strong evidence of the existence of this peneplain in the region in question, though it

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*Op. cit., p. 297.

is not so well marked as about Asheville. Considerable study has been given to the region just north of this province by Davis, who suggests in the paper above cited* the probability of the extension of the Cretaceous peneplain over the entire southern Appalachians. Though he makes no definite statements as to its elevation and attitude, yet he concludes that the summits of the Blue ridge, south of the Pennsylvania line, probably represent this baselevel. The present writers have searched quite carefully for definite evidence as to the existence of the peneplain in this region and so far have been unable to find anything entirely satisfactory. That the region in question was baseleveled is conceded by all who are familiar with its topography, but the present elevation and attitude of the peneplain are less certain. Southeast of the Blue ridge there are a few outliers or isolated knobs standing above the Tertiary plain, and these show a uniform altitude of about 1,000 feet. It seems scarcely possible that these outliers should have been reduced to so nearly a common level unless that level were the baselevel of erosion. Immediately north of the Blue ridge, the Massannutten mountain shows traces of baseleveling at altitudes varying from 2,400 to 2,500 feet, and the valley ridges to the northward probably show traces at still greater altitudes. The Blue ridge varies greatly in altitude; its crest rises toward the south from 1,200 feet at Harpers Ferry to 4,000 feet at the Peakes of Otter, in central Virginia, and toward the north to 2,300 feet on the Maryland-Pennsylvania line. If there were a corresponding gradient in the peneplain it would necessitate a deformation along a cross-axis, of which there is no trace further westward; also the crest line of the Blue ridge between the points mentioned is extremely irregular and bears no resemblance to the remnant of a baseleveled plain. The varying elevations of the plain, determined on either side of the Blue ridge, agree with certain features of the ridge itself and make it decidedly probable that the peneplain here is highly tilted eastward; the strike of the plain—*i. e.*, the direction of the contours representing the restored surface—crosses the ridge at a low angle instead of being parallel with it. The result of these complex conditions is that no two remnants of the old plain are found along the trend of the ridge at the same altitude, and consequently they are extremely difficult to recognize. Assuming this attitude of the peneplain

* Bull. Geol. Soc. Am., vol. ii, 1891, p. 562.

as a working hypothesis, traces of a baselevel can be found in places that otherwise afford no evidence of its existence; a terrace cut here and a wind-gap there serve to locate the plain so that it can be restored and contoured with considerable confidence. The restored surface corresponds with the summits of the ridges at Harpers Ferry, where proximity to the Potomac insured complete reduction to baselevel and afforded opportunity for subsequent erosion to almost completely dissect the plain. On either side, away from the river, the crests become more irregular, and evidently stand above the peneplain, while the present wind-gaps show traces of baseleveling, and probably correspond in altitude very nearly with the plain. On the eastern side of the Blue ridge throughout North Carolina there is but little data available for reconstructing the Cretaceous peneplain. The present writers are personally unacquainted with the region and a large part of it has never been mapped with contours. At only one point has the phenomenon of baseleveling been recognized. Kerr has described certain topographic features observed in the vicinity of Morganton, North Carolina,* and likened them to the Asheville baselevel. His theory as to their glacial origin cannot be accepted, but from his description it may be inferred that the valley of the Catawba river has been baseleveled to about the same extent as the French Broad at Asheville, and that the plain has been nearly as well preserved. Its altitude here is 1,400 feet, so that it must have a very rapid ascent toward the west in order to reach an altitude of 2,400 or 2,500 feet at Asheville, which is only fifty miles distant. This sharp ascent of the Cretaceous peneplain on the eastern slope of the Blue ridge dies out rapidly southward, partly through the flattening out of the fold in that direction and partly through the influence of a cross-axis of depression in the vicinity of Atlanta.

Southern marginal Type.—In the region southwest from Atlanta as far as the Coosa river the present attitude of the peneplain differs from that in any other portion of the province. In this region the baseleveled plain has suffered but little uplift from the position in which it was formed, and this slight elevation has taken place in very recent geologic time. Hence the peneplain is well preserved and many of the present streams, as the

* Origin of new Points in the Topography of North Carolina, by W. C. Kerr: Am. Jour. Sci., 3d series, vol. xxi, 1881, pp. 216–219.

Tallapoosa and its tributaries, are flowing partly on this old surface and partly in channels which they have been able to sink but a short distance below it, although it now stands from 1,000 to 1,400 feet above sealevel. In northern Georgia it merges into the Smoky mountain type, differing from the latter in the greater perfection to which the baseleveling process was carried and in the more perfect preservation from subsequent erosion. This peneplain is well preserved in Dug Down mountain, south of Rockmart, Georgia, and it is from this plain that the historic knobs of Kennesaw and Stone mountain stand up so prominently.

When the peneplain was formed it must have extended to the margin of the Cretaceous sea which at that time bounded the province on three sides; but it is this marginal portion which was subjected to the greatest erosion, so that wherever any considerable elevation took place the peneplain has been wholly destroyed. Hence there is a narrow belt within which no data are available for reconstructing the peneplain, except by interpolation from the approximately known position of the sea margin and the remnants of the surface still to be found at greater or less distances therefrom. These distances are not usually so great as to cause much uncertainty in determining the position of the peneplain at any point.

PHYSIOGRAPHY OF THE CRETACEOUS PENEPLAIN.

The existing remnants of the Cretaceous peneplain having been described in some detail, a fairly complete view may be gained of its physiography at the close of the long period of quiescence during which it was formed. Although this is the most perfectly baseleveled plain ever developed in the province, and although it was exceptional for its extent and regularity, it did not have a perfectly horizontal surface; in fact, it was level only where erosion acted under the most favorable conditions, either near sea margin and along the largest streams or where the rocks were easily removed by solution. Where soft and hard rocks alternated, the former were quickly reduced, while the latter remained above baselevel for longer or shorter periods, according as they were more or less remote from the main drainage lines. Where the location was most favorable for erosion, hard and soft rocks alike were perfectly reduced, and the rivers wandered in sinuous courses and with sluggish currents, uninfluenced by the character or attitude of the underlying strata. That this was rather the exceptional case, however, is inferred from the infrequence of superimposed drainage which can be attributed directly to baselevel wanderings. Probably the outcrops of many if not most of the hard beds appeared embossed in low relief upon the baseleveled plain. The distribution of the unreduced areas, so far as they can be determined at the present time, is shown in plate 5. It will be seen that these areas coincide in position with the present mountain regions. Doubtless many points which then stood slightly above the peneplain have been so reduced by subsequent erosion that their summits no longer rise above its general level. Western North Carolina as early as Cretaceous time was the culminating point of the Appalachian highlands, a position which it has held unterruptedly from that time to the present. At the close of the period of baseleveling the mountains here stood at altitudes varying from 3,000 to 3,600 feet above sealevel, and in some portions of the region they have changed in appearance but little from that time to this. Thus, in the Asheville region there was then a broad, level valley, over whose surface the streams meandered in winding courses. Encircling the valley were the same mountains as today with almost the same contours. The chief difference is in the altitude of the baseleveled valley, which then stood near sealevel, but now has an elevation of 2,400 feet, and in the deep gorges which the present streams have etched below its surface. The present line of the Blue ridge in Virginia was marked by a series of monadnocks, isolated or in groups, but not comparable in extent with the mountain mass toward the southwest.

In the region of the Cumberland mountains, across the Appalachian valley from the Great Smokies, the map shows some areas not reduced to baselevel. These formed a group of monadnocks the highest of which, the Big Black mountains, did not much exceed 1,500 feet in altitude. They are composed of rocks not specially obdurate and, as suggested above, probably owe their preservation from erosion to the surrounding barrier formed by the great Carboniferous conglomerate, and also to their position in the interior, away from the main drainage lines.

In the valley region where the rocks are highly tilted and present sharp contrasts in capacity for resisting erosion, many short ridges or linear monadnocks stood from 100 to 1,000 feet above the baselevel. These form the higher portions of many of the present valley ridges, while the present wind-gaps represent the former baseleveled intervals between the monadnocks. In the plateau region south of the Crab Orchard mountains no areas of sufficient extent to be represented on the map remained unreduced. The peneplain in this portion of the province was less perfect than in some others and occasional slight elevations remain clearly above its general level. These are sometimes due to the attitude of unusually resistant beds, but more often to the accidents of erosion acting on tolerably homogeneous material.

DEFORMATION OF THE CRETACEOUS PENEPLAIN.

One of the most important conclusions contained in the present paper, in its bearings upon geomorphology, is the recognition of the nature of the deformation found recorded in the present attitude of the baselevel peneplains. It is that these deformations have been mainly produced by true orogenic movements affecting comparatively narrow areas along certain well defined axes; that they were not epeirogenic or continental uplifts such as would preserve a peneplain in approximately its original horizontal position; nor even, as suggested by Willis,* uplifts which broadly arched the surface across the whole expanse of the province; also that orogenic activity has not been continuous along any one axis nor always in the same direction, though the total effect of the intermittent motion has been to elevate the whole province.

Deformations of the baselevel peneplains have been recognized in this and adjacent regions by other writers, especially Davis and McGee. Thus Davis has shown that the Cretaceous peneplain in Pennsylvania, New Jersey and portions of New England is tilted seaward, but he has not located its axis of elevation; also McGee has shown that in the southern Appalachians every subsidence has been greatest at the sea margin and every elevation greatest in the interior, which implies a cumulative seaward tilting. The class of facts from which he derived his evidence did not enable him to locate the main axes of uplift, though he clearly recognized the transverse Memphis-Charleston axis, which will be more fully described on a subsequent page.

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*Topography and Structure of the Bays Mountains, Tennessee, by Bailey Willis: School of Mines Quarterly, vol. viii, 1887, p. 252.

In order to represent in as graphic a manner as possible the present form of this Cretaceous peneplain a contoured map of the deformed surface has been constructed. Upon this map are assembled all available data derived from a careful comparison of the various known remnants of the plain within the province. The result appears as plate 5, and although regarded by the writers as preliminary, it embodies all the information at present attainable. Although imperfect, the map is highly suggestive, and it is hoped that it may lead to the construction of similar maps of other regions in which equally important results would undoubtedly be obtained. Different portions of the map represent widely different proportions of fact and hypothesis, and hence differ in value. Thus in the southern part of the province the peneplain, as already described, is well preserved; also the map of this portion is based upon a large number of personal observations and may be considered fairly accurate. In some regions in the northern portion of the province only scanty remains of the peneplain can be found, and the evidence of its existence is so indefinite that while the present map is unsatisfactory it is doubtful if anything better can be constructed even with fuller field observations. Other portions are based upon a study of imperfect topographic maps or railroad profiles and verbal descriptions of topography, so that the results are correspondingly unsatisfactory.

As already indicated, the deformations of the Cretaceous peneplain represented by the contour map (plate 5) are not the result of a single elevation or a single system of orogenic movements, but the algebraic sum of all movements both of elevation and depression which have affected the region since the peneplain was formed. Not only have the movements been in opposite directions and at different periods, but the axes of maximum motion have not always been the same nor even parallel; they have intersected at various angles, and the surface has been warped accordingly. The data are not sufficient for mapping all the details and a description of the principal axes only will be attempted.

Longitudinal Axes of Elevation.—There are three principal longitudinal axes, and so far as known, these are axes of elevation alone, though depression of which no record is left may have taken place along them also. They are indicated by broken lines on plate 5 and marked by the letters *C D*, *E F* and *G H*.

These are lines of maximum elevation and they have had a predominant influence in producing the present topography of the province. They coincide with the present mountains and in a general way parallel the great structural features of the Appalachian valley.

Transverse Axes of Oscillation.—In addition to the predominating longitudinal axes a number of interesting transverse axes are brought out by the contours representing the deformed Cretaceous peneplain. In the central portion of the map the contours swell out on either side, giving a broader and more regular profile to the elevation than elsewhere. This is suggestive of a transverse line of uplift intersecting the longitudinal axes nearly at right angles. If this line be prolonged in both directions it is found to connect Cincinnati and cape Hatteras, both of which have been recognized as occupying regions of recent elevation. As early as 1871 Shaler* described a transverse uplift which he concluded had produced the great projection of the coast line at cape Hatteras; also McGee has shown that this axis has been an important factor in determining the form of the coast line during the time represented by the deposition of the coastal plain sediments. He describes it † as "an axis of interruption or change in epeirogenic movement during every geologic period since the Cretaceous." If this line from cape Hatteras to Cincinnati be continued across the Ohio river its direction will be found to coincide with that of the main or northwestward branch of the Cincinnati arch which crosses Indiana to Chicago. Although, with the information at present available, it cannot be asserted that motion has taken place along the southeastern portion of the line except in post-Cretaceous time, still the coincidence of the two axes suggests the probability that there was orogenic movement in the Appalachian region during the uplift of the Cincinnati arch in Ohio and Indiana, and, conversely, that north of the Ohio river may yet be found traces of post-Paleozoic movements corresponding to the later uplifts in the vicinity of cape Hatteras. The probability of such contemporaneous movement is increased by the fact that in the southern portion of the province evidence was found by the writers proving that certain

* On the Causes which have led to the Production of cape Hatteras, by Professor N. S. Shaler: Proc. Bost. Soc. Nat. Hist., vol. xiv, pp. 110–121.

† The Lafayette Formation, by W J McGee: 12th Annual Report U. S. Geological Survey, 1891, p. 403.

axes of post-Cretaceous oscillation have also been lines of Paleozoic movement.

A second and more clearly defined axis of elevation, *O P*, is found crossing the province in the vicinity of Chattanooga. Its trend is nearly due north and south, and it has been traced nearly as far north as Cincinnati. If the axis be continued across the Ohio river it falls in line with the eastern branch of the Cincinnati arch passing through Findlay and Toledo, Ohio. This also may be only a coincidence, but it strongly suggests genetic connection between the portions of the axis north and south of Cincinnati.

The third and most prominent of the transverse axes crosses the southern portion of the province, passing near Atlanta and forming a tangent to the great northwestward bend of the Tennessee river. It was first recognized by McGee in studying the sediments of the southern Atlantic coastal plain and Mississippi embayment. He describes this "Charleston-Memphis axis"* as an axis of maximum subsidence during both low level periods (represented by the Lafayette and Columbia formations) and an axis of maximum uplift during both high level periods. It is represented on the map by the broken line *A B*, having a nearly east-and-west direction; it intersects the last described north-and-south transverse axis as well as the longitudinal axes, and since, as shown by the contours, it is at present a line of depression the effect of the elevation along the other axes is wholly or partially neutralized at their intersections. The oscillations on this axis *A B* have been an important factor in determining the drainage of this region and will be again referred to in the second part of this paper.

The probability of orogenic forces having been active upon the transverse axes during Paleozoic time was mentioned above. In case of the axis *A B*, there is proof of such activity at two or more distinct epochs. In mapping the Paleozoic formations of northern Georgia and Alabama it was found that two terranes which present strong indications of having been deposited under shore conditions terminate abruptly against this line. These shore formations are the Birmingham breccia at the top of the Knox dolomite and the Oxmoor sandstone occurring in the lower Carboniferous. Other stratigraphic changes scarcely less

* The Gulf of Mexico as a Measure of Isostacy (abstract), by W J McGee: Bull. Geol. Soc. Am., vol. iii, p. 503.

striking mark this as a line of instability during the whole of Paleozoic time and the physiographic evidence shows that the instability has continued down almost to the present. Hence it seems at least probable that orogenic activity has been persistent on the other axes in pre-Cretaceous or Paleozoic time, and that the forces which produced the Cincinnati arch are the same as those which have deformed the Cretaceous peneplain.

Considerable evidence has been collected bearing upon the relative age of the oscillations recorded in the deformed peneplain, but since it is closely connected with topographic features to be described later its consideration is postponed to a subsequent page.

DEFORMED TERTIARY PENEPLAIN.

The long period of quiescence, during which the Cretaceous peneplain was produced, was terminated by a general elevation of the larger part of the province. Like most of the oscillations that have occurred since, it was compound in character, combining epeirogenic and orogenic movements; the former affected the entire province, carried the coast line considerably beyond its previous location and stimulated the streams to increased activity; but the energies culminated along certain axial lines and resulted in pronounced orogenic uplifts that warped and twisted the surface as it arose.

The immediate effect of this elevation was to stimulate erosion, and the streams which for a long period had been carrying only the finest sediments began the rapid corrasion of their channels and quickly trenched the rising land. The process was carried on differently in different parts of the province; where the elevation was slow, erosion was very moderate in its effects, but where elevation was rapid the streams were greatly stimulated and rapidly dissected the peneplain.

The movements which inaugurated this cycle still continued to affect the province, not continuously along any one axis, but by intermittent and gradually decreasing elevations and depressions. These oscillations were terminated by a second period of quiescence, during which the surface was again reduced to a base-level peneplain.

The extent of the movements occurring between these two periods of baseleveling can be roughly measured by the vertical distance between the two peneplains. The uplift attained its maximum of about 2,600 feet in northern Virginia and West Virginia, and was apparently continuous from the close of one period of baseleveling to the inauguration of the other. As a direct consequence of this steady uprising of the land we find in this portion of the province the Cretaceous peneplain almost completely dissected, and it is extremely doubtful if any of the level surface is still preserved. From this maximum the elevation decreased in an irregular manner toward the margin of the province, where the earlier and later baselevels coincide.

The period of Cretaceous baseleveling was a very long one—so long that over much of the province the rocks, hard and soft alike, were reduced nearly or quite to the same level. The period of Tertiary baseleveling, on the other hand, was comparatively short when measured by geologic standards. It sufficed for the complete removal of the previous peneplain only about the margin of the province, where conditions of erosion were exceptionally favorable, and for the cutting of broad valleys upon the soft rocks of the interior. Since only the softer rocks were reduced to baselevel, there is less diversity in the Tertiary than in the Cretaceous peneplain, but when the surrounding erosion slopes are considered in connection with the plain, as they must necessarily be, there is found a great variety of topographic forms, depending jointly on the kind of rocks, location with reference to the margin of the sea or large drainage channels, and amount of pre-Tertiary elevation. This peneplain, like the Cretaceous, has been greatly modified by late erosion, but even in this the three elements named above are the controlling ones and mainly responsible for the forms produced.

Marginal Types.—In the western portion of the province conditions were favorable for the production of an extensive baselevel peneplain during this period. The very perfect Cretaceous plain was elevated from a few feet at the margin of the Tertiary sea to about 1,000 feet at the western line of the Cumberland escarpment. The greater part of the rocks thus raised above baselevel were limestones, in which the streams quickly lowered their channels and by lateral corrasion entirely removed the intermediate highlands, with the exception of a few isolated monadnocks, of which Short mountain, already described, is the type. Owing to the coincidence throughout central Tennessee of the Carboniferous limestone and the Tertiary baselevel, this peneplain was formed up to the base of the steep plateau escarpment and far within the narrow limestone coves which indent its border. In the time that has elapsed since the formation of this pleneplain the streams have not been able to cut their gorges back to the escarpment, so their head-waters are still flowing upon that old plain, though at an altitude of from 1,000 to 1,100 feet. Thus in a belt of country bordering the plateau on the west and extending northeastward from Huntsville, Alabama, to the Kentucky-Tennessee line the conditions were favorable for the production and have since been favorable for the perservation of this peneplain.

Across Kentucky the conditions were similar to those of Tennessee, except that the hard Coal Measure sandstones were less elevated and formed no plateau, and subsequent erosion, as the Ohio river is approached, has been more and more active, until in the immediate vicinity of the river the pleneplain is recognized with difficulty. The conditions north of the Ohio river are at present entirely unknown, and the only suggestion the present writers can offer is that probably the two peneplains gradually approach each other in that direction until they practically coincide.

About the southern margin of the province the elevation between the two periods of baseleveling was so slight that the rocks have been practically exposed to baselevel conditions from nearly the beginning of Cretaceous to Neocene time, and as a result are deeply decayed and but poorly preserve the records of the past. In the Coosa valley the Tertiary peneplain is generally distinguishable, although subsequent erosion has cut deeply into its surface and, owing to the decay of the rocks, has reduced the least resistant members to a still lower baselevel—that at which the present streams of the region are flowing. Continuing eastward, the vertical interval between the Cretaceous and Tertiary baselevels decreases and in the vicinity of Atlanta they practically coincide, so that the recognition of the two peneplains is almost impossible. The streams have not cut below the old peneplains in their upper courses and the tributaries of the Chattahoochee and Tallapoosa rivers still flow upon the surface of the Cretaceous peneplain.

On the southeastern margin of the province, throughout the piedmont plain, the Tertiary peneplain is well developed and only occasional monadnocks show the position of the Cretaceous plain. Although crystalline rocks are generally regarded as offering great resistance to erosion, they are, under baseleveling conditions, subject to very deep decay and probably at the close of the Cretaceous cycle were softened to a far greater depth than at the present time. As the elevation succeeding the Cretaceous period of baseleveling was not great, the streams quickly swept away this mantle of residual material down to baselevel. Under such conditions the Tertiary peneplain was very perfectly developed throughout the whole of the piedmont plain. The subsequent erosion of this peneplain has been comparatively slight and in many parts, especially in the vicinity of the James and Potomac rivers, it is almost perfectly preserved.

Interior Valley Type.—As stated above, this period was not sufficiently long for hard rocks to be reduced except under peculiarly favorable conditions. In the interior of the province only areas of limestone and shale were lowered to the newly established baselevel. These rocks formed the surface chiefly in the zone of folded rocks known as the Appalachian valley. Upon the elevation of the region the streams sank their channels mainly within these belts of easily erodible rocks, although in some cases their wanderings during the preceding period of baseleveling had led them across hard rocks upon which they thus became superimposed. The greatly stimulated erosion rapidly reduced the soft rocks to baselevel in the immediate vicinity of the large streams; the valleys were broadened until checked by hard rocks which remained at the level of the old peneplain, either as the valley ridges, the plateaus upon the west, or the present mountain valleys upon the east. This removal of the soft rocks progressed well toward the head branches of most of the rivers within the Appalachian valley. In many cases the divides between adjacent river basins were almost perfectly baseleveled, though in some cases (explained in Part II of this paper) the present divides were then crossed by large streams whose courses were subsequently changed. The Shenandoah valley may be taken as the type of this portion of the Tertiary peneplain. Its level floor, cut in the soft limestone and shale, is abruptly terminated on either side by steep slopes, composed of more resistant strata. The divide between the

Shenandoah and James is but little higher or narrower than the valleys themselves. The same is true of the divides between the James and Roanoke and the Roanoke and New rivers, and their valleys are almost as perfectly baseleveled as that of the Shenandoah. In the southern portion of the Appalachian valley the great Cambro-Silurian limestone becomes very silicious and its surface was less perfectly reduced than in Virginia. Many rounded ridges of residual chert reach slightly above the level of the Tertiary peneplain, even in the vicinity of the larger streams. The amount of the erosion, however, was even greater than on the Shenandoah and James, for the valley in eastern Tennessee and northwestern Georgia is considerably wider than in northern Virginia. In the New-Kanawha basin the Tertiary peneplain was extensively developed; conditions of erosion appear to have been exceptionally favorable, for not only limestones but considerable areas of sandstone and shales were very completely reduced. Owing to subsequent elevation this Tertiary plain now forms a plateau 2,500 feet above sealevel and the present streams have cut their channels 1,500 feet or more below its surface. The altitude of the peneplain decreases rapidly westward and in the valley of the Ohio corresponds with the highest bluffs, below which the river has sunk its bed from 400 to 700 feet.

Plate 6 shows the portions of the surface not reduced to the Tertiary baselevel, and from it more easily than from descriptions may be obtained a general idea of the physiography of the Tertiary peneplain at the end of this baseleveling process. These areas are seen to be very extensive on both sides of the Appalachian valley, while only the narrow ridges remain within the latter. The area unreduced to baselevel during this period is in round numbers 45,000 square miles, and the ratio of this area to that of the entire province then above sealevel is 1 : 4.7. During the Cretaceous baseleveling, on the other hand, the unreduced portion is only 8,700 square miles and its ratio to the then existing province 1 : 22.

A comparison of these ratios affords some idea of the relative duration of the two periods. The reduction of a surface to baselevel, however, does not vary directly as the time, but rather as some highly complex function of the time, being a process which decreases in its rate as it approaches completion. Hence the comparative duration of the two periods cannot be determined without considering other factors whose values are at present unknown. Nevertheless, it seems probable that the earlier period was at least eight or ten times as long as the later one.

DEFORMATION OF THE TERTIARY PENEPLAIN.

Although the second peneplain was less perfectly developed than the first, it has been more perfectly preserved, and so can be reconstructed with even greater certainty. The same plan of representation has been pursued as in the case of the Cretaceous peneplain, and the deformed surface is represented by contour lines with an interval of 200 feet; also similar qualifications should be made here as in the case of the map representing the Cretaceous peneplain. Not all parts are equally reliable by reason of differences both in degree of baseleveling and also in the quality of maps and other data upon which it is based.

The deformation is somewhat exaggerated, especially in the interior of the province, for the gradient of the baseleveled valleys has not been taken into account. This gradient varies with the size of the stream, but present knowledge of baselevel conditions is not sufficient to warrant definite statements as to the altitude of the baselevel in the interior. Probably the error in determining the altitude of the peneplain at any point is greater than the error introduced by neglecting its gradient.

The contours in plate 5 represent the algebraic sum of all movements which have affected the province since the completion of the Cretaceous peneplain, while the contours in plate 6 represent movements which have occurred since the close of the Tertiary period of baseleveling; hence the contours of plate 5 represent all the deformation expressed in plate 6 plus the deformation occurring between the two periods of quiescence. The amount of this intermediate deformation or the vertical distance between the two baselevels at any point may be found by subtracting altitudes indicated by the contours on plate 6 from those on plate 5.

The character of the orogenic activity which followed the comparatively long period of Tertiary quiet is much better known than that which followed the longer Cretaceous period. It is much nearer the present than the latter, and the evidence for deciphering its history has not yet been obliterated. Part of this evidence consists of modified physiographic forms, but the larger portion is found in the sediments deposited around the seaward margin of the province. We are largely indebted to

McGee for their interpretation and the determination of their bearing on Appalachian history. The conclusions will be stated briefly without attempting to give the evidence on which they are based, although some of it is contained a subsequent page.

The series of oscillations occurring since the close of the Tertiary period of baseleveling consists, first, of a depression which allowed the waters of the ocean and the Mississippi embayment to advance inward far beyond their previous margin.* Following this came an elevation of the entire province that again started the streams in a career of great activity, and the sea retreated probably beyond the present shoreline. These broad movements may properly be termed epeirogenic, as they affected the entire province, but in every case the movements culminated along certain axial lines and produced decided local or orogenic warping. In the subsidence the greatest depression was along the cross-axis *A B*, but in the subsequent elevation the greatest movement was along the main longitudinal axes. A period of comparative quiescence followed, during which the land stood somewhat higher than at present and much higher than during the Tertiary baseleveling period. It was during this interval that the rivers of the eastern coast carved their broad outer valleys, now almost completely submerged beneath the waters of the Atlantic, and the Mississippi corraded its broad valley from Cairo to the Gulf.

In very recent geologic time these oscillations have been repeated in the same order and with a similar effect. The land first subsided and the Columbia sediments were laid down; then it arose to its present position and the modern gorges mark the duration of the present high level attitude of the land.

INTERRELATIONS OF THE TWO PENEPLAINS.

The greatest divergence in altitude between the two deformed peneplains is in the northern portion of the province. This great pre-Tertiary elevation is somewhat dome-shaped and attains its maximum elevation of 2,400 feet about 30 miles northwest of Harrisonburg, Virginia; from this point it descends quite rapidly in all directions, but shows a partial agreement with the axes *C D* and *E F* (plate 5). Toward the west the actual coincidence of the two plains cannot be determined, but they appear

*The Lafayette Formation, by W J McGee: 12th Ann. Rep. U. S. Geol. Survey, 1890–'91, pp. 508, 509.

to be within 200 feet of each other in the vicinity of West Union, forty miles east of Parkersburg, West Virginia. On the eastern margin of the province the upper peneplain is completely obliterated, but the two probably coincide in the vicinity of Richmond, Virginia. Along the axes the descent was much less rapid. On the Pennsylvania line the uplift probably did not exceed 1,200 feet, while toward the southwest, along the axis *E F* (plate 5), it extended certainly as far as the Tennessee line. South of this line the uplifts were much more irregular and distributed over a broader area, so that their general effect has been to produce a broad fold extending from Greenville, South Carolina, to Nashville, Tennessee, and with an altitude not exceeding 1,000 feet. In this broad uplift can be traced several local orogenic disturbances, of which the uplift along the axis *O P* is quite prominent, but the greatest elevation occurred along the axis *G H* (plate 5). Many minor folds both of elevation and depression can be distinguished in this region, but their meaning is as yet obscure and we only know that they are intimately associated with the general warping of the surface of the province. In the vicinity of Atlanta the two baselevels are so near the same altitude that their peneplains cannot be discriminated, and the same is true along a line toward the northeast as far as Asheville. In the upper portion of the French Broad basin only one peneplain can be detected and it is ascribed to Cretaceous time. The streams have, however, barely sunk their channels through the mantle of disintegrated rock, although the present altitude of the region renders them extremely active. Westward from Asheville the two baselevels diverge under the influence of an uplift along the axis *G H* and indications of the two corresponding peneplains are found along the lower course of the French Broad river.

DISSECTION OF THE TERTIARY PENEPLAIN.

By far the larger part of the erosion of the Tertiary peneplain was accomplished during the period of high level which preceded the Columbia depression. The streams were greatly stimulated, and where the elevation was considerable they carved deep gorges along their lower courses, giving rise to the numerous bays and broad-mouthed rivers now indenting the Atlantic coast. The distance these gorges were cut toward the interior varies greatly, depending upon the elevation of the land and the character of the rocks. Where the uplift was considerable the streams cut narrow gorges in their rocky floors, but where the elevation was slight the valleys were widened and present more the appearance of corrasion under baseleveling conditions.

This broad dissection of the Tertiary peneplain is greatest in the southern portion of the province, for there the elevation was only sufficient for the streams to work upon the decayed rock and residual mantle which had accumulated during the preceding period. The streams were almost entirely occupied in broadening their valleys, so that in the Coosa-Alabama basin probably a third of the surface was removed during this period. After the Columbia depression this region was once more elevated and the streams have deeply trenched their broad valleys. In the vicinity of Chattanooga the Tennessee river has lowered its channel but 250 feet below the Tertiary peneplain, and this has been accomplished gradually, for the contours are generally flowing and well rounded, except where the river cuts some unusually hard stratum. Throughout the basin of the Tennessee river northeast of Chattanooga the amount of cutting is variable, depending upon the amount of deformation of the peneplain. Streams located upon the axes of maximum elevation were stimulated to a high degree of activity, while those located between such axes in areas of minimum uplift received only a moderate acceleration. The Clinch and Holston rivers show in a striking manner the effect of the warping on the erosion of the peneplain. The upper Clinch is located upon the axis *K L*, plate 6, and has cut a canyon from 500 to 700 feet deep through the limestones and calcareous shales, with slopes as steep as such material will stand. In striking contrast with this is the broad open valley of the Holston, located in an area of minimum elevation between the axes *K L* and *M N* and about twenty miles southeastward of the Clinch river.

The great gorges cut in the Tertiary peneplain in the New-Kanawha basin have been referred to. They indicate clearly that the conditions which prevailed here in post-Tertiary time have been different from those in any other portion of the province. The uplift which elevated the Tertiary peneplain to an altitude of 2,500 feet, as shown in plate 6, was confined almost entirely to the axis *K L*. This axis crosses the river in its lower course, but the river had sufficient volume to hold its antecedent position across the rising fold. In doing so it has cut a narrow, rugged gorge 1,500 feet deep, and is still actively corrading its channel. The movement along the axis must have been practically continuous from the completion of the Tertiary peneplain down to the present.

The region northeast of New river, in which rise branches of the Potomac, the James, the Kanawha and the Monongahela, has probably been an area of continuous uplift during every period of orogenic activity affecting the province. The Cretaceous peneplain, of which only a few doubtful remnants exist, was elevated at least 2,400 feet and Tertiary erosion was proportionally stimulated. It succeeded, however, only in reducing to baselevel and slightly broadening the valleys of the larger streams. A post-Tertiary elevation of 1,600 feet has renewed their activity, so that it has been continued with scarcely a pause from the close of the Cretaceous period down to the present.

The result of this almost continuous downward stream cutting has been to produce the most sharply cut region in the Appalachian province. The slopes are steep and generally uniform from the highest points, which may represent the surface of the earlier peneplain, down to the present streams, with only an occasional trace of terracing to mark the Tertiary baselevel.

The elevation of the Tertiary peneplain along the eastern border of the province has been only moderate, and the streams have accomplished correspondingly little erosion upon its surface. The Roanoke, the James and the Potomac have cut rather narrow and shallow valleys across the piedmont plain. These become shallow gorges in the broad baseleveled valleys west of the Blue ridge.

RELATIVE DATES OF THE OROGENIC MOVEMENTS.

Before closing this portion of the paper it is perhaps advisable to review hastily, as far as the evidence will admit, the succession of oscillations in post-Paleozoic time. As already stated, the determination of the character of these movements is one of the most important results derived from this study, since the entire physiography of the region, including the arrangement of its drainage systems, has been modified to a great extent by them.

Movements in the Tertiary Cycle.—It is not advisable at present to go farther back in geologic time than to the close of the Cretaceous period of baseleveling, although there are traces of simsimilar movements in the preceding ages of post-Paleozoic time.

In one portion of the province only has the elevation since then been practically continuous. This is in northern Virginia and West Virginia and, as shown in plate 5, exhibits an aggregate uplift since the completion of the Cretaceous peneplain of 4,000 feet. During the Tertiary baseleveling this region was necessarily free from movement, but at no other time does there seem to have been a complete cessation of the uplift. The axes along which it culminated in pre-Tertiary time are *C D* and *E F* (plate 5). While the movement along these axes occurred synchronously and at their maximum reached the same elevation, the deformation on the two was quite different. Along the axis *C D* it extended but little south of the Kanawha river, while in the opposite direction it passed into Pennsylvania, extending probably half way across that state. Along the axis *E F* the elevation reached only a little north of the Potomac, but continued in the other direction as far as Tennessee. These axes are arranged *en echelon* and the maximum elevation occurred at the point of overlap. Some time during this period the uplift extended southwestward along the axis *E F*, but only sufficient to raise a low swell a few hundred feet in altitude. This is quite intimately connected with a later uplift along the same line and probably occurred late in the interval between the two periods of baseleveling.

It seems probable that an uplift took place in the Smoky mountain region quite early in this epoch, its axis coinciding approximately with the state line between Tennessee and North Carolina. The reason for assigning this movement to the early part of the epoch is that there are traces of an uplift along this same line in pre-Cretaceous time, and probably the later uplift was but the continuation of the earlier, following immediately the Cretaceous period of quiescence. This late uplift increased toward the northeast, reaching 1,200 feet on the southern line of Virginia.

Some movement occurred along the Hatteras axis during this epoch, reaching its maximum elevation on the northwestern side of the province near the Ohio river. The longitudinal uplift of the Great Smoky mountain region terminated at this transverse line, and their combined forces caused a pronounced dome-shaped elevation in the Cretaceous peneplain.

An uplift occurred at the beginning of this epoch along the axis *O P*, reaching a maximum near Chattanooga, from which it descended rapidly toward the south and gradually toward the north. The continuation of the axis *O P* beyond the Ohio river is quite uncertain, but it probably extended far into Ohio and there may have been within that state a development of the fold similar to the one near Chattanooga.

Besides these axes of elevation there are several along which depression occurred during this interval. These depressions were not pronounced, but sufficient to vary the altitude of the Cretaceous peneplain from 100 to 400 feet. One of these is located between and parallel with the axes *E F* and *G H* (plate 5); another is the axis *A B*, along which some movement occurred at this time; and the third probably connected these, lying east of and parallel with the axis *O P*. There is no evidence in the physiography of the region to show when these were active, but a careful study of the costal-plain sediments will probably determine the question.

Movements in the present Cycle.—One of the most pronounced movements connected with the close of the Tertiary baseleveling was subsidence along the axis *A B* (plate 6). This, as described later, occurred during the deposition of the Lafayette formation. After this depression there came a period of apparent quiescence, during which no movement is recorded along this line. In the time of the Columbia depression this axis was affected in a manner similar to the Lafayette depression.

Uplift along the axis *K L* (plate 6) occurred soon after the general elevation of the land following the Lafayette depression. The uplift increased from the Tennessee river in Alabama, reaching a maximum of 2,600 feet at the Virginia-West Virginia line south of New river. From this point it gradually decreased northward, passing into Pennsylvania with a probable altitude of 1,500 feet. As before stated, the northern portion of this uplift has been practically continuous, but the southern portion has probably been intermittent in its activity.

Early in the present cycle an uplift occurred along the northern end of the axis *M N*, and this seems to have been connected with movement along the eastern portion of the Hatteras axis. According to McGee, the Hatteras axis, from Roanoke to the coast, has been the seat of activity since Eocene time. Its influence is shown on plate 6, in the eastward trend of the axis *M N* at its northern extremity and the outward swelling of the contour lines. About the middle of the present cycle the uplift extended southwestward along the axis *M N*, so that in very recent geologic time the Tertiary peneplain from Asheville to Atlanta and southwestward has been elevated to its present position.

Movements have occurred along some minor axes chiefly of subsidence, but their exact date cannot be fixed.

The latest movements which can be detected in the province are along the axes *K L* and *O P*. That along *K L* has resulted in a slight ponding of the Tennessee river in the vicinity of Huntsville, Alabama, while the uplift along *O P* has affected the Cumberland river above point Burnside, Kentucky, in a similar manner.

Part II.—Drainage Development.

SUBDIVISIONS OF THE PROVINCE.

Geologically, and topographically as well, the southern Appalachian province falls into four well-marked divisions. These are (1) an eastern piedmont plain, sloping gently seaward and composed of metamorphic and crystalline rocks; (2) a montanic tract, embracing the Blue ridge and the Great Smoky range with its many outliers and containing chiefly crystalline rocks with sediments which have undergone various degrees of metamorphism; (3) a central broad valley with numerous parallel ridges of Paleozoic sediments; (4) a western dissected plateau of upper Silurian and Carboniferous rocks.

OUTLINE OF THE PRESENT DRAINAGE.

In the northern portion of the province the water parting between the Atlantic and Gulf drainage is westward of the Appalachian valley. The Potomac heads upon the edge of the plateau and flows eastward across the Appalachian valley, the montanic tract and the piedmont plain. From the western point of Maryland the divide passes nearly due southward, crossing the Appalachian valley diagonally, so that the James and Roanoke drain only the eastern part of the valley, but, like the Potomac, flow eastward across the montanic tract and the piedmont plain. South of these streams the divide follows near the eastern margin of the montanic tract to its southern extremity, only the eastern slope being drained by streams crossing the piedmont plain toward the southeast. The westward-flowing streams in the northern portion of the province drain only the plateau region. Farther southward New river heads well toward the eastern side of the montanic tract and flows northwestward across the Appalachian valley and the plateau to the Ohio. Between New river and the Tennessee-Georgia line most of the montanic tract and the Appalachian valley are in the drainage basin of the Tennessee, whose many branches flow northwestward across the former region and southwestward within the latter to Chattanooga, where the river turns abruptly and enters the plateau region. It crosses first the Walden plateau through a deep canyon, and after flowing seventy miles in Browns valley, parallel to its former course, again enters the plateau and flows northwestward to the northeastern corner of Mississippi, the margin of the former Mississippi embayment. Here it makes another abrupt change in its course, flowing directly northward to the Ohio. South of the Tennessee-Georgia line the Appalachian valley, with the adjacent portions of the montanic tract, are drained by the Coosa-Alabama river, which flows directly to the Gulf. The greater part of the plateau region lying between the New-Kanawha and Tennessee rivers is drained toward the northwest by streams flowing into the Ohio. The most important of these are the Kentucky and Cumberland.

CLASSIFICATION OF DRAINAGE.

Applying to the streams of the southern Appalachian province the accepted principles of classification, representatives of all the main divisions are found.

A few show indications of following, in part at least, antecedent courses in which they have persisted through all the vicissitudes the region has suffered. The most striking example of this class is perhaps the New-Kanawha, which seems to hold the course occupied antecedent to the development of the present structure of the region. To the same class belong probably the eastern tributaries of the Tennessee and Alabama systems which cross the montanic tract from its eastern border northwestward to the Appalachian valley; also the streams of the plateau flowing into the Ohio river may be placed in this, although there are some grounds for placing them in the next class.

A few of the streams are directly consequent upon the structure of the region, flowing in synclines where their position has been determined by the flexures of the strata. To this class belong portions of the Tennessee and Coosa tributaries, generally rather small streams which in the process of drainage adjustment have been robbed of the greater part of their original basins by others more favorably situated.

Many of the stream courses are directly dependent upon the structure, but occupy positions which they have acquired by a process of adjustment subsequent to the deformation of the surface. This class of maturely adjusted subsequent streams includes most of those within the area of folded rocks of the Appalachian valley.. Their courses are on or near the axes of anticlines, positions manifestly impossible in early stages of the folding or before a long process of adjustment had taken place.

A few streams show superimposition, probably not from a superjacent horizontal terrane, but by wandering during the later stages of a very complete baseleveling period. Examples of this are seen in the course of the Clinch river where it crosses Lone mountain, and of the Ocoee where it crosses the point of Beans mountain.

Finally some streams appear to have become adjusted to certain past conditions of slope and baselevel, so that their courses are not such as they would seek under the influence of conditions now existing. A most striking example of such an anomalous course is that of the Tennessee river. Portions of it may be regarded as inherited from conditions to which they were adjusted in the past, but which have wholly or in part disappeared.

By a study of the drainage, especially streams of the latter class, a tolerably definite idea of these conditions may be reached. The present river courses indicate the changes in altitude and attitude which have taken place within recent geologic epochs. The history of the same period, interpreted from the topographic features of the province, has been presented in Part I. Evidence was found of an almost continuous succession of orogenic oscillations, separated by well marked epochs of tranquillity. These periods, both of tranquillity and orogenic activity, have left an unmistakable impression upon the topography, and it seems reasonable to suppose that they should have produced an equally marked effect upon the drainage. There is a third method of interpreting this history, which until recent years has been considered the only one available; this consists of a study of the sediments derived from the waste of the land during the interval and deposited as a fringe around its margin.

That the conclusions reached by these three methods of investigation should agree is manifest, and our confidence in them may be in proportion to their concordance. It remains to be seen whether the conclusions already reached can be verified by the study of the drainage and by the sediments deposited in the surrounding seas.

CYCLES OF DRAINAGE DEVELOPMENT.

The evolution of the drainage of this region began with the earliest emergence of Paleozoic sediments from the sea and the consequent increase of the eastern continental area toward the west. This process of emergence is believed to have begun in Cambrian time and to have continued at intervals to the close of the Carboniferous. The character of the drainage is much better known since the final emergence of the entire province than during Paleozoic time. Its modifications can be traced much more definitely because the surrounding conditions are better understood, and hence the history of the drainage development which can be read with any degree of certainty may be considered as beginning with the close of Paleozoic time. This development has not been a continuous process, but has been at times rapid, and then again for long periods almost stationary. This recurrence of similar conditions in the life history of a river may be termed cycles of drainage development. First comes a general elevation of its drainage basin, by which the stream is rejuvenated. The elevation ceasing, the stream in the course of long ages accomplishes its life-work and sinks into the sluggish inactivity of old age. This is followed by an uplift and the cycle of events is repeated.

Two such cycles are represented on the accompanying diagram, figure 1. The heavy line represents the position of the surface with reference to present sealevel, and hence its changes in altitude, by the slow process of degradation and the more rapid process of orogenic movement. The horizontal spaces are roughly proportional to the duration of the periods which constitute a cycle. The first of these cycles was extremely long, reaching from the final emergence of the western half of the province to near the close of the Cretaceous period. It includes the most extensive period of baseleveling known to have affected this

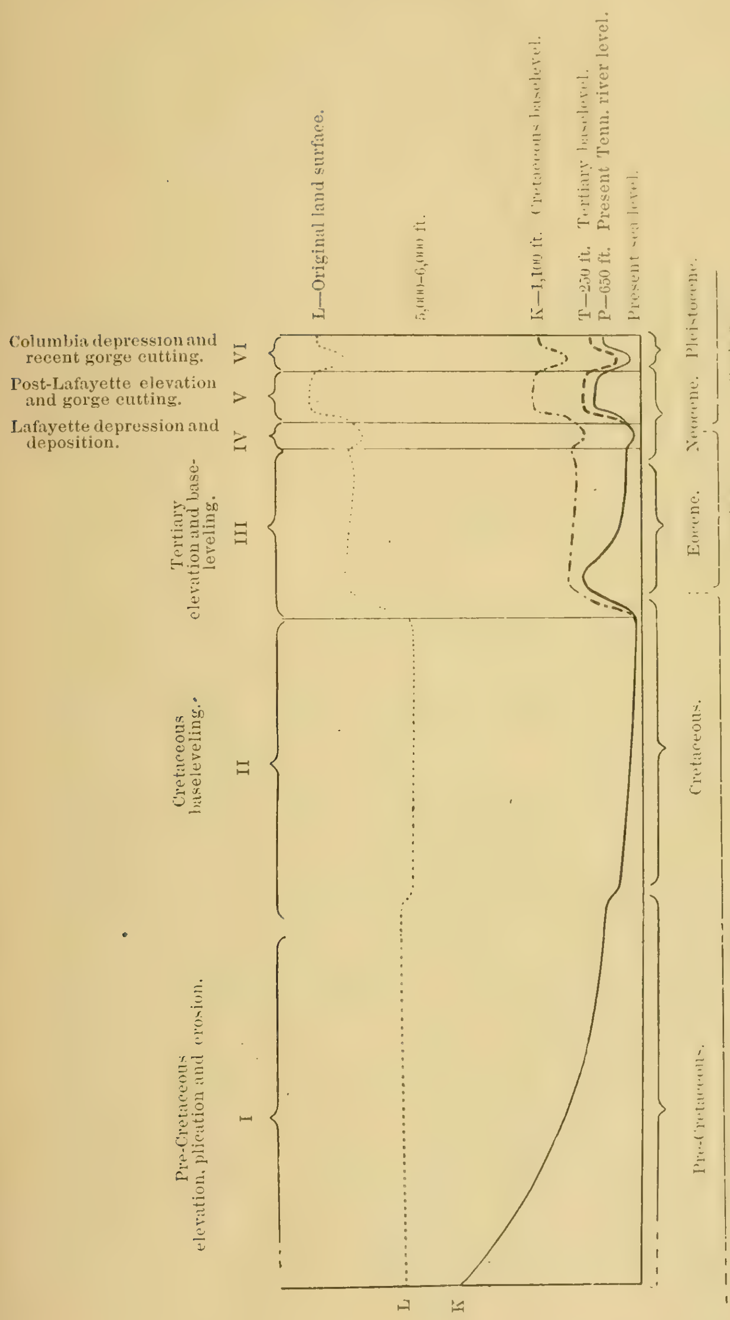


FIGURE 1.—*Diagram showing the Oscillations of the land Surface at Chattanooga, Tennessee, and Cycles of drainage Development.*

region. The second cycle was much shorter, but the time was sufficient for the warping of the Cretaceous peneplain and the reduction of considerable portions of its surface to a second baselevel. The region has barely entered upon its third cycle, which has thus far been a period of elevation and active erosion, and a peneplain is again in process of formation.

CONDITIONS PRECEDING CYCLE 1.

Present knowledge of the physiography of the Appalachian province prior to the beginning of this cycle is extremely vague; but the conditions which then prevailed are so intimately connected with the subsequent drainage, having determined the location of the ancestors of the present streams, that they should briefly be considered. As far back as the history of the province can be traced, from near the beginning of Paleozoic time, a continental land area existed to the eastward of the present Appalachian valley. How far this land extended eastward is not known with any certainty, but it probably reached somewhat beyond the present Atlantic coast line. The process is not well understood by which the land included in the present Appalachian valley was added to this old continent. It has been generally supposed that the folding of the region and its elevation above sealevel occurred wholly in post-Carboniferous time. Recent investigations, however, afford ground for the theory that folding occurred at various epochs in the Paleozoic, and that during many of these periods of folding the land area was materially increased and the coast line of the interior sea was pushed further and further westward.

Streams flowing westward from the portion of the continent now included in the southern Appalachian province bore down the materials eroded from the land and spread them out over the bottom of the Paleozoic sea. These rivers were certainly the early representatives of the present streams and a few may have persisted in their original courses to the present. The effect upon these streams of the additions to the land area was probably less marked in the northern than in the southern portion of the province. Thus in northern Virginia the drainage was westward, though by what stream or streams is not known, from the time of the first emergence of Paleozoic sediments until the entire province was raised above sealevel; in central Virginia the New-Kanawha occupied much the same position as at present; while farther southward some axial drainage may have been developed before the beginning of cycle 1, as defined above. This axial drainage was at first consequent upon the folded surface and afterward became subsequent by the process of stream adjustment, but how far the process had gone previous to the beginning of cycle 1 is not known.

1.—CRETACEOUS CYCLE.

In the post-Paleozoic history of stream development the first cycle was long and complex—probably very much longer than all the time which has elapsed since its conclusion. It began with the final emergence of the western part of the Appalachian region above sealevel, near the close of the Carboniferous, and ended with the production of the Cretaceous baselevel peneplain which has already been described in Part I. It covered a period of elevation, deformation and erosion, but the products of this erosion were carried far beyond the margin of the sea as located in succeeding epochs and deeply buried beneath the later sediments; hence we are deprived of the evidence which might be afforded by the character of the material, as to the relative elevation and slope of the land. It is not known how many partial peneplains may have been formed during this time, but it is inferred that it was in general a period of rapid degradation and correspondingly rapid sedimentation.

As stated above, little is known of the process by which the Appalachian valley and the western portion of the province was added to the Paleozoic continent—whether the folding and emergence took place at the same or at different periods. If the corrugation was extremely slow the larger streams may have been and probably were able to cut their channels through the rising folds and for a long time hold their original or antecedent courses toward the northwest. On the other hand, if the folds rose rapidly the streams must have been ponded and most of them diverted to entirely new courses in the synclines; but by the process of river adjustment the final result would be the same in either case. The difference would be that if the folding were very slow the drainage would be first *antecedent* and then subsequent, while if it were rapid it would be first *consequent* and then subsequent. Since there is no evidence in this region, so far as known, that lakes formed by corrugation ever existed, only the first hypothesis—that of slow and long-continued folding—need be considered. Local diversion of small streams may very likely have taken place by folding, but the drainage at the close of the Cretaceous cycle was essentially the result of spontaneous adjustment of the streams to the structure surface revealed by erosion. The chief difficulty in deciphering the record of this drainage development is to determine how much of the adjustment took place within this cycle and how much before its beginning.

Drainage of northern Virginia.—In the northern portion of the province the main streams held their westward courses across the rising folds and found an outlet in the shrinking mediterranean sea. At some time during the early part of the cycle a depression occurred in the present piedmont plain, in which the Newark sediments were subsequently deposited. This depression was different from the purely Appalachian type of synclinal fold, more nearly resembling those uplifts described in Part I—slight orogenic movements by which the surface was somewhat broadly arched or depressed, but unaccompanied by any perceptible folding of the rocks. This eastward tilting produced a decided effect upon the drainage of the northern portion of the province. The headwaters of the former streams were soon reversed by the pronounced eastward slope and the divides were forced back some distance from the margin of the Newark sea. Thus the Potomac, the James and the Roanoke had their birth in the subsidence which preceded the deposition of the Newark formation, and presumably in the very earliest stages of this cycle. The influence of this eastward tilting evidently diminished toward the south, for the Potomac drains more of the Appalachian valley than the James, and the James more than the Roanoke, while the New-Kanawha holds its original westward course, unaffected by any tilting which may have occurred about its headwaters.

Drainage of the southern Appalachian Valley.—South of the New-Kanawha basin the main streams also doubtless persisted across the rising folds for a short time after the beginning of the cycle, although in this region the chances of diversion to synclinal troughs were much greater than farther northward, even with extremely slow folding. As soon as the folds had risen sufficiently high so that erosion upon their flanks and summits became active and beds of varying hardness were exposed, southward flowing axial streams, aided by the general southward pitch of the axes, began a career of conquest and the original streams were successively diverted to southern courses. There are indications in the extreme southern portion of the province that the drainage was more immediately turned to and longer held in consequent courses by the folding than elsewhere. This may have been due to the occurrence of broad synclinal troughs whose axes have a decided southward pitch. There are at present a few synclinal streams in this region and during the Cretaceous cycle the number and size of such must have been considerably greater; but even here the drainage had probably become so far adjusted that the main streams had subsequent courses upon the anticlinal axes. In the central portion of the province the Cumberland river probably drained a portion of the Appalachian valley in southwestern Virginia, holding its antecedent course through Cumberland gap and flowing into the extreme end of the Mississippi embayment.

The conquest of axial over transverse streams progressed at a diminishing rate toward the northeast as far as the New-Kanawha, which had sunk its antecedent channel sufficiently deep for its own protection.

Thus at the close of the cycle nearly the whole of the Appalachian valley southward from the New-Kanawha constituted a single drainage system whose main trunk was a large river flowing southwestward into the Cretaceous sea and occupying very nearly the present position of the Coosa river. The present writers propose the name Appalachian river for this Mesozoic stream, since it was almost entirely limited to the Appalachian valley and drained more than half the area of the valley within this province.

Drainage of central Kentucky and Tennessee.—In most of the region west of the Appalachian river basin the strata are so nearly horizontal that stream adjustment produced but little modification in the original drainage. The rivers of central Kentucky and Tennessee have shifted their channels under the influence of more recent surface warping, but at the close of the Cretaceous cycle they probably flowed directly down a gently sloping surface toward the Mississippi embayment. Many of them were the beheaded lower courses of those streams which originally flowed from the highlands on the east, but had been robbed of their upper drainage basins by the subsequent Appalachian river.

Drainage of the Sequatchie Anticline.—The Walden plateau syncline must originally have been occupied by a consequent southward flowing stream, since the axis pitches in that direction and the fold reached the margin of the Cretaceous sea. The lower portion of this stream still holds its original position and is now the Black Warrior river.

West of Walden plateau the Sequatchie anticlinal fold brought soft limestones above the Cretaceous baselevel and so afforded ample opportunity for stream adjustment to act. That the Walden synclinal stream did not migrate westward to the anticlinal axis was probably due to the southward pitch of the latter in northern Alabama by which the hard Carboniferous conglomerate was brought down to baselevel around the point of the anticline; but a stream flowing northwestward in nearly the position of the present Tennessee appears to have been able to capture the drainage of the Sequatchie anticline at some time during the Cretaceous cycle. It is quite possible that the southern portion of the anticline now forming Browns valley was for a time in the Black Warrior drainage; but that the westward diversion occurred rather early in the cycle is apparent from the imperfect development of the Cretaceous peneplain about its southwestern end, where a subsequent stream flowing into the Black Warrior must have escaped from the anticline, while, on the other hand, the country was very perfectly reduced to baselevel in the vicinity of the present westward outlet. It was shown in Part I that the axis *A B*, plate 5, has been the locus of oscillations from very remote geologic time down nearly to the present, and it appears probable that the location of the diverting stream was determined by this axis. The altitude of the Cretaceous peneplain relative to the geologic structure shows that this was a zone of relative elevation during a portion at least of the cycle, and consequently was a line of weakness which erosion would most readily follow, since the soft limestone was there brought nearest the surface.

At the close of the first cycle, then, the whole province, except the few residual areas shown on plate 5, was reduced to an almost featureless plain, over which the streams, as sketched above, flowed with sluggish currents in meandering courses. Their transporting power was greatly diminished, so that the land was being degraded almost wholly by solution and the surface was covered by a heavy mantle of residual material, resulting from a long period of subaerial rock decay. The divides were low, slopes gentle, and the drainage systems delicately adjusted among themselves.

2.—TERTIARY CYCLE.

The first cycle was brought to a close and the second cycle inaugurated by an uplift of the province. As explained in Part I, the maximum uplift was along certain axial lines which produced a warping of the previously formed peneplain. The first effect of elevation was to revive the streams, so that they began active erosion of their channels. If the uplift had been uniform over the province the streams would simply have persisted in their old courses, but the warping gave some streams a decided advantage over others and the process of adjustment to new conditions produced some decided changes in the drainage. Owing to the delicate interadjustment which the streams had reached during the preceding long period of baseleveling, they were peculiarly susceptible to change, and the first slight warping, after the baseleveling, was productive of greater changes than that which occurred later.

Effects of Uplift on the Axis O P.—The first decided movement at the beginning of this second cycle appears to have taken place along the axis *O P*, shown on plate 5. The effect which it produced upon the drainage had so direct a bearing on the subsequent diversion of the Appalachian river to the present course of the Tennessee that a somewhat detailed account of its effects will be given.

It must be borne in mind that at the beginning of this cycle the most of the Appalachian valley was occupied by southward flowing streams, which discharged their waters directly into the Cretaceous sea; that the Sand mountain syncline south of the Tennessee gorge was occupied by a consequent stream also flowing southwestward to the Cretaceous sea, and that the Sequatchie anticline was held by a subsequent stream flowing, in its lower course, northwestward to the Mississippi embayment. The Cumberland river was at the same time a vigorous stream, probably flowing nearly due westward along the present Kentucky-Tennessee line to the upper end of the Mississippi embayment. The plateau region was almost completely reduced to baselevel and the streams nicely balanced against each other. Under such conditions the slight uplift occurring along the line *O P* checked some streams and started others upon careers of conquest. Only the larger streams continued across the axis, and the courses of these were shifted by the uplift. Thus the axis became a well marked divide between eastward and westward flowing streams. It crossed the present Tennessee gorge about midway from Chattanooga to the Sequatchie valley and determined the position of the divide against which streams of the Appalachian and Sequatchie systems worked during the whole of the second cycle. Northward from the Tennessee gorge it diagonally crossed Walden plateau, the Sequatchie anticline and the Cumberland plateau to the western escarpment of the latter, diverting to the eastward Appalachian system the heads of many streams which had previously flowed westward. The uplift on this axis was greatest in the vicinity of Chattanooga, from which it decreased in either direction. Toward the north the pitch of the axis was quite rapid, producing a marked effect upon the course of the Cumberland river.

That stream, as stated above, probably flowed due westward near the present Kentucky-Tennessee line. It was too large to be diverted eastward to the Appalachian system, but it was so checked by the rising fold that a tributary crossing the axis 50 miles further northward, where the uplift was less, had sufficient advantage over the main stream to carry off its headwaters to the more favorable position.

As indicated above and shown upon plate 4, the streams of Sand mountain south of the Tennessee gorge flow westward from the extreme eastern edge of the plateau and have cut deep notches in its western side, in some cases even beyond the center of the basin. In Walden ridge, a continuation of the same plateau north of the Tennessee gorge, all the streams flow eastward, heading in some cases only a few hundred yards from the western escarpment. These have cut deep notches in the eastern side of the plateau. This peculiar drainage is due chiefly to the axis of uplift $O\ P$, described above, but also in part to local conditions which continued from the preceding cycle. In the first place, the anticlinal valley west of the plateau was formed by a southward flowing stream, so that its southern portion was first excavated and erosion progressed toward the north; hence the streams flowing from the plateau into the southern part of the valley had lower outlets, and so cut more rapidly than those toward the north. East of this southern part of the plateau is an anticlinal and synclinal fold—Lookout valley and mountain—of which the latter was probably not reduced entirely to the Cretaceous baselevel, and hence afforded a protecting bulwark against erosion upon the eastern side of Sand mountain. North of the present Tennessee gorge the conditions were exactly reversed. The western side of the plateau was protected from erosion by the Sequatchie anticline, the eastern limb of which, composed of heavy conglomerate, had probably remained somewhat above the Cretaceous baselevel, turning the drainage eastward to the Appalachian rivers, whose valleys were rapidly lowered upon soft rocks early in the Tertiary cycle. These streams cut deep notches in the eastern side of the plateau as far south as Chattanooga, beyond which the eastern side was protected by the Lookout mountain syncline of hard sandstone, as already explained. As a result of these peculiar conditions the plateau was attacked by streams on both its eastern and western sides only within a strip a few miles broad, where the Tennessee river now crosses. Here deep notches were cut on opposite sides of the plateau and the capping sandstone removed on several lines entirely across. So long as the uplift on the axis *O P* continued the divide was held stationary and neither set of streams encroached upon the territory of the other, but the cols were reduced nearly to the valley level on either side, and the way thus prepared for the diversion of the Appalachian river, later in the cycle. The uplift along this axis probably continued with diminishing force through the first half of the Tertiary cycle or possibly longer. During the same period variable amounts of uplift occurred in other portions of the province, which was thus brought to an altitude from 100 to 1,000 feet higher than that held at the close of the Cretaceous cycle. Probably other stream adjustments similar to those described in the Chattanooga district were brought about by this unequal uplift; but in general the streams simply sank their channels below the surface of the peneplain, following the same courses as in the preceding cycle. Wherever these courses were located upon soft rocks the rivers were quickly lowered to the newly established baselevel and began to widen their channels, forming a second peneplain.

Condition of Drainage prior to the Lafayette Depression.—Thus toward the close of the Tertiary cycle the streams flowing westward had cut broad baselevel valleys, described in Part I, in the soft horizontal limestone of the plateau region and in some of the folded rocks immediately eastward. The greater part of the Sequatchie anticline had thus been reduced to a peneplain continuous with the more extensive one through the plateau to the westward. Cumberland river had cut deeply into the old Cretaceous peneplain and again baseleveled its valley in the soft limestones of the plateau region. It also probably baseleveled a small area of folded rocks in the Appalachian valley—the present basin of Powell river which then flowed westward through Cumberland gap. The New-Kanawha had cut an extensive peneplain in the Carboniferous limestone on the eastern side of the West Virginia coal field, and also in the folded Cambro-Silurian limestone of the valley region. The latter limestone is less soluble and homogeneous than the former, so that its outcrops were less perfectly reduced, forming a rolling surface instead of a level plain.

In the southeastern portion of the province the uplift of the Cretaceous peneplain was so slight that the streams were scarcely at all accelerated, and in the vicinity of Atlanta deepened their channels not more than 100 feet throughout the whole Tertiary cycle.

From the New-Kanawha southwestward to the margin of the Tertiary sea the Appalachian river and its tributaries had cut deeply into the Cretaceous peneplain and reduced all areas of soft rocks, more or less completely, to the new baselevel. The physiography of this Tertiary peneplain has already been described in some detail. The plain was very perfectly developed over areas of pure limestone, while silicious limestones, shales and sandstones formed a rolling surface or ridges of varying heights, in proportion to their induration or capacity for resisting erosion.

It seems probable that the great Appalachian river was formed by two main branches which flowed in nearly parallel courses to their junction west of Rome, Georgia. The western branch followed the present course of the Clinch and Tennessee to Chattanooga, and thence of the Chickamauga and Chattooga to the junction of the latter with the Coosa; the eastern branch followed the course of the Holston and continued southward from Knoxville along the base of the Great Smoky mountains to the Coosa at Rome, and thence to its junction with the western branch.

DIVERSION OF THE APPALACHIAN RIVER.

It is stated above that the drainage of the Appalachian valley was southwestward, from the New-Kanawha basin to the sea margin, until the close of the Tertiary baseleveling period. Since the date of diversion of this drainage is an extremely important point in the history of the region and since the above statement is liable to be questioned, the grounds on which it is based will be given in some detail. The evidence is derived from (1) the perfectly baseleveled divide between the Tennessee and Coosa river basins; (2) a comparison of the volume of material eroded from the Appalachian valley with that of the Tertiary sediments in central Alabama; and (3) the immaturity of the Tennessee gorge through the plateau below Chattanooga.

Evidence from the Coosa-Tennessee Divide.—As already stated, a peneplain, extending from the Cumberland plateau on the northwest to the Great Smoky mountains on the southeast, stretches from the head of the Holston and Clinch rivers to the edge of the Tertiary sediments in central Alabama. This peneplain is well shown in the photograph of the relief map of this region reproduced as plate 4. It is as perfectly developed across the Coosa-Tennessee divide as elsewhere, and shows no perceptible variation in the two basins except the gradual southward descent shown in plate 6 and due to subsequent differential elevation. It extends across the Appalachian valley from Pigeon mountain to the base of the Cohutta mountains, a distance of 40 miles, interrupted only by the valley ridges of hard sandstone or by low knobs of silicious Knox dolomite. Since the peneplain is developed only on soft rocks, it is possible that the divides might have been cut down to their present altitudes by backward erosion of headwaters while the streams occupied their present courses; but while the altitude of the divides is not conclusive evidence that the main streams have flowed across them, the breadth of the valley upon the divide materially strengthens the evidence. By the backward cutting of streams at their headwaters a characteristic dendritic, inosculating drainage is developed, and it seems improbable that the divides should have been maintained in their present position throughout the Tertiary cycle without producing this characteristic surface, which is conspicuously absent.

It should be remarked that while the writers formerly regarded the character of the divides between these drainage basins as conclusive evidence that large streams flowed across them until the close of the Tertiary period of baseleveling, they have recently found reasons for modifying this conclusion. A study of the divides between drainage basins throughout the Appalachian valley from Pennsylvania southward shows that most of them are quite perfectly reduced to the altitude of the Tertiary peneplain in adjacent basins, although not generally so broadly cut as the one in question. There is no reason, so far as known, for supposing that the divides between the Potomac and James or the James and Roanoke basins have shifted during the Tertiary cycle, yet they are nearly as inconspicuous as those between the Tennessee and Coosa. On the other hand, the divide between the New and Holston basins has the form of a narrow col, such as would be expected to characterize all long-maintained divides.

Evidence from the Volume of Material eroded and deposited.—The second line of evidence bearing on the date at which the Appalachian drainage was diverted to its present westward course is derived from a comparison of the volumes of Tertiary erosion and Tertiary sediments. It is comparatively easy to compute the volume of the material which was removed by the rivers during the Tertiary cycle, when the vertical distance between the previously existing peneplain and the one developed during the Tertiary cycle is known, together with their lateral extent; also a tolerably safe estimate may be made of the volume of sediments deposited by each of the rivers during the Tertiary cycle. If the drainage during the whole of the cycle was essentially as it is at present, then the volume of sediments which would naturally be deposited by the present streams and the volume of the material eroded by those streams should show a practical agreement. The formations laid down during the Tertiary cycle are regarded as including (1) the Ripley—sands and sandy clays overlying the Rotten limestone and marking the uplift which terminated the preceding cycle; (2) Lignitic; (3) Buhrstone; (4) Claiborne; (5) White limestone*—a series decreasing in coarseness and increasing in amount of calcareous

* The Tertiary and Cretaceous Strata of the Tuscaloosa, Tombigbee and Alabama Rivers, by Eugene A. Smith and Lawrence C. Johnson: U. S. Geological Survey, Washington, Bull. 43, 1887, 189 pp., 21 pls.

matter contained. The sediments brought down by a Tertiary stream, corresponding in location to the present Alabama river, were spread over the adjacent sea bottom, mingling on the east with the sediments brought down by the Chattahoochee and on the west with those brought down by the Tombigbee. It is probable that more sediment was brought down by the Alabama than by the streams on either side, since it occupies the axis of uplift where the greatest erosion took place. Hence if a line be drawn midway between the Alabama and Chattahooche on the east and between the Alabama and Tombigbee on the west the area included would certainly not be wider than the deposition area of the axial river. The area included by these lines and by the limits of the Ripley and White limestone formations is about 6,500 square miles. The thickness of the sediments in this area, down to the bottom of the Ripley, varies from 0 at the northern edge to 1,900 feet at the southern edge, and their volume is about 1,170 cubic miles; but these formations extend under the covering of later deposits, thinning out seaward, and while it is impossible to determine their extent or thickness in that direction, it seems a conservative estimate to regard the volume of the sediments in the seaward extension of the formations as equal to that of the actual outcrops. This estimate would make the volume of the sediments which may be attributed to the stream whose lower course occupied the present position of Alabama river during the Tertiary cycle about 2,340 cubic miles.

Turning now to the volume of material eroded from the Cretaceous peneplain during the Tertiary cycle by the Alabama and its tributaries, the basis for an estimate is somewhat better than in the case of the sediments. The greater part of the erosion has been in the valley of the Coosa and comparatively little in that of the Tallapoosa—first, because the vertical distance between the baselevels is greater in the former than the latter river basin, and, second, because the rocks are softer and hence have been more perfectly reduced. Throughout most of the Coosa basin the two peneplains are sufficiently well preserved so that a definite estimate can be made of the material removed during the Tertiary cycle. The amount of elevation and distortion which the Cretaceous peneplain suffered at the close of the Cretaceous cycle may be determined from a comparison of plates 5 and 6. It varies from 900 or 1,000 feet at the

Tennessee-Georgia line to 0 where the two plains coincide in southern Alabama. A careful estimate shows that the volume of material removed by the Alabama and all its tributaries during the Tertiary cycle is about 622 cubic miles. The great disparity between this and the volume of sediments laid down during this cycle by a river occupying the position of the Alabama leads us to seek farther for the source of the great mass of material. Manifestly this source is in the Appalachian valley north of the Coosa basin and at present drained by the Tennessee toward the northwest. The volume of material removed from the Tennessee basin above Chattanooga during the Tertiary cycle combined with that removed from the Alabama basin is about 2,500 cubic miles. Comparing this with the 2,340 cubic miles of sediments deposited during the Tertiary cycle by the Alabama river, the agreement is so close that the conclusion seems to be inevitable that the drainage of the Appalachian valley was southward until near the end of the Tertiary cycle.

Evidence from the Character of the Gorge below Chattanooga.—A third line of evidence bearing on the date at which the Appalachian drainage was diverted to its present westward course is derived from an examination of the Tennessee gorge below Chattanooga and a comparison of this gorge with other portions of the Tennessee valley formed under analogous conditions.

The winding course of the Tennessee river through Walden plateau has been considered as evidence that this portion of its course was determined during a period of baseleveling when the present summit of the plateau stood near sealevel; that with subsequent uplift the river continued to flow in its sinuous course, acquired under baselevel conditions, cutting its present gorge below the surface of the old peneplain. If this explanation of its winding course is correct, it follows either that the Tennessee is here flowing in an antecedent course or that it was diverted some time before the close of the Cretaceous cycle; but this conclusion is at variance with that reached by the two lines of evidence given above, as well as by a consideration of the gorge itself. The character of the gorge is shown on plate 4. Its sides are extremely steep from the cliffs at the plateau summit to the water's edge. In most places there is scarcely room for a wagon road between the abrupt slope and the river, and only a few narrow strips of flood-plain occur throughout its entire length. On the hypothesis of diversion in the Cretaceous cycle, the river has occupied this narrow gorge throughout the entire period during which the enormous erosion of the Appalachian valley was accomplished. That a peneplain should have been developed from 20 to 40 miles in breadth and from central Virginia to northern Georgia by the same river in the same time that the insignificant strips of flood-plain in the gorge were being cut is quite improbable. It is true, the conditions of erosion in the two cases were not the same. The Tertiary peneplain in the Appalachian valley is developed only on areas of soft rocks which are generally steeply inclined; but, even allowing the greatest possible weight to the different conditions of erosion, the discrepancy in amount of erosion requires some further explanation, if the time were the same in both cases.

While a direct comparison cannot be made between the Walden gorge and the upper Tennessee valley on account of difference in conditions, such a comparison can be made between the gorge and a valley in northern Alabama, extending from Scottsboro southwestward to the mouth of Flint river. A portion of it is shown on plate 4. It is nowhere less than six miles broad, and its floor is very regular, forming a portion of the Tertiary peneplain. The age of this valley is easily determined; it is carved in the Cretaceous peneplain; therefore it is more recent than the Cretaceous; it is continuous with the Tertiary peneplain, and hence was completed at the close of the Tertiary baseleveling period; and at the close of that period it was deserted by the stream which carved it. The conditions under which this valley was cut are practically the same as those now prevailing in the gorge through Walden plateau. In both cases the rocks are nearly horizontal, heavy sandstones capping the plateau, with easily erodible Carboniferous limestones beneath. Such conditions are highly favorable for rapid corrasion of a river channel. The sandstone cap is undermined and its débris rolls down and forms a talus on the lower slopes. The rate at which the cliffs recede depends largely on the rate at which the sandstone talus is removed from the slopes and the limestone is exposed to erosion. No conditions could be more favorable for this rapid removal of the protecting débris than those now present in the Walden gorge, where the base of the slope is washed by a stream competent to remove all talus from the cliffs above, the coarsest as well as the finest. Certainly the conditions in the gorge are fully as favorable as they were in the valley west of

Scottsboro when that was being cut, and the stream which flowed in that valley was probably smaller than the present Tennessee; therefore, if under the same conditions a smaller stream than the present Tennessee could cut so broad a valley as it did in northern Alabama during the Tertiary cycle, the conclusion seems inevitable that the present gorge through Walden plateau has been occupied a very much shorter time, and hence the Appalachian drainage was not diverted to its present westward course till after a part or the whole of the Tertiary cycle. The explanation of the manner in which the writers believe the present winding course of the Tennessee through the plateau was acquired will be given in describing the process by which the diversion was accomplished.

Conditions immediately preceding the Diversion.—During the rapid elevation which inaugurated the Tertiary cycle and the much slower uplift which occurred near the close of the baseleveling period, the land area was enlarged by the addition of successive narrow belts of newly emerged sediments. In most cases the streams pushed their way across these belts by the shortest line to tidewater. The stream draining the Sequatchie anticline flowed westward through the plateau of northern Alabama by the broad valley already described; from the mouth of Flint river its course coincided with that of the present Tennessee to the Mississippi line. From this point it flowed southwestward to the Mississippi embayment very nearly in the present position of Black river, crossing the Cretaceous sediments as they were exposed at the close of the Cretaceous cycle and the successive belts of Tertiary sediments as they slowly emerged during the latter part of the Tertiary cycle.

The Tertiary cycle was marked near its close by a depression which effectually stopped the baseleveling process. This depression was not uniform, but like the preceding elevation was accompanied by warping of the surface. As indicated by the contemporaneous sedimentation, the depression was very slight at the present Gulf coast, 25 feet more or less at Mobile, increasing northward to 650 feet or more on the Memphis-Charleston axis (*A B*, plate 6). Northward from this axis the depression decreased, passing into a pronounced uplift in the northern portion of the province. In other words, the southern portion of the province was tilted northward, decreasing its seaward gradient, while a portion at least of the interior was tilted southward, increasing its slope. There was also some warping on the lateral axis, so that the depression on *A B* was less in the Appalachian valley than on either side. As the first result of this depression, the sea, which had retreated beyond the present Gulf coast during the Tertiary, advanced past the inner limits of Tertiary and Cretaceous sediments, while the Mississippi embayment became a broad, shallow gulf and a portion of the Sequatchie valley a narrow tidal estuary. During this depression the Lafayette formation was deposited. The previously baseleveled streams, by the warping of the land, were accelerated in the interior and brought down vast quantities of detrital material which had accumulated during a long period of subaerial rock decay. This was spread out mantle-wise over the submerged border of the province and along the lower courses of the streams where their currents were checked. These gravels are found on the remnants of the Tertiary peneplain about Chattanooga, 250 feet above the present river; they are also found on the Tertiary peneplain in Sequatchie valley, 150 feet above the river, but so far as known they are entirely absent from the divide between the Tennessee and Coosa rivers. These gravels have the same character on both sides of Walden plateau, being composed of quartzite and vein quartz, of which the latter at least must have been brought from far to the eastward; therefore it appears certain that the Appalachian drainage was diverted from the present Tennessee-Coosa divide westward to its present course through the Walden gorge very early in the period of Lafayette depression. Following this period of depression came one of uplift, when the streams of the province were stimulated to renewed activity and began cutting the present river channels. That the Appalachian drainage was diverted to its present course before this uplift is quite certain, for no channels are cut in the Tertiary peneplain across the Coosa-Tennessee divide.

Manner in which the Diversion was accomplished.—Having fixed its date in geologic time with a fair degree of certainty, the process by which the diversion was effected may now be described in detail. The conditions which prevailed in the region between Chattanooga and Sequatchie valley during the Tertiary cycle have been already described. With the uplift at the beginning of that cycle the main southward flowing streams rapidly sank their channels on the soft limestone, while their tributaries began an active contest for the intervening territory. The axial uplift on the line *O P* determined the location of the divide between the contending streams and held it stationary for a long time, neutralizing the advantage which local conditions would have given one or the other system and preventing consequent encroachment.

Figure 2 represents a restoration of the drainage as it probably existed when the Tertiary cycle was well advanced. The present course of the Tennessee river is represented by broken lines and the present relief by dotted contours. A rather large tributary, *M M*, joined the Sequatchie where that river now joins the Ten-

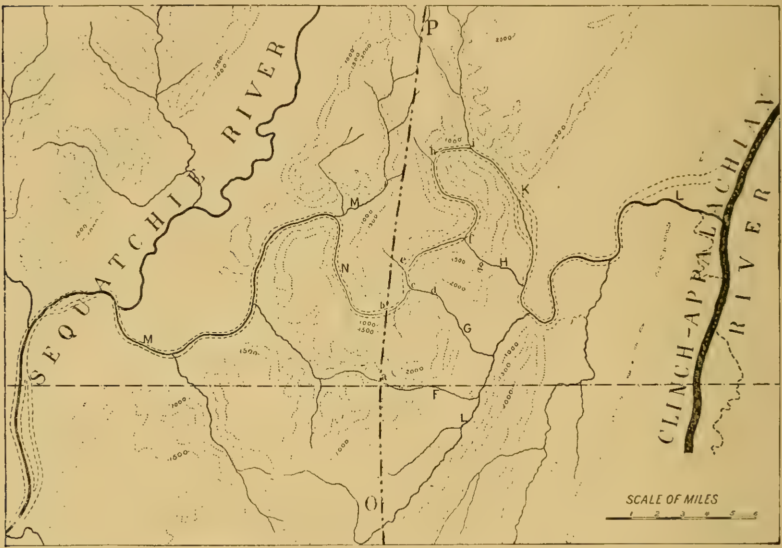


FIGURE 2.—*Sketch Map of the Tennessee Gorge, showing the present Course of the Tennessee River through Walden Plateau and the probable Arrangement of the Drainage immediately preceding the westward Diversion of the Appalachian River.*

nessee. It had numerous branches on the east heading against the divide along the axis *O P*. Flowing into the Clinch-Appalachian river on the east, the principal stream was *L L*, with the branches *F*, *G*, *H* and *K*, also heading against the divide *O P*. At the points *a* and *b* streams were cutting backward toward the same part of the divide from opposite directions, and as the process continued the heavy sandstone capping the plateau was removed and deep cols formed on the limestone. Under such conditions the divides may have been cut very low at these points without appreciable shifting. That the col at *a* was reduced nearly to its present altitude by erosion during the Tertiary cycle appears from a comparison of the amount of cutting which has since taken place in the most favored localities along the rivers and in the least favored localities on the divides. In the former the post-Tertiary erosion has been from 150 to 300 feet, and 100 feet seems a liberal estimate of the erosion in the same period upon the divides; but 100 feet added to the present altitude of the col at *a* would still leave the divide in soft shale or limestone. Since the divide at *b* is the one through which the contending streams finally forced a passage, it is not unreasonable to suppose that it offered some advantage which the divide at *a* did not possess. This was doubtless its altitude, which was in all probability considerably less than that of the divide at *a*. At the same time the divides *e* and *h*, between the streams *G*, *H* and *K*, had been similarly reduced, although the streams belong to a single drainage basin. On the above hypothesis it appears that the conditions were quite favorable for diversion of drainage, since the heavy conglomerate had been removed not alone from the main divide at *b*, but also from a series of connecting channels occupied by the streams *G*, *H* and *K*.

A careful study of the Tertiary peneplain in this region shows it to be higher on the eastern than on the western side of Walden plateau. In the vicinity of Chattanooga its altitude is nearly 900 feet, while in Sequatchie valley it is somewhat less than 800 feet; hence there appears to be a difference of at least 100 feet in the altitude of these two neighboring peneplains formed during the same period of baseleveling. A corresponding difference in the altitude of the Lafayette gravels was noted above. The probable explanation of this difference in altitude is found in the fact that the Sequatchie river had during the Tertiary cycle a more direct outlet to the sea than the Appalachian river, and also was flowing on softer and more homogeneous rocks; hence its valley was more perfectly baseleveled, and indeed it seems probable that under the exceptionally favorable conditions there prevailing the Sequatchie river may have reduced its gradient southward from the Tennessee line almost to zero. If the Appalachian river on the opposite side of Walden plateau were 100 feet higher than the Sequatchie it would have a descent of 100 feet in about 400 miles, or a fall of 3 inches per mile. Considering the nature of the rocks over which it was flowing, this rate would seem quite consistent with the formation of an extensive peneplain.

This difference in altitude of the drainage on opposite sides of Walden plateau gave the streams flowing westward a very decided advantage over those flowing eastward. So long as the uplift continued on the line *O P* this advantage was not sufficient to push the divide eastward beyond that line. Before the close of the Tertiary baseleveling, however, this uplift probably ceased and the westward streams then began a career of conquest which resulted in changing the course of the entire drainage of eastern Tennessee.

The process by which this conquest was accomplished is probably somewhat as follows: The advantage which the westward drainage possessed by reason of its more rapid descent enabled the stream *N* to push the divide from *b* to *c*, capturing a portion of the drainage area of the eastward flowing stream *G*. The contest was thus transferred to the divides *c* and *e*. The large volume of water coming from the plateau northward apparently determined the location of most rapid cutting at *e*, for while the divide *c* was pushed back only a short distance to its present position at *d*, the stream *e f* was reversed and the headwaters of *H* diverted westward, *f* and *h* thus becoming the actively contested divides. As in the previous case, cutting was most rapid at *h*, and while the divide *f* was pushed back to its present position at *g*, the branch *h i* was reversed and the headwaters of *K* diverted to the westward drainage. How far this process had gone before the end of the Tertiary baseleveling it is impossible to say, but it was probably well under way. The warping which accompanied the Lafayette depression gave the westward streams a still further advantage, and early in that depression the divide *i* was pushed eastward, reversing the flow, first, of the stream *K*, and then *L* to the junction of the latter with the Clinch-Appalachian river. Although the latter was a comparatively large river, the advantages possessed by the westward stream were sufficient to overbalance the advantage of size, and the Clinch-Appalachian river was captured and led off westward through the newly cut gorge. The capture of the western fork of the Appalachian river was probably followed shortly after by that of the eastern fork. This was accomplished by a tributary of the former working backward from Kingston to Loudon. Thus the drainage of the Appalachian valley assumed practically the form which it has today.

As indicated in the above discussion of drainage adjustment, the present writers have reached the conclusion that an extremely important factor in the process is the slow and gentle warping of the surface which has accompanied every epeirogenic movement of which there is any record. We believe this factor is only less important than the great structural features of a region, and in some cases, of which the Tennessee is a notable example, the structure of the region has played a secondary part in determining the drainage courses. This gentle warping of the surface has hitherto been recognized only in a general way and few attempts have been made to locate axes; consequently the manner in which it influences drainage has not yet been discussed. The writers have in preparation a paper in which an attempt will be made to formulate the laws of this action and to show much more fully than the limits of the present paper will permit to what extent it has determined the courses of the Appalachian streams.

3.—PRESENT CYCLE.

Northward diversion of the Tennessee River.—The Lafayette depression, with its accompanying deposition of coarse sediments about the border of the province, occupied the closing epoch of the Tertiary cycle. The next, which may properly be termed the Present cycle, was inaugurated, like the two preceding, by uplift, and the uplift was accompanied by warping of the surface. The southern portion of the province was tilted northward, probably somewhat beyond the Memphis-Charleston axis. The rivers whose lower courses had been rendered sluggish or even submerged by the preceding depression were stimulated to renewed activity and began a rapid trenching of the lately deposited Lafayette formation. The land area was extended considerably beyond its present limits, and the rivers throughout their lower courses cut deep gorges, forming notches in the present submerged continental shelf. The uplift along the southern border of the province was so rapid that only the larger streams or those favorably located upon soft rocks were able to keep their channels down near baselevel. The Alabama river, although only the shrunken representative of the once powerful Appalachian river, had its lower course located on soft Tertiary limestones, sands and clays, so that it was able to keep pace with this uplift and retain its southward course unchanged to the Gulf. The Mississippi, by reason of its greater volume, was also able to keep near baselevel, and as the land rose cut a deep gorge through the Lafayette and well into or through the underlying Tertiary and Cretaceous formations.

The westward flowing stream which had diverted the Appalachian drainage occupied in its lower course about the position of Black river, and it probably continued in this course a short time after the post-Lafayette elevation began—long enough, at least, to cut through the mantle of Lafayette gravel down to the Grand gulf, which is the most indurated of all the Mississippi embayment formations. While the lower course of this river was thus held in check by the elevation of the indurated beds, northward flowing streams were greatly stimulated by the tilting of the surface in that direction. Small streams flowing northward to the Ohio along the strike of the easily erodible Cretaceous beds therefore had a double advantage over those flowing westward or southwestward, and by cutting backward were able to capture and divert the Tennessee river to a northward course.

After a comparatively short period of elevation the province was again depressed, though not so much as during the Lafayette epoch, and this depression was in turn followed by elevation to the present altitude. The record of these oscillations is found chiefly in the deposits and erosion forms of the region bordering the Appalachian province, and hence is somewhat beyond the scope of this paper. The time was too short for permanent records to be inscribed on the land surface in the interior. Minor stream adjustments doubtless occurred, and the rivers sank their channels within the surface of the Tertiary peneplain, in some regions deeply dissecting that surface, as already described in Part I.

SUMMARY OF THE DRAINAGE DEVELOPMENT AND LAND OSCILLATIONS.

It is seen from the foregoing that the present course of the Tennessee river is extremely complex, and that a history of its development is practically a history of the province in post-Paleozoic time. Different portions of the river course furnish a record of the various vicissitudes through which the province has passed, or at least confirm the record found in other physiographic features. We have seen that most of the eastern tributaries are very old, having occupied approximately their present positions while the western portion of the province was still covered by the great inland sea. From the eastern highlands they brought down the vast Paleozoic sediments and built the floor of the future continent. As successive belts of these sediments were lifted to form dry land and the sea margin migrated westward, the streams extended their lower courses to the shrinking sea. Then during the long period of Appalachian folding and the longer period of degradation these westward-flowing streams were diverted to southward courses and collected in a single great stream, the Appalachian river. In the early part of this long cycle the southern portion of the province stood relatively higher, so that until the close of the Jurassic the materials carried down by the Appalachian river were swept to unknown distances and deeply buried beneath the later Mesozoic sediments. Early in the Cretaceous the land was tilted seaward and the water advanced to the present inner margin of the Cretaceous sediments. At the close of the cycle the Appalachian river wandered over a broad and nearly featureless plain. The second cycle began with uplift of the land, and broad valleys were cut by the streams nearly to their headwaters. Then came the Lafayette depression, accompanied by warping, which gave so great advantage to the streams flowing westward along the axis *A B* that the upper Appalachian drainage was captured and led off to the Mississippi embayment. The great river was scarcely adjusted to its new position before the tilting of the surface again changed it northward to its present course into the Ohio. Thus the lower portion of the Tennessee river dates from the present cycle. The portion in northern Alabama and across Walden plateau was occupied at the close of the Tertiary cycle; that in the Appalachian valley was adjusted during the long Cretaceous cycle; and, finally, the tributaries flowing from the present Smoky mountains have inherited their courses from the early Paleozoic continent.

In conclusion, a graphic representation of this history will be given, in order to bring together the conclusions contained in the preceding portions of this paper. The oscillations of the surface have been so variable, accompanied by such diverse warping, that the relations of the surface of the whole region to sealevel cannot be represented diagramatically; but if a single point on the surface be taken its relations to sealevel may be so represented. A point on the present site of Chattanooga has been selected as fairly representative and where the various altitudes can be well determined. These relations are represented in the diagram, figure 1, page 99. The vertical lines divide the space into five time divisions. These divisions are only approximately proportional to the time, the late divisions being much too large and the earlier divisions too small. Taking the horizontal line at the base of the diagram as sealevel, the full line represents the altitude of the main stream channels and the dotted lines their altitudes at former periods marked by the remnants of baselevel peneplains still existing. The upper dotted line *L* in the diagram indicates the position of the original land surface with reference to sealevel. Its distance above the present land surface at the right of the diagram corresponds with the thickness of strata removed by erosion from the point taken, which is on an anticlinal fold and hence upon rocks low in the series. The thickness of the rocks eroded is only represented approximately, since the original thickness of the Carboniferous is not known. The line *K* represents the altitude of the land surface slowly approaching sealevel by degradation during the long cycle of Cretaceous baseleveling. It is scarcely probable that the land remained stationary during this long period. There were doubtless minor oscillations, but these have left no record upon the surface and hence cannot be represented. At the close of the Cretaceous cycle came the elevation of the surface shown by the rise in the line *K* at the beginning of the second time division. With the elevation, the line *K* ceases to represent the stream level which is indicated by the heavy line *T*, diverging from *K* at first rapidly and then slowly, the peneplain being developed during the Tertiary cycle. Since this cycle was not so long as the preceding and the baseleveling not so complete, the line *T* does not approach so near sealevel as the line *K*. During the third period, which was one of depression, the lines *K* and *T* remain parallel, since little, if any, erosion was taking place at Chattanooga at that time. With the elevation at the end of the Lafayette depression the line *T* in turn ceases to represent the stream level which is indicated by the line *P*, and this diverges continually to the present except during the Columbia depression. Thus the various lines at the right of the diagram indicate the position of various plains of erosion with reference to each other and to present sealevel, but not to sealevel in past time. The lowest line, *P*, the present flood plain of the Tennessee river, is 650 feet above sealevel; the second, *T*, the Tertiary peneplain, is 250 feet above the present river; the third, *K*, the Cretaceous peneplain, is about 1,100 feet above the Tertiary; and, last, the original land surface is about 5,000 or 6,000 feet above the Cretaceous baselevel.

Part III—Sedimentary Record.

The variation in character of sediments deposited on the southern border of the Appalachian province during Cretaceous and later time has been briefly referred to, and also the correlation between kind of sediment and attitude of land. The conclusions reached by other lines of evidence are so fully borne out by a consideration of the sediments that the subject merits a somewhat fuller treatment. The character of sedimentary rocks is usually regarded as indicative of the depth of water in which they were formed, and while this is in a measure true, a more important element is probably the character and attitude of the adjacent land from which the sediments were derived.

High land is subjected to active degradation, especially if it has been recently elevated and is covered by a heavy mantle of residual material. Its streams have rapid fall and are supplied with an abundant load of coarse mechanical sediment which they carry in great volume to the sea. Under such conditions of rapid erosion the deposits formed are gravels, sands and clays, generally highly colored from the complete oxidation of the residual mantle before transportation. Solution is at the same time going on, but the volume of material removed by that means is small in comparison with the mechanical sediment, and the proportion of calcareous matter is correspondingly small in the deposits formed. As the cycle advances the gradients of the streams decrease, and with it their carrying capacity. Hence the proportion of matter in solution is increased by the diminution in the absolute amount of mechanical sediment and the deposits become correspondingly more calcareous. In the final stages of baseleveling, chemical agents are more active than mechanical; the sluggish streams are able to transport only the finest silt in suspension and the resulting deposit is a more or less pure limestone. The character of the sediments derived from the southern Appalachian region during the long period of degradation which it has suffered ought to show gradations from arenaceous to calcareous, corresponding with the stage of development of the cycle in which deposition occurred, coarse sands and clays when a surface subjected to a long period of subaerial decay and rock disintegration was elevated so as to stimulate stream transportation, and calcareous shales and limestones when the surface had been so far reduced to baselevel that only fine sediment in suspension or matter held in solution was carried by the streams. Since the geomorphy of the interior proves the existence of several of these cycles of continental development, one should expect to find cycles of sedimentation corresponding in geologic age and degree of completeness.

The record of sedimentation in the Gulf region from the Tuscaloosa (probably late Jurassic or early Cretaceous) to the close of the Vicksburg or White limestone (late Eocene) is fairly continuous and complete. Arranging the formations intervening between these limits in their proper order and assigning to each a space, not in proportion to its thickness, but to the probable time occupied by its formation, the curve shown in figure 3 is derived, in which the horizontal coordinates represent relative time, and the vertical coordinates relative coarseness or fineness of the sediments. Thus the curve expresses immediately the variation in character of the sediments carried into the sea by the southern Appalachian rivers during Cretaceous and Tertiary time and, by inference, the altitude of the land over which the rivers flowed. The character and amount of material carried off by these streams during the long period of degradation preceding the Cretaceous can only be inferred from the known character and amount of rocks removed, for the sediments were carried to an unknown distance seaward and concealed by overlap beneath the subsequent formations. The accessible record begins with the Tuscaloosa, a thick deposit of sands and clays marking rapid erosion and great carrying power of the streams, and hence a considerable altitude of the land surface. Through the Eutaw and into the Rotten limestone the sediments show a decrease in coarseness and an increase in calcareous matter, and the curve approaches the horizontal axis, continuing approximately parallel with it throughout nearly the whole of the Rotten limestone. This marks a long period during which the transporting power of the streams was gradually diminishing and the surface approaching baselevel at a constantly decreasing rate. This great mass of calcareous sediment, part of which is a mechanical deposit, points to erosion of extensive limestone areas which must have been in the Appalachian valley; hence the character of the formation supports the conclusion reached from other evidence, that the drainage of that region was southward during the whole of the Cretaceous cycle. Passing the Rotten limestone, the curve leaves the horizontal axis, and in the Lignitic reaches its farthest distance therefrom, marking a period of high land or steep slopes and rapidly cutting streams. From this point it rapidly descends through the Buhrstone and Claiborne to the Vicksburg

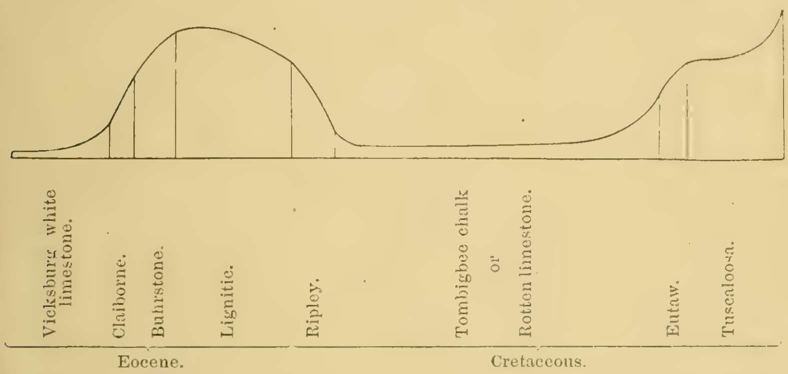


FIGURE 3.—*Diagram showing variation in Character of Cretaceous and Tertiary Sediments in Alabama.*

limestone, showing a rapid decrease in carrying power of the streams and a near approach to baselevel in the valleys.

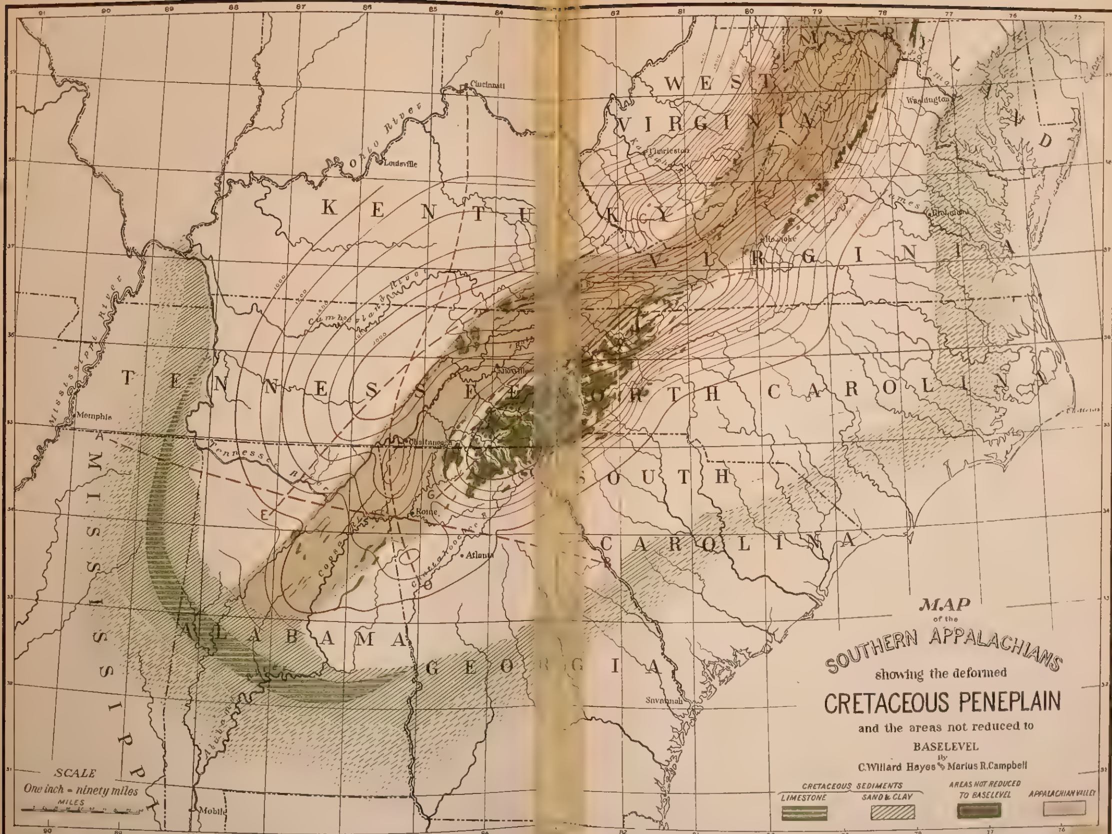
It is thus seen that during the time covered by the sedimentary record in southern Alabama there were two periods in which the land stood high and the streams were rapidly degrading the surface, and that these alternated with two periods in which the land was low, approximately at baselevel, and the streams carried little sediment, but were degrading the surface by solution. Hence two baselevel peneplains separated by a considerable uplift are to be sought in the region from which the sediments were derived. The two already described fulfill all the theoretical conditions, and the correlation of these peneplains, from other considerations, with Cretaceous and Tertiary time is greatly strengthened. On the Atlantic slope the data are not so complete. Almost all of the sediments were derived directly from the granitic rocks of the piedmont plain, and hence show less differentiation in character than the rocks of the Gulf coast. So far as known there is nothing in the character of the Atlantic coastal plain sediments which will conflict with the conclusions given above, but exact correlations cannot at present be made.

Thus the same history of the province which was read in the forms of the land surface and in the location of the streams is also found recorded in the sediments derived from its erosion. The three lines of investigation outlined at the beginning of this paper are found to lead to harmonious results and each to supplement the others. While many details remain to be worked out, the main features of post-Paleozoic history of the southern Appalachians as given above seem fairly well determined.

UNITED STATES GEOLOGICAL SURVEY,
Washington, D. C.


Cincinnati
Ohio River
Louisville
K E N T U
Cumberland River
T E N N E S S E E
Mississippi River
Memphis
Knoxville
Chattanooga
Tennessee River
Rome
Atlanta
Coosa R.
Chattahoochee R.
M I S S I S S I P P I
A L A B A M A
G E O
Alabama R.
Mobile
SCALE
One inch = ninety miles
MILES

THE NORRIS PETERS CO. PHOTO-LITHO. WASH


MAP
of the
SOUTHERN APPALACHIANS
showing the deformed
CRETACEOUS PENEPLAIN
and the areas not reduced to
BASELEVEL
By
C.Willard Hayes & Marius R.Campbell
CRETACEOUS SEDIMENTS
LIMESTONE
SAND & CLAY
AREAS NOT REDUCED TO BASELEVEL
APPALACHIAN VALLEY
SCALE
One inch = ninety miles
MILES
KENTUCKY
WEST VIRGINIA
VIRGINIA
MARYLAND
TENNESSEE
NORTH CAROLINA
SOUTH CAROLINA
GEORGIA
ALABAMA
MISSISSIPPI
Cincinnati
Louisville
Charleston
Washington
Roanoke
Knoxville
Chattanooga
Rome
Atlanta
Memphis
Savannah
Mobile
Ohio River
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Tennessee River
Mississippi River
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Coosa R.
Chattahoochee R.
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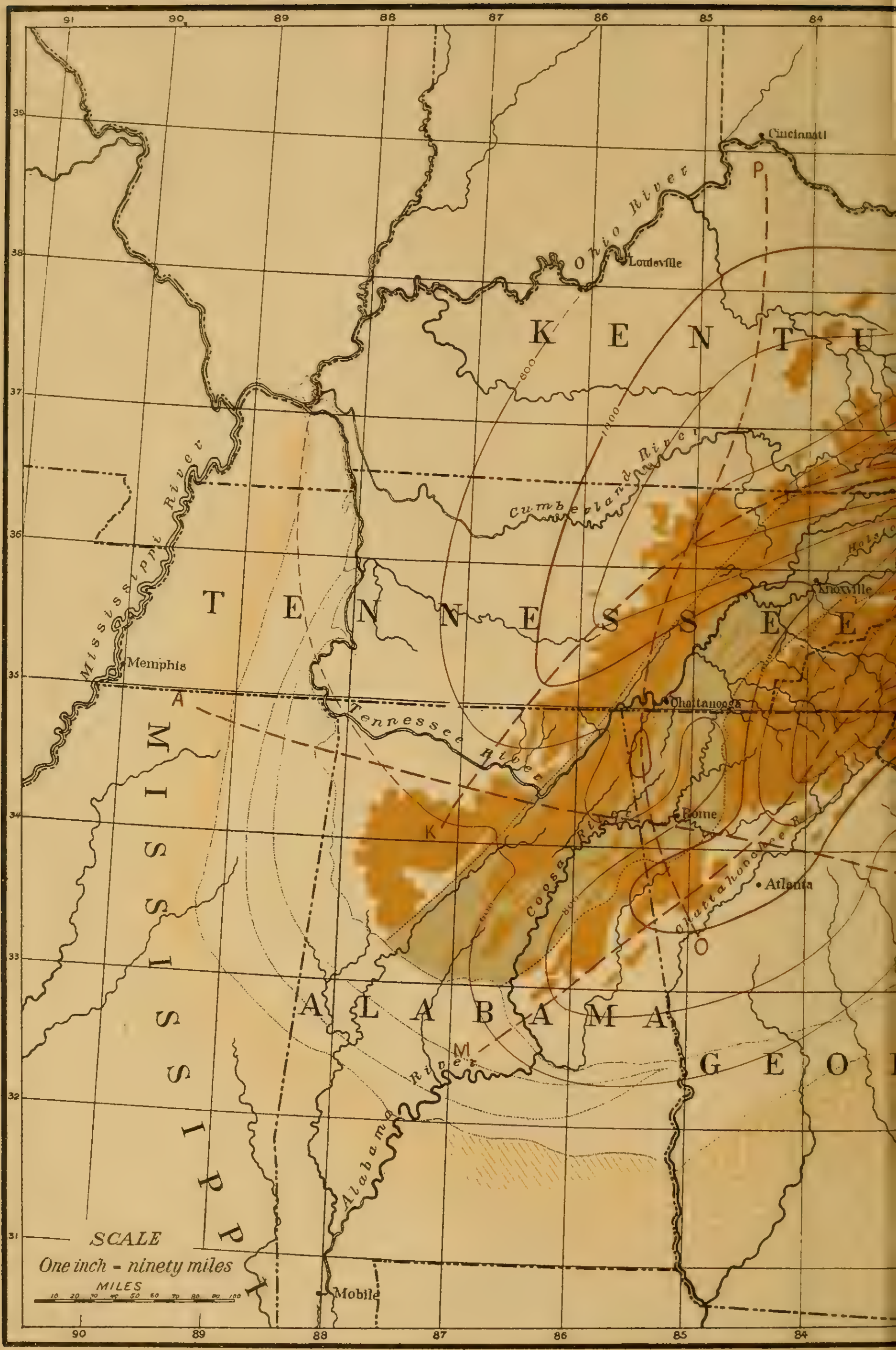
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Mississippi River
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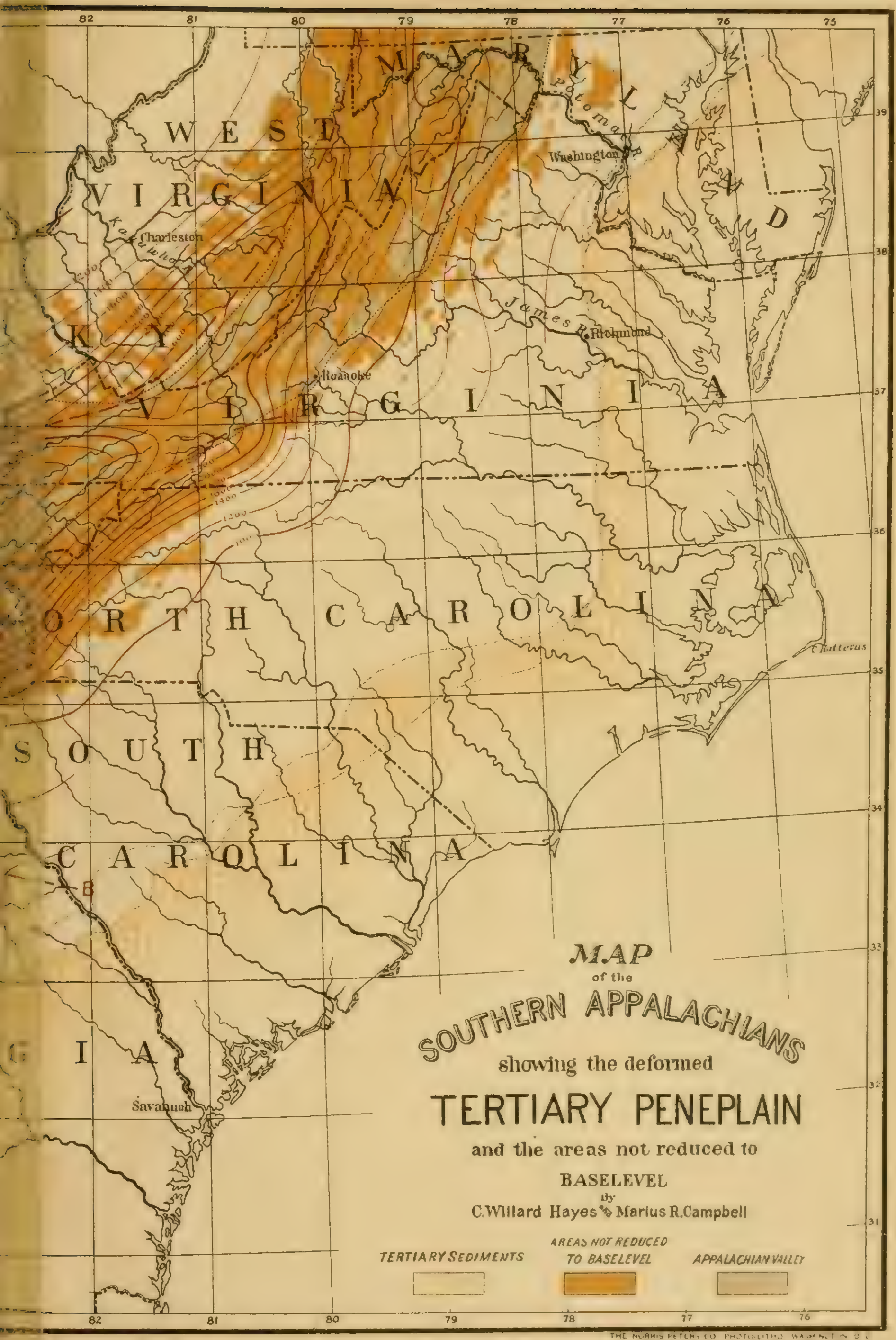
Coosa River
Chattahoochee R.
Alabama River
SCALE
One inch - ninety miles
MILES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Charleston
Roanoke
Richmond
Savannah
Potomac R.
James R.
Kanawha
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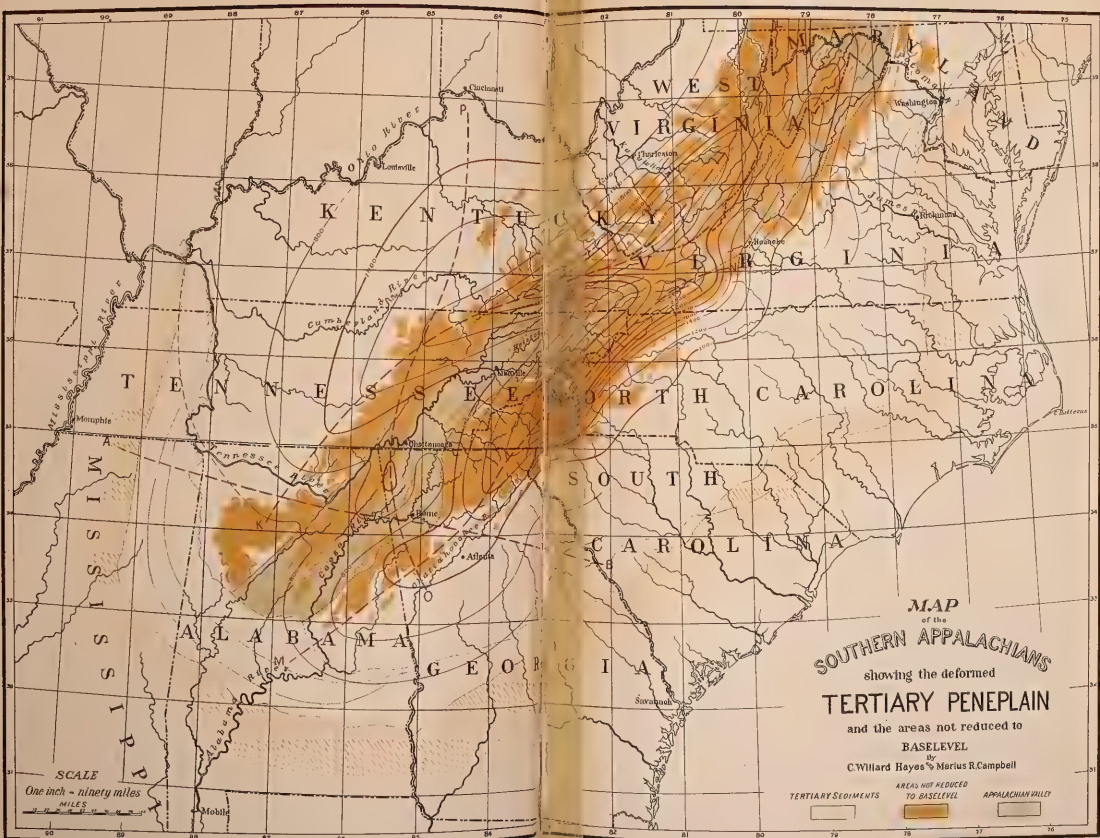

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Vol. VI, pp. 127-148, Pls. 7, 8 June 22, 1894

THE

NATIONAL GEOGRAPHIC MAGAZINE

THE BATTLE OF THE FOREST

B. E. FERNOW

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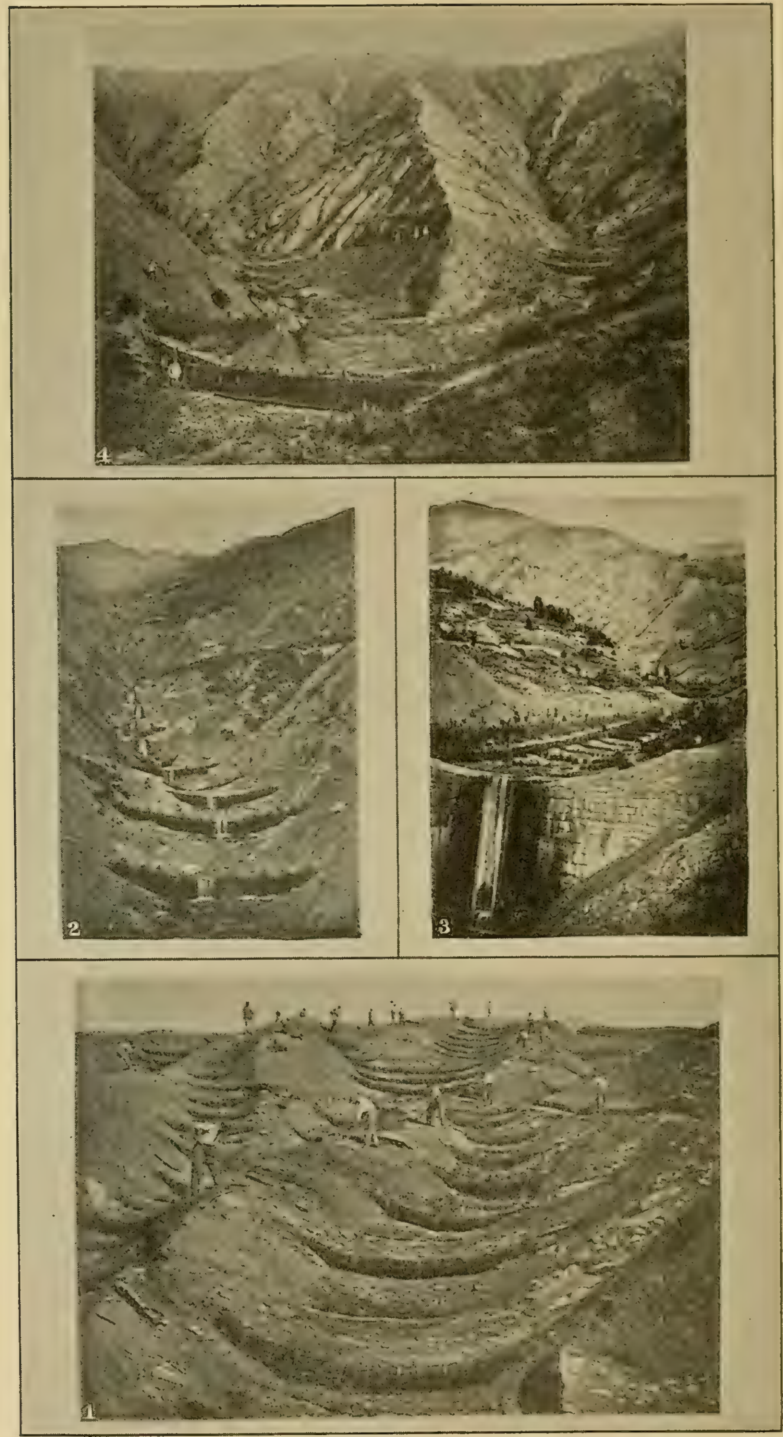

DROWNING THE TORRENT.

1. Wattle-work at summit.
2. Sprouted wattle dam.
3. A masonry dam.
4. Reforestation of denuded mountain side.

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NATIONAL GEOGRAPHIC MAGAZINE

THE BATTLE OF THE FOREST

BY

B. E. FERNOW

(*Presented before the Society December 15, 1893*)

The earth is a potential forest. Given time, freedom from geologic revolutions and from interference by man, and tree-growth must finally dominate everywhere, with few excepted localities.

Its perennial nature and its elevation in height above all other forms of vegetation, together with its remarkable recuperative powers, assure to the arborescent flora this final victory over its competitors.

So impressed was Dr Asa Gray with the persistence of individual tree life that he questioned whether a tree need ever die: "For the tree [unlike the animal] is gradually developed by the successive addition of new parts. It annually renews not only its buds and leaves, but its wood and its roots; everything, indeed, that is concerned in its life and growth. Thus, like the fabled Æson, being restored from the decrepitude of age to the bloom of early youth, the most recent branchlets being placed by means of the latest layer of wood in favorable communication with the newly formed roots and these extending at a corresponding rate into fresh soil, why has not the tree all the conditions of existence in the thousandth that is possessed in the hundredth or the tenth year of its age?

"The old and central part of the trunk may, indeed, decay, but this is of little moment, so long as new layers are regularly formed at the circumference. The tree survives, and it is difficult to show that it is liable to death from old age in any proper sense of the term."*

However this may be, we know trees succumb to external causes. Nevertheless they are perennial enough to outlive aught else, "To be the oldest inhabitants of the globe, to be more ancient than any human monument, as exhibiting in some of its survivors a living antiquity compared with which the mouldering relics of the earliest Egyptian civilization, the pyramids themselves, are but structures of yesterday." The dragon trees, so called, found on the island of Tenerife, off the African coast, are believed to be many thousand years old. The largest is only 15 feet in diameter and 75 feet high. Our sequoias are more rapid growers and attain in 3,000 to 4,000 years, which may be the highest age of living ones, more than double these dimensions.

While this persistence of life is one of the attributes which in the battle for life must count of immeasurable advantage, the other characteristic of arboreal development, its elevation in height above everything living, is no less an advantage over all competitors for light, the source of all life. Can there be any doubt that in this competition size must ultimately triumph and the undersized go to the wall?

Endowed with these weapons of defensive and offensive warfare, forest-growth, through all geologic ages during which the earth supported life, has endeavored and no doubt to a degree succeeded in gaining possession of the earth's surface.

As terra firma increased emerging in islands above the ocean, so increased the area of the forest, changing in composition to correspond with the change of physical and climatic conditions.

As early as the Devonian age, when but a small part of our continent was formed, the mud flats and sand reefs, ever increasing by new accumulations under the action of the waves and currents of the ocean, were changed from a bare and lifeless world above tidelevel to one of forest-clad hills and dales.

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*Longevity of Trees: "Scientific papers of Asa Gray" (selected by Chas. Sargent), vol. 2, 1889, p. 71.

Not only were such quaint forms as the tree rushes or *Calamites*, *Lepidodendra* and *Sigillaria* present, but the prototype of our pine, the *Dadoxylon*, had made its appearance.

The same class of flowerless plants known as vascular cryptogams, with the colossal tree ferns added, became more numerous and luxuriant in the Carboniferous age, as well as the flowering *Sigillaria* and coniferous *Dadoxylon*. This vegetation probably spread over all the dry land, but the thick deposits of vegetable remains accumulating in the marshy places under dense jungle growth and in shallow lakes with floating islands, were finally in the course of geologic revolutions, turned into the great coal fields.

In those and subsequent geologic times some of the floral types vanished altogether and new ones originated, so that at the end of Mesozoic times a considerable change in the landscape had taken place.

In addition to coniferous trees, the palms appeared, and also the first of angiosperms, such as the oak, dogwood, beech, poplar, willow, sassafras and tulip tree. Species increased in numbers, adapted to all sorts of conditions; the forest in a most varied and luxuriant form climbed the mountain sides to the very crests, and covered the land to the very poles with a flora of tropical and semi-tropical species.

Then came the leveling processes and other changes of post-Tertiary or Quaternary times; the glaciation of lands in northern latitudes, with the consequent changes of climate, which brought about corresponding changes in the ranks of the forest, killing out many of the species around the north pole. Only the hardier races survived, and these were driven southward in a veritable rout.

When these boreal times subsided in a degree, the advance of the forest was as sure as before; but the battle order was somewhat changed to suit the new conditions of soil and climate. Only the hardiest tribes could regain the northernmost posts, and these found their former places of occupancy changed by fluvial and lacustrine formations and the drifts borne and deposited by the ice-sheets, while some by their constitution were entirely unfitted from engaging in a northern campaign or found insurmountable barriers in the refrigerated east-west elevations of Europe and western Asia.

In addition, there had come new troubles from volcanic eruptions, which continually wrested the reconquered ground from the persistent advance guards of the arboreal army, annihilating them again and again.

Finally, when the more settled geologic and climatic conditions of the present era arrived and the sun arose over a world ready for human habitation, man found what we are pleased to call the virgin forest—a product of long continued evolutionary changes—occupying most, if not all the dry land, and ever intent upon extending its realm.

This prehistoric review of the battle of the forest cannot be left without giving some historic evidences of its truth.

Not only have paleobotanists unearthed the remnants of the circumpolar flora, which give evidence that it resembled that of present tropic and semi-tropic composition, but they have also shown that sequoias, magnolias, liquidambars and hickories existed in Europe and on our own continent in regions where they are now extinct. We have also evidences of the repeated successes and reverses of the forest in its attempts to establish itself through long geologic transformations.

One of the most interesting evidences of these vicissitudes in the battle of the forest is represented in a section of Amethyst mountain in Yellowstone National Park, exhibiting the remains of fifteen forest-growths, one above the other, buried in the lava. Again and again the forest subdued the inhospitable excoriations; again and again it had to yield to superior force.

Among these petrified witnesses of former forest glory, magnolia, oak, tulip tree, sassafras, linden and ash have been identified, accompanying the sequoia in regions where now only the hardiest conifer growths of pines and spruces find a congenial climate.

As the forest formed and spread thus during the course of ages, so does it form and spread today, unless man, driven by the increasing needs of existence, checks its progress and reduces its area by the cultivation of the soil. This natural extension of the forest cover or afforestation takes place readily wherever soil and climate is favorable, but it is accomplished just as surely, though infinitely slower, in unfavorable situations. On the naked rock, the coarse detritus and gravel beds, on the purely siliceous sand deposits of river and ocean, or in the hot dry plains, the preliminary pioneer work of the lower vegetation is required. Algæ, lichens, mosses, grasses, herbs and shrubs must precede to cultivate the naked rock, to mellow the rough gravel beds, to make the soil, to increase the soil moisture by shading the ground and gradually render it fit for the abode of the forest monarch. The army of soil-makers and soil-breakers, the pioneers, as it were, of the forest, are a hardy race, making less demands for their support than those that follow. They come from different tribes, according to the soil conditions in which they have to battle. As soon as they have established themselves they begin their cultivatory activity, which consists in withdrawing from the rock or soil and from the air the nutritive elements, returning them to the soil when they die and decay, in a form much more suitable for the support of the higher plants. The nutritive elements and the physical properties of the soil are improved and augmented by the repeated growth and decay of these pioneers, in that the soil is deepened and made mellow and its capacity for moisture increased. The waters charged with carbonic acid derived from the decay of the vegetal humus hasten the decomposition of the underlying rock, and the fertile soil layers increase until more fastidious plants can subsist. The humblest workers, algæ, lichens, cacti and mosses, are followed by sedges, dry grasses, herbs and shrubs, or in the drier climates by agaves and yuccas. Then come the succulent grasses and herbs, gradually covering the soil with a meadow or prairie, the shrubs become more numerous, by degrees closing up, shading the ground and overshadowing the grasses, and finally the time is ripe for the arborescent flora. Nor does then the forest appear at once in its fullness and variety of form. Single trees, stragglers or skirmishers in small numbers, and shrub-like and stunted forms first arrive, gradually increasing in number and improving in form. These by their shade and by the litter formed from the fall and decay of their foliage improve the soil for their betters to follow.

The aspen (*Populus tremuloides*) is one of these forerunners, which, thanks to its prolific production of light feathery seed, is readily wafted by the winds over hundreds of miles, readily germinates and rapidly grows under exposure to full sunlight, and even now in the Rocky mountains and elsewhere quickly takes possession of the areas which man has ruthlessly destroyed by fire. This humble and ubiquitous but otherwise almost useless tree is nature's restorative, covering the sores and scalds of the burnt mountain side, the balm poured upon grievous wounds.

Though short-lived, with its light summer foliage turning into brilliant golden autumn hues, it gives grateful shade and preserves from the thirsty sun and wind some moisture, so that the better kinds may thrive and take its place when it has fulfilled its mission.

One of the shrubs or half trees which first take possession of the soil in the western mountain country is the socalled mountain mahogany (*Cercocarpus ledifolius*) covering the bared slopes after the fire has killed the old timber.

In other regions, as on the prairies of Iowa and Illinois, hazel bushes; or in the mountains of Pennsylvania and the Alleghenies in general, ericaceous shrubs like the laurel and rhododendrons or hawthorn, viburnum and wild cherry are the first comers, while along water-courses alders and willows crowd even the water into narrower channels, catching the soil which is washed from the hillsides and increasing the land area.

One of the most interesting soil-makers, wresting new territory from the ocean itself, is the mangrove along the coast of Florida. Not only does it reach out with its aerial roots entangling in their meshes whatever litter may float about and thus gradually building up the shore, but it pitches even its young brood into the advance of the battle, to wrestle with the waves and gain a foothold as best it may.

Not less interesting in this respect is that denizen of the southern swamp, the bald cypress with its curious root excrescences known as cypress knees, which, whatever their physiologic significance, are most helpful in expediting change of water into land sufficiently dry to be capable of supporting the more fastidious species in regard to moisture conditions.

In passing, the remarkable adaptation to diverse conditions of some of the tree species should be noticed, as it gives them significance as geographic factors. The trees of the swamp, or at least many of them, seem to indicate their independence of moisture conditions by the range of climate and soil in which they are found. In fact, they grow in the swamp, not because that is their most suitable locality, but because they can do so to the exclusion of other competitors. The bald cypress itself will grow in the dry soil and arid atmosphere of Texas and Mexico; the oak which associate with it in the swamp will occupy almost any soil and site; the sweet gum or liquidambar is found in similar places of habitat. The juniper or red cedar, which is a large tree in the swamps of Florida, covers also the driest ridges of the eastern Rocky mountains, with a gnarly growth and hard texture, supplying the most lasting poles and posts. This latter species is also noticeable as having the widest distribution of all American forest trees. In fact, few trees seem so indifferent to climatic and soil conditions. From semi-tropical Florida to the cold shores of New Brunswick, and from the humid Atlantic coast it crosses the continent and the snow-covered Rockies to British Columbia and Washington.* It associates as well with the oak, hickory and magnolia in the rich river bottoms, or with the cypress, ash and tupelo in the swamps, as with the pine on the hot sands and barren mountain sides. Thanks to the taste of the birds for its berries, it finds ready dissemination within this wide field, forming with the equally frugal aspen and cottonwood the very foremost advance guard of the forest.

On the dry hot mesas and in the arroyos of the southwestern tier of our states and territories we meet a different set of skirmishers following up the huge cacti and agaves, which together with the tree yuccas, penetrate into the very desert. In these regions the mesquite or algaroba and others of the acacia tribe form the second phalanx, as it were, gradually advancing their lines in spite of adverse conditions. In other regions the pine, satisfied with but scanty favor of soil moisture, and the spruce, able to sustain life in shallow soil, and the fir, in the higher, colder and wetter elevations, sometimes much stunted, form the skirmish line. These improve the soil in its moisture conditions by their shade, and by the foliage and litter falling and decaying they deepen the soil, forming a humus cover. The duff that is found covering the rocky subsoil of the Adirondacks is formed in this way at the rate of about one foot in 500 years. They are soon followed by the birche, maple, elm and ash and in moister situations by the oak—first, that hardy pioneer, the black oak tribe, and then the more fastidious white oak, with whom the slower but persistent hickories, beeches and other shade-enduring species begin to quarrel for the right of occupancy of the ground, until the battle is no longer that of the forest against the elements and lower vegetation, but between the mighty conquerors themselves. This struggle we can see going on in our primeval forests, wind-storms and decay acting as allies now to

* According to some authorities the juniper found beyond the Rocky mountains does not include this particular species, *Juniperus virginiana*.

one, now to the other side, and thus changing the balance of power again and again.

In this struggle for supremacy between the different arborescent species the competition is less for the soil than for the light, the most important factor of life, especially for tree-growth. It is under the influence of light that foliage develops and that leaves exercise their functions and feed the tree by assimilating the carbon of the air and transpiring the water from the soil. The more foliage and the more light a tree has at its disposal, the more vigorously it will grow and spread itself.

Now the spreading oak or beech of the open field finds close neighbors in the forest, and is narrowed in from all sides and forced to lengthen its shaft, to elevate its crown, to reach up for light, if it would escape being overshadowed, repressed and perhaps finally killed by more powerful densely foliaged competitors.

The various species are differently endowed as regards the amount of light which they need for their existence. Go into the dense forest and see what kinds of trees are vegetating in the dense shade of the older trees, and then go into an opening recently made, an abandoned field or other place, where the full benefit of light is to be had by all alike, and one will find a different set altogether occupying the ground and dominating. In the first case there may be found, perhaps, beech and sugar maple or fir and spruce; in the second case aspen, poplar, willow, soft maple, oak or pine, tamarack, etc.

All trees thrive ultimately best in full enjoyment of light. But some, like those first mentioned, can at least subsist and their foliage functionate with a small amount—they are shade-enduring kinds, usually having a dense foliage, many leaves, and each one needs to do but little work—and exert considerable shade when fully developed. Those last named, however, are light-needing kinds, and having less foliage, cannot exist long without a considerable amount of light.

To offset this drawback in the constitution of these latter, nature has endowed them as a rule with the capacity of rapid height growth, to escape their would-be suppressors; but again, what they have gained in the rapidity of development they lose in the length of life. They are mostly short lived species, while the shade enduring are generally slower growers, but persistent and long lived. Some kinds, like most of the oaks, stand between the two; while exhibiting a remarkable capacity of vegetating in the shade, they are really light-needing species but comparatively slow growers and long lived. One and the same species behaves also somewhat differently under different soil and climatic conditions; for instance, as a rule the light-needing species can endure more shade on moist soils and the shade enduring require more light on drier soils.

In the earliest stages of life the little seedlings of most trees require partial shade and are quite sensitive in regard to light conditions. Some have such a small range of light and shade endurance that, while there may be millions of little seedlings sprouted, they will all perish if some of the mother trees are not removed and more light given; and they will perish equally if the old growth is removed too suddenly and the delicate leaf structure, under the influence of direct sunlight, is made to exercise its functions beyond its capacity.

Left to itself, as the forest grows up and as the individual trees develop, each trying to hold its ground and struggling for light, a natural thinning takes place, some trees lagging behind in growth and being shaded out, until in old age only as many trees remain as can occupy the ground without incommoding each other.

This struggle among the individuals goes on during their entire life. Some few shoot ahead, perhaps because of a stronger constitution or some favorable external cause, and overtower their neighbors. These, lagging behind, fall more and more under the shading influence of their stronger neighbors until entirely suppressed, when they only vegetate until they die. The struggle continues, however, among the dominant class and it never ends. For as Hercules the unconquerable succumbed to the poison that penetrated to his bones, so does the mighty giant of the forest fall a prey to the insidious work of rot and fungus and insects. When its heart is riddled and weakened, first the dry branches crumble and gradually give opportunity for the young aftergrowth of shade-enduring kinds, patiently waiting for light, to strengthen; then break the large limbs and the dry top, and after having weathered the onslaught of the storms for centuries and the guerillas of the fungus tribe for decades, finally the giant falls, with its decaying substance enriching the soil for future generations. Into the breach rush the young epigones, each struggling to supplant its progenitor.

Thus the alterations of forest-growth take place, oak following pine or pine following oak; the poplar, birch and cherry appearing on the sunny burns, or the hickory, beech and maple creeping into the shadier pine growths. While in the eastern forest under natural conditions the rotation of power is accomplished in at least from 300 to 500 years, the old monarchs of the Pacific, towering above all competitors, have held sway 2,000 or more years. In this warfare, with changes in climatic and soil conditions going on at the same time, it may well occur that a whole race may even be exterminated.

I have dwelt thus long upon the formative period of the forest in order to make you realize that the virgin forest is a product of long struggles, extending over centuries, nay, thousands of years. Some of the mightiest representatives of old families, which at one time of prehistoric date were powerful, still survive, but are gradually succumbing to their fate in our era.

The largest of our eastern forest trees, reaching a height of 140 feet and diameters up to 12 feet, the most beautiful and one of the most useful, the tulip tree (*Liriodendron tulipifera*), is a survivor of an early era once widely distributed, but now confined to eastern North America, and doomed to vanish soon from our woods through man's improper partisanship.

Others, like the *Torreya* and *Cupressus*, seem to have succumbed to a natural decadence, if we may judge from their confined limits of distribution. So, too, the colossal sequoias, remnants of an age when things generally were of larger size than now, appear to be near the end of their reign, while the mighty taxodium or bald cypress, the big tree of the east, still seems vigorous and prosperous, being able to live with wet feet without harm to its constitution, weird with the gray tillandsia or Spanish moss.

Having thus scanned through the traditions of unwritten history of the battle of the forest, having seen some of the combatants in the struggle and learned something of their methods of conquering the earth and each other, we may take a look at the condition of things on the North American continent as it presumably was in the beginning of historic times or within our century.

As far as occupancy of the soil by the forest is concerned, we find that the struggle had not yet been determined in its favor everywhere. While a vast territory on the Atlantic side and a narrower belt on the Pacific coast, connected by a broad belt through the northern latitudes, was almost entirely under its undisputed sway, and while the back-bone of the continent, the crest and slopes of the Rocky mountains, was more or less in its possession, there still remained a vast empire in the interior unconquered.

Of parts of this territory we feel reasonably certain from strong evidences that the forest once occupied them, but has been driven off by aboriginal man, the firebrand taking sides with the grasses, and the buffalo probably being a potent element in preventing reestablishment. In other parts it is questionable whether the lines along the river courses, the straggling trees on the plateaus and slopes, are remnants of a vanquished army or outposts of an advancing one. In some parts, like the dry mesas, plateaus and arroyos of the interior basin, and the desert-like valleys toward the southern frontiers, it may reasonably be doubted whether arborescent flora has more than begun its slow advance from the outskirts of the established territory.

Certain it is that climatic conditions in these forestless regions are most unfavorable to tree-growth, and it may well be questioned whether in some parts the odds are not entirely against the progress of the forest.

Temperature and moisture conditions of air and soil, determine ultimately the character of vegetation, and these are dependent not only on latitude, but largely on configuration of the land, and especially on the direction of moisture-bearing winds with reference to the trend of mountains.

The winds from the Pacific ocean striking against the Coast range are forced by the compression and subsequent cooling to give up much of their moisture on the windward side; a second impact and further condensation of the moisture takes place on the Cascade range and Sierra Nevada. On descending, with consequent expansion, the wind becomes warmer and drier, so that the interior basin, without additional sources of moisture and no additional cause for condensation, is left without much rainfall and with a very low relative humidity, namely, below 50 per cent. The Rocky mountains finally squeeze out whatever moisture remains in the air currents, which arrive proportionally drier on the eastern slope. This dry condition extends over the plains until the moist currents from the gulf of Mexico modify it. Somewhat corresponding, yet not quite, to this distribution of moisture, the western slopes are found to be better wooded than the eastern, and the greater difficulty of establishing a forest cover here must be admitted; yet since the forest has the capacity of creating its own conditions of existence by increasing the most important factor of its life, the relative humidity, the extension of the same may only be a question of time.

Temperature extremes, to be sure, also set a limit to tree-growth, and hence the socalled timber line of high mountains, which changes in altitude according to the latitude.

If, now, we turn our attention from the phyto-topographic consideration of the forest cover to the phyto-geographic and botanical features, we may claim that the North American forest, with 425 or more arborescent species, belonging to 158 genera, many of which are truly endemic, surpasses in variety of useful species and magnificent development, any other forest of the temperate zone, Japan hardly excepted. In addition there are probably nowhere to be seen such extensive fields of distribution of single species.

These two facts are probably explained by the north-and-south direction of the mountain ranges, which permitted a reestablishment after the Ice age of many species farther northward, while in Europe and the main part of Asia the east-west direction of the mountains offered an effectual barrier to such reestablishment, and reduced the number of species and their field of distribution; nor are the climatic differences of different latitudes in North America as great as in Europe, which again predicates greater extent in the fields of distribution north and south. On the other hand, the differences east and west in floral composition of the American forest are greater than if an ocean had separated the two parts instead of the prairie and plains. This fact would militate against our theory that the intermediate forestless region was or would be eventually forested with species from both the established forest regions, if we did not find some species represented in both regions and a junction of the two floras in the very region of the forestless areas.

In the sand hills which traverse Nebraska from east to west there are now found in eastern counties the sand-drowned trunks of the western bull pine, and the same pine belonging to the Pacific flora is found associated with the black walnut of the eastern region along the Niobrara river.


NORTHERN
PACIFIC
CONIFEROUS
COAST PACIFIC
SUB TROPICAL
INTERIOR PACIFIC
NORTHERN MEXICAN
NORTHERN
ATLANTIC
MIDDLE
MAINLY BROAD LEAVED
SOUTHERN LIMIT
NORTHERN PINE
SOUTHERN
NORTHERN LIMIT OF SOUTHERN PINES
EVERGREEN (SUBTROP.) BROADLEAVED FOREST
TROPICAL FOREST
MISSOURI RIVER
95°
40
MAP
SHOWING THE NATURAL DIVISIONS
OF THE
NORTH AMERICAN FORESTS
EXCLUSIVE OF MEXICO

We may, however, divide the North American forest, according to its botanical features, into two great forest regions, namely, the Atlantic, which is in the main characterized by broad-leaved trees, and the Pacific, which is made up almost wholly of coniferous species. (See plate 8.)

In the Atlantic forest we can again discern several floral subdivisions, each of which shows special characteristics. The southernmost coast and keys of Florida, although several degrees north of the geographic limit of the tropics, present a truly tropical forest, rich in species of the West Indian flora, which here finds its most northern extension. There is no good reason for calling this outpost *semi*-tropical, as is done on Sargent's map. With the mahogany, the mastic, the royal palm, the mangrove, the sea grape and some sixty more West Indian species represented, it is *tropical* in all but it geographic position. That the northern flora joins the tropic forest here, and thus brings together on this insignificant spot some hundred species, nearly one-quarter of all the species found in the Atlantic forest, does not detract from its tropical character.

On the other hand, the forest north of this region may be called subtropical, for here the live and water oak, the magnolia, the bay tree and holly and many other broad-leaved trees are mixed with the sabal and dwarf palmetto. As they retain their green foliage throughout the winter, this region is truly semitropical in character, and under the influence of the Gulf stream, extends in a narrow belt some 20 or 25 miles in width along the coast as far north as North Carolina.

While this evergreen, broad-leaved forest is more or less confined to the rich hummocks and moister situations, the poor sandy soils of this as well as of the more northern region are occupied by pines; and as those, especially the long-leaf pine, are celebrated all over the world and give the great mercantile significance to these forests, this region may well be called the great southern pine belt. North of the evergreen subtropic forest stretches the vast deciduous-leaved forest of the Atlantic, nowhere equaled in the temperate regions of the world in extent and perfection of form, and hardly in the number of species. This designation applies to the entire area up to the northern forest belt, for the region segregated on the census map as the northern pine belt is still in the main the dominion of the deciduous-leaved forest. On certain areas pines and spruces are intermixed, and on certain soils, especially gravelly drifts and dry sand plains, as on the pine barrens of northern Michigan, they congregate even to the exclusion of other species. Instead, we can divide this deciduous-leaved forest by a line running somewhere below the fortieth degree of latitude, where with the northern limits of the southern magnolias and other species we may locate in general the northern limit of the southern forest flora. Northward from here, in what may be called the "middle Atlantic forest," the deciduous species rapidly decrease and the coniferous growth predominates until we arrive at the broad belt of the northern forest, which, crossing from the Atlantic to the Pacific and composed of only eight hardy species, takes its stand against the frigid breath and icy hands of Boreas.

Abounding in streams, lakes and swampy areas, the low divides of this region are occupied by an open stunted forest of black and white spruce, while the bottoms are held by the balsam fir, larch or tamarack, poplar, dwarf birch and willow. The white spruce, paper or canoe birch, balsam, poplar and aspen stretch their lines from the Atlantic to the Pacific over the whole continent.

On the Pacific side the subdivisions are rather ranked from west to east. While the northern forest battles against the cold blasts from icy fields, the front of the Pacific interior forest is wrestling with the dry atmosphere of the plains and interior basin. Here on the driest parts, where the sage brush finds its home, the ponderous bull pine is the foremost fighter, and where even this hardy tree cannot succeed in the interior basin several species of red cedar hold the fort, in company with the nut pine, covering with an open growth the mesas and lower mountain slopes. Small and stunted, although of immense age, these valiant outposts show the marks of severe struggles for existence.

On the higher and therefore moister and cooler elevations and in the narrow canyons, where evaporation is diminished and the soil is fresher, the somber Douglas, Engelmann and blue spruce and the silver-foliaged white fir join the pines or take their place.

With few exceptions the same species, only of better development, are found in the second parallel, which occupies the western slopes of the Sierra Nevada. Additional forces here strengthen the ranks, the great sugar pine, two noble firs, a mighty larch, hemlocks and cedars vie with their leaders, the big sequoias, in showing of what metal they are made. The third parallel, occupied by the forest of the Coast Range, the most wonderfully developed, although far from being the most varied of this continent, is commanded by the redwood, with the tide-land spruce, hemlock and gigantic arborvitæ joining the ranks.

Broad-leaved trees are not absent, but so little developed in comparison with the mighty conifers that they play no conspicuous part except along the river bottoms, where the maple, cotton, wood, ash and alder thrive, and in the narrow interior valleys, where an open growth of oak is found. Toward the south and on the lower levels these broad-leaved trees again become evergreen, as on the Atlantic side, but of different tribes, and form a subtropic flora.

Along the coast we find several species of true cypress, including the well known although rare Monterey cypress which clings to the gigantic rocks and braves the briny ocean winds, and with its branches twisted landward. Finally, flanking the battle order of the Pacific forest, we find another section of the army, composed of the northern extension of the Mexican flora-mingled with which are species from the Pacific forest on the west and from the Atlantic on the east.

The mesquite and some acacias, the tree yuccas and the giant or tree cactus are perhaps the most characteristic and remarkable species of the deserts of this region, while the high mountains support dense forests of firs and pines.

So far we have considered the forest only from the geographic and botanical point of view, and have watched the history of its struggle for existence against the elements and against the lower vegetation and other forces of nature. A new chapter of its life history, which we shall have time only to scan very briefly, began when man came upon the scene and the economic point of view had to be considered.

For ages man has taken sides against the forest. Not only has he contested for the occupancy of the soil, in order to cultivate his crops or to make the meadow for his cattle—a most legitimate and justifiable proceeding,—and not only has he utilized the vast stores of wood accumulated through centuries, for the ten thousand uses to which this material can be applied, and in the application of which he exhibits his superior intelligence, but he has also shown a woeful lack of intelligence in the willful or careless destruction of the forest without justifiable cause, and by just so much curtailing the bountiful stores provided by nature for him and his progeny. Not only has he, like a spendthrift, wasted his stores of useful material, but more—he has wasted the work of nature through thousands of years by the foolish destruction of the forest cover, wresting from it the toilsomely achieved victory over the soil. He has destroyed the grasses and even all vestige of vegetation, and has handed over the naked soil to the action of wind and water. As the fertility and agriculture of the plain is dependent upon the regular and equable flow of water from the mountains, such as a forest cover alone can secure, he has by baring the slopes accomplished in many localities utter ruin to himself, and turned them back into inhospitable deserts as they first were before the struggle of the forest had made them inhabitable.

One would hardly believe that certain mountains in France had ever seen a luxuriant forest growth, and could during historic times have been so utterly despoiled of their vegetal cover. Yet axe, fire and cattle have been most successful, and the consequences have been felt not only in the mountains, but in the valleys below. The waters in torrents have brought down the soil and débris, covering out of sight the fertile fields of thousands of toiling farmers. They themselves have brought this ruin upon them on account of their ignorance of the relation of forest cover to their occupation. Now, with infinite hard work and expenditure of energy and money, the slow work of restoring the forest to its possessions has begun. The first work is to take care of the rain waters, and by artificial breaks turn them from rushing torrents over the bare surface into a succession of gentle runs and falls by fascine and stone works. This work must be begun at the very top of the mountains, at the very source of the evil, where the water receives its first momentum in the descent to the valley. The fascines or wattles, laid across each rivulet at more or less frequent distances from each other and fastened down by heavy stones, are made of live willows or other readily sprouting species, which in course of time strike root and become living barriers. The pockets behind these breastworks gradually fill up, and the contour of the mountain side is changed from an even and rapid descent into a series of steps with gentle fall, over which the formerly rushing waters, gradually and without turbulence, find their way to the valley below. Where the incline is too steep and higher breastworks are necessary, they are made of masonry, sometimes at great expense. At the base of these overflow dams an opening is left for the water to drain through, even after the depression behind the rampart has filled up with débris and soil has washed down from above. Then, when in this way the soil has come to rest, forest planting begins, and gradually the torrent is "drowned in vegetation." Sometimes, where on a steep mountain side the naked rock alone has been left, it becomes necessary to carry in baskets the soil to the trenches hewn in the rock, where the little seedlings may take their first hold, until they are strong enough to fight their own battle and make their own soil, gradually restoring the beneficent conditions which nature had provided before the arrival of man and his senseless, improvident, self-destructive greed. By the irrational destruction of the forest, first for the supply of timber, then through the careless use of fire, by the clearing for unsuitable farm use, by excessive grazing of sheep and goat, the mountain sides themselves are not only devastated and made useless, but fertile farms for 200 miles from the source of the evil are ruined by the deposit of the débris, and the population pauperized and driven from their homes. Many millions of dollars have been and many more will have to be spent before these regions become habitable again. On plate 7 are shown various views of these processes of afforestation as now practiced in France.

That we are working in this country toward the same conditions is too well known to need rehearsal. Go to the shores of lake Michigan or visit the coast of New England, New Jersey, Pennsylvania, down to the Gulf, and you can see the destructive action of the shifting sands set loose by improvident removal of the plant-cover. Go to the Adirondacks, the highlands of Mississippi, or the eastern slopes of the Rocky mountains, and aspects similar to those derived from France will meet your view.

Thus McGree graphically describes the formation of the Mississippi bad lands:*

With the moral revolution of the early sixties came an industrial evolution; the planter was impoverished, his sons were slain, his slaves were liberated, and he was fain either to vacate the plantation or greatly to

*In a paper read before the American Association for the Advancement of Science, at Washington, in 1891 (not printed).

restrict his operations. So the cultivated acres were abandoned by thousands. Then the hills, no longer protected by the forest foliage, no longer bound by the forest roots, no longer guarded by the bark and brush dam of the careful overseer, were attacked by raindrops and rain-born rivulets and gullied and channeled in all directions; each streamlet reached a hundred arms into the hills, each arm grasped with a hundred fingers a hundred shreds of soil, and as each shred was torn away the slope was steepened and the theft of the next storm made easier.

So, storm by storm and year by year, the old fields were invaded by gullies, gorges, ravines and gulches, ever increasing in width and depth until whole hillsides were carved away, until the soil of a thousand years' growth melted into the streams, until the fair acres of ante-bellum days were converted by hundreds into bad lands, desolate and dreary as those of the Dakotas. Over much of the upland the traveler is never out of sight of glaring sand wastes where once were fruitful fields; his way lies sometimes in, sometimes between, gullies and gorges, the "gulfs" of the blacks whose superstitions they arouse, sometimes shadowed by foliage, but oftener exposed to the glare of the sun reflected from barren sands. Here the road winds through a gorge so steep that the sunlight scarcely enters; there it traverses a narrow crest of earth between the chasms, scores of feet deep, in which he might be plunged by a single misstep. When the shower comes he may see the roadway rendered impassable, even obliterated, within a few minutes; always sees the falling waters accumulate as viscid brown or red mud torrents, while the myriad miniature pinnacles and defiles before him are transformed by the beating raindrops and rushing rills so completely, that when the sun shines again he may not recognize the nearer landscape.

This destruction is not confined to a single field or a single region, but extends over much of the upland. While the actual acreage of soil thus destroyed has not been measured, the traveler through the region on horseback daily sees thousands or tens of thousands of formerly fertile acres now barren sands; and it is probably within the truth to estimate that 10 per cent of upland Mississippi has been so far converted into bad lands as to be practically ruined for agriculture under existing commercial conditions, and that the annual loss in real estate exceeds the revenues from all sources; and all this havoc has been wrought within a quarter century. The processes, too, are cumulative; each year's rate of destruction is higher than the last.

The transformation of the fertile hills into sand wastes is not the sole injury. The sandy soil is carried into the valleys to bury the fields, invade the roadways, and convert the formerly rich bottom lands into treacherous quicksands when wet and blistering deserts when dry. Hundreds of thousands of acres have thus been destroyed since the gullying of hills began a quarter of a century ago. Moreover, in much of the uplands the loss is not alone that of the soil, *i. e.*, the humus representing the constructive product of water work and plant work for thousands of years; but the mantle of brown loam, most excellent of soil stuffs, is cut through and carried away by corrasion and sapping, leaving in its stead the inferior soil stuff of the Lafayette formation. In such cases the destruction is irremediable by human craft—the fine loam once removed can never be restored. The area from which this loam is already gone is appalling, and the rate of loss is increasing in a geometric proportion.

What the farmer has brought upon himself here by excessive clearing, the lumberer, prospector, miner or hunter prepares in the farther west by reckless and purposeless use of fire. Burnt mountain sides, where no living thing can subsist in comfort, cover not acres but hundreds of square miles in the western country. While the first fire only deadens the trees or undermines their constitution, the second or third fire usually is sufficient to kill what remain alive and even to clean up the fallen timber. That these bald spots are not more frequent than they are is only due to the short period of our endeavors in disturbing the balance of nature.

But as our nation prides itself on the rapidity of its development, exercising to the utmost our constructive energies, so do we excel in destructive and wasteful energies and tendencies, and we shall come to grief with our resources much sooner than some of our happy-go-lucky friends would like to make us believe. While these exhibitions of American vandalism are beyond the proprieties of legitimate warfare, there is not much more propriety or intelligence visible in the manner in which we levy tribute from the forest for our legitimate needs. Forests grow to be used, but there is a great difference between intelligent and unintelligent use. Improvidence and ignorance characterize the present methods of using the forest-growth. The value of it is not even known. Of the 425 or more species which are represented in the forests, not more than 40 or 50 at the most are found in the markets. Although, to be sure, many of the species are of but little or of no economic value, the number of the truly useful trees is probably twice or three times as great as that actually used. Ignorance as to the true value of them keeps many from little more than simply a strictly local use or from their most fit employment. The story of the black walnut used for fence rails or firewood is well known. Six years ago the red gum or liquidambar, now a fashionable finishing material, was despised. Ten years ago large hemlock trees were mouldering in the woods after the bark had been taken for tanning purposes because the value of the wood was unknown. Cypress and Douglas spruce cannot yet overcome the prejudice of the market. On the other hand, cottonwood and tulip poplar, not long ago among the despised or only locally used, can hardly now be furnished in sufficient quantities, and the long-leaf pine, which had been bled for turpentine, was considered an inferior material, which, as has lately been shown, is nothing but an unwarranted prejudice.

In a vague empirical way the choice of the useful has been attempted and only lately have we begun to systematically study our forest resources, to determine the qualities and adaptabilities of our timbers, and to find out the conditions under which they produce not only the largest amount but the best quality of timber.

Yet in another direction do the forest users act unintelligently. As we have seen, most of our forest trees are of a social character. With few exceptions, they keep company with other kinds than their own; they appear in mixed forests. Hence, except where certain species as the pines and spruces become gregarious and form unmixed, pure forests, the axe of the lumberer does not as a rule level the entire forest, but he selects the kinds which he wishes to use—he culls the forest. At first sight this would appear rather an advantage for the existence of the forest. So it is from a botanical, geographic or landscape point of view, yet from an economic point it is exactly the reverse—it is disastrous.

This can be readily understood if we recall our story of the battle of the forest monarchs among themselves, the struggle which each species sustains to occupy the ground. Man taking sides in the struggle by culling the best, the most useful, decides the battle for the least deserving, leaving the advantage to the scrubs and inferior tribes; and since these are left to overshadow the ground and to spread their own brood over the open spaces, the culled forest, while still a forest to the casual observer, has lost its economic value not only for the present, but for the future also, for it prevents the reproduction of the better kinds. The intelligent forester also acts as a partisan; he also uses the axe, but to better purpose. Before he utilizes the kinds for which he wishes to perpetuate the forest, he culls the inferior and leaves the superior—*i. e.*, the most useful races; he gives direction and assists the most fit in the struggle for supremacy; he substitutes artificial for natural selection, assuring the protected survival of the most useful; he hastens the decision of the struggle by obviating, if possible, useless expenditure of energy by timely interference, thereby securing not only a larger total and more valuable product for the present, but a reproduction of only the best kinds for the future.

In the well managed forests of Germany the undeserving species are exterminated and the most useful fostered, just as the agriculturist exterminates the weeds and cultivates the crop. Not only is the forest there confined to those soils and locations which cannot be used to better advantage or which require a forest cover in order to protect the soil against detrimental dis-

FIGURE 1.—*A German spruce Forest under management.*

placement, but it is so managed as to become a more and more valuable resource, a crop of increasing importance, under the management of skilled foresters, of whom, in a late debate on the floor of the Landtag of Prussia, it was said that "While most other productive business has declined, the forest administration has steadily improved and yielded increasing revenues." In figure 1 is shown one of these protected German forests of spruce, as they grow, not planted, but naturally regenerated by skillful management and use of the axe.

The battle of the forest in this country is now fought by man, the unintelligent and greedy carrying on a war of extermination, without the knowledge that their victory may lead eventually to their own destitution; the intelligent and provident trying to defend the forest cover and endeavoring to prevent its removal from such lands as cannot serve a better purpose, and to restrict the use of the balance to such rational harvest of its material, without injurious effects on soil and water conditions, as will insure an ever reproducing crop and a permanent national resource.

While man may *study* the geography of the earth as it exists, here is about the only opportunity for him to *make* geography, to shape the surface conditions of the earth, and even to some extent influence its climatic conditions.

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THE

NATIONAL GEOGRAPHIC MAGAZINE

SURVEYS AND MAPS

OF THE

DISTRICT OF COLUMBIA

MARCUS BAKER

WASHINGTON
Published by the National Geographic Society

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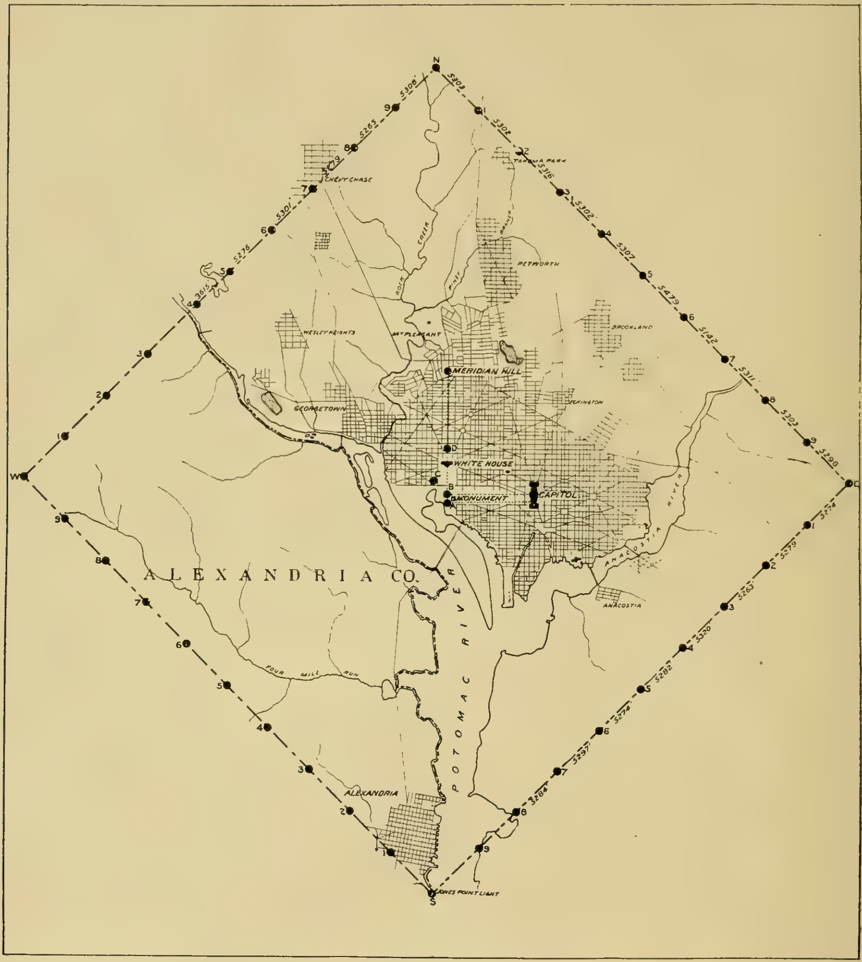

DISTRICT OF COLUMBIA.

The figures on the border show the numbers of the milestones marking the boundary and their distances apart in feet. One mile equals 5,280 feet.

A = *Capitol stone.*—South of the *White House* and west of the south end of the old Capitol. Undressed and unmarked sandstone, about 4 feet high, set in 1804, now gone and site unmarked.

B = *Jefferson stone.*—South of center of *White House* and west of center of Capitol. A "freestone obelisk," set in 1804, 175 feet 8½ inches north of the *Capitol stone;* said to be now used as a hitching post at the Reform school. Site now marked by a granite post flush with sod in the Monument lot.

C = *Center of the original District of Columbia.*—It is near the corner of Seventeenth and C streets, being 1,305 feet north and 1,579 feet west of the Washington monument.

D = *Stake at intersection of "Sixteenth and northern edge of north I street."*—Set in 1804. Whether still in place is not known.

Meridian Hill.—"A freestone obelisk," set in 1804, "to mark the initial meridian for longitudes in the United States." Stone gone and site unmarked. Stone said to be in use as a carriage step at Fourteenth and R streets; also said to be in use as a hitching post at the Reform school.

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SURVEYS AND MAPS OF THE DISTRICT OF COLUMBIA

BY

MARCUS BAKER

(*Presented before the Society March 23, 1894.*)

On the 15th of April, 1791, there was laid, with solemn and elaborate masonic ceremonial, the corner stone of the District of Columbia. This stone, still standing, though hidden from view, forms a part of the foundation wall of the lighthouse at Jones point, near Alexandria, Virginia. It is under the gateway in front of the south door of the lighthouse. The long and tedious discussion which led to the selection of a district, not to exceed ten miles square, on the banks of the Potomac, between its Eastern branch and the Conogocheague, does not belong to the present theme. It suffices to say that selection had been made by act of Congress July 16, 1790. Under this authority President Washington directed a preliminary or provisional survey of the area to be taken for the Federal Government. This preliminary survey he directed should begin at a point on Hunting creek determined by running a line from Alexandria courthouse southwestward half a mile and thence southeastward to the northern shore of Hunting creek. From the point so found a tract substantially like the District of Columbia as it existed prior to the retrocession of Alexandria county to Virginia, in 1846, was selected; but this tract included a portion of Maryland lying *south* of the Eastern branch of the Potomac, or Anacostia river, and could not be taken under the terms of the act, which provided that the Federal territory should lie wholly *north* of the Eastern branch. This being reported to Congress, an amended act was promptly passed authorizing the boundaries of the District as originally laid out. Washington then gave directions for running the definitive boundary lines. As is well known, Washington was a surveyor, and therefore well qualified to draw up instructions to surveyors. It is interesting to quote his language:

> Now, therefore, for the purpose of amending and completing the location of the whole of said territory of ten miles square, in conformity with the said amendatory act of Congress, I do hereby declare and make known that the whole of said territory shall be located and included within the four lines following, that is to say:
>
> Beginning at Jones point, being the upper cape of Hunting creek, in Virginia, and at an angle in the outset of forty-five degrees west of the north, and running in a direct line ten miles, for the first line; then beginning again at the same Jones point and running another direct line, at a right angle with the first, across the Potomac ten miles, for a second line; thence from the termination of said first and second lines, running two other lines of ten miles each, the one crossing the Eastern branch aforesaid and the other the Potomac, and meeting each other in a point.

To take charge of the newly created territory, supervise its survey, and attend to the business growing out of its condemnation for public use, Washington appointed, January 22, 1791, three commissioners, Thomas Johnson, Daniel Carroll, then a member of Congress from Maryland, and Dr David Stuart.

Two months later, March 28, 1791, Washington arrived in Georgetown from Philadelphia, and the next day made a tour of inspection of the District in company with the three commissioners and two surveyors, Andrew Ellicott and Major Peter Charles L'Enfant. The commissioners held their first meeting on the 12th of April following, in Georgetown, and three days later, namely, the 15th of April, 1791, as already mentioned, the corner stone at Jones point was laid with solemn masonic ceremonial, in the presence of a large gathering of citizens, chiefly from Alexandria. The survey then proceeded, and in September following the commissioners decided upon the name which was to be given to this new Federal territory and the city to be created within it. They ordered that the title of the map prepared by Major Ellicott should be "A map of the city of Washington, in the Territory of Columbia." Before this time the future city was referred to as the Federal city.

How the boundaries of the District were run I do not know, but suppose that it was done with transit and chain. As the country was timbered, and as the boundary crossed the Potomac twice and the Eastern branch once, it will be seen that the task was not a perfectly simple one. It appears that the work of measuring and staking out the outline of the District was completed in 1791; that during the following year the line was cleared of timber to the width of 20 feet on each side; and that in this 40-foot lane through the woods stone mileposts were erected. These posts are two feet high and one foot square. They are marked on the District side, "JURISDICTION *of the UNITED STATES*," followed by an inscription showing the distances from that corner of the District from which they are numbered, such as "*Miles 3*," "*Miles 6 & 10 P.*," etc; on the opposite side, "*Maryland*" (or "VIRGINIA"); on the third side, the year "*1792*" (except the Virginia stones, marked "*1791*"); and on the fourth side, the variation of the compass. The stones are numbered from 1 to 9 on each line, from south to west, west to north, etc.*

About ten years ago the Coast Survey executed a triangulation for the purpose of determining the geographic positions of

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* Since the foregoing was written I have personally visited and inspected most of the boundary monuments of the original District of Columbia, set in 1791 and 1792. Though this inspection is still incomplete, it is deemed advisable to print here the following table, showing the condition of the monuments so far as inspected, and especially to print the *variation of the compass* recorded upon them. These variations are the earliest ones observed and recorded for the District of Columbia, and the only record of them known to me is upon these boundary monuments. These monuments are of Aquia creek sandstone and were sawed out. Through abuse and exposure to the weather the inscriptions are becoming obscured, a few being already totally lost.

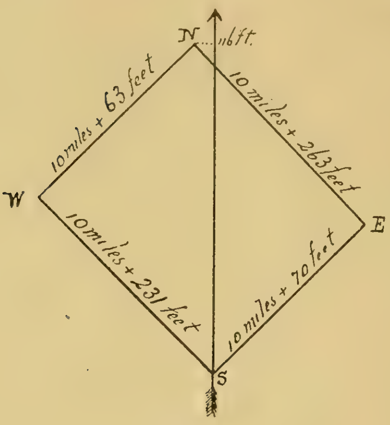

FIGURE 1.—*District of Columbia.*

the corners of the original District, as well as some other points. The work was done by Mr C. H. Sinclair, of the United States Coast and Geodetic Survey. To his courtesy and that of the Coast Survey office I am indebted for the following facts respecting the boundary line. The District is not an exact square or spherical quadrilateral. Its distortion, much exaggerated, is shown in figure 1. The northern point is not exactly north of the southern point, but bears 5′ 19″.7 west of north of it.

BOUNDARY MONUMENTS OF THE DISTRICT OF COLUMBIA.

Erected in 1791–'92. Condition in 1894.

Monument.	Variation.	Condition, etc.	Monument.	Variation.	Condition, etc.
S.	?	Invisible; built into L. H. wall.	N.	1° 2?′ E.	Fair condition; erect.
S. W. 1	0° 30′ W.	Erect; good condition.	N. E. 1	1° 06′ E.	Fair condition; leaning.
2	? ?	Stone gone.	2	1° 12′ E.	Fair condition; erect.
3	? ? E.	Very bad condition; figures illegible.	3	0° 18′ W.	Fair condition; erect.
4	....	....	4	0° 25′ W.	Good condition; erect
5	....	....	5	0° 22′ E.	Leaning; fair condition.
6	....	....	6	0° 51′ E.	Erect; very good condition.
7	0° 05′ E.	Leaning; bad condition; open field.	7	1° 08′ E.	Erect; seamed; in woods.
8	....	....	8	0° 24′ E.	Erect; good condition.
9	....	....	9	0° 19′ E.	Poor condition; erect.
W.	....	....	E.	0° 10′ E.	Erect; good condition.
N. W. 1	....	....	S. E. 1	....	....
2	0° 35′ E.	Erect; bad condition; in woods.	2	0° 04′ E.	Erect; excellent condition.
3	0° 10′ E.	Broken down by army wagon; very bad condition.	3	0° 08′ W.	Bad condition.
4	0° 03′ W.	Erect; fair condition; in woods.	4	?	Illegible; very bad condition.
5	0° 4?′ W.	Erect; fair condition.	5	0° 21′ E.	Erect; fair condition.
6	?	Illegible; bad condition; at roadside.	6	0° 18′ E.	Erect; excellent condition.
7	0° 59′ E.	Erect; good condition; in meadow.	7	0° 25′ E.	Buried nearly out of sight.
8	0° 29′ E.	Erect; fair condition; in young timber.	8	0° 34′ E.	Partly buried in swampy thicket.
9	2° 00′ E.	Erect; fair condition; in thick woods.	9	0° 37′ E.	Leaning; at river edge; fair condition.

Variation in 1792, *teste* Ellicott, mean of 27 values.............................. 0° 25′ E.
Variation in 1894 (assumed).. 4° 25′ W.
Change in 102 years.. 4° 50′
Change in 1 year... 0° 2′.8

It is therefore 116 feet west of the meridian through the southern corner. The lengths of the four sides, intended to be exactly ten miles long, are found to be in fact as follows:

Southwestern	side	is	10	miles	plus	230.6	feet	long.
Northeastern	"	"	10	"	"	263.1	"	"
Southeastern	"	"	10	"	"	70.5	"	"
Northwestern	"	"	10	"	"	63.0	"	"

Thus the District is approximately a rectangle, the northeastern and southwestern sides exceeding ten miles by about 245 feet, and the southeastern and northwestern sides each exceeding ten miles by about 65 feet. If a more critical examination be made, it will be found that the distances between the various mileposts differ quite sensibly from miles, and it will be found further that the stones are not in line. The actual lengths of these supposed miles may be seen on plate 9.

As to direction, consider line number 1, or the southwestern line. It is intended to bear 45° west of north. Its actual direction, as now appears from the Coast Survey determinations already referred to, is 44° 59′ 24″.6 west of north, or about half a minute less than intended. The second, or southeastern line, which was to bear north 45° east, is found actually to bear north 45° 1′ 45″.6 east, exceeding the intended value by $1\frac{3}{4}'$.

Site of Washington before 1790.—How did the site of Washington and the District of Columbia look before 1790? No contemporary map, so far as I know, exists to answer this question. Still, scattered bits of information here and there, diligently and patiently collected by Dr J. M. Toner, have enabled a map to be made which in part answers the question. Twenty years ago Messrs E. F. M. Faehtz and F. W. Pratt, authors and publishers of a real estate directory of Washington, published a book entitled "Washington in Embryo," in which they include a map "compiled from the rare historical researches of Dr J. M. Toner." This map shows the drainage, farm outlines, etc, of the tract on which Ellicott laid out a great city in 1791. Within this tract existed one real and two paper towns. Georgetown was the real town, and had been in existence some 35 or 40 years, while Carrollsburg and Hamburgh existed on paper only.

Carrollsburg was a tract of 160 acres on the northern bank of the Anacostia, just east of the Arsenal grounds. Before its subdivision into 268 town lots it was known as Duddington manor or Duddington pasture. The town laid out in the latter part of 1770, near the deepest water of the Eastern branch, was doubtless named after Daniel Carroll, an extensive land owner on Capitol hill. The subdivision was made under a deed of trust recorded at Marlborough, Maryland, November 2, 1770.

Hamburgh is or was the name of a town surveyed and laid off in town lots by its owner, Jacob Funk, whose plat is recorded at Marlborough, Maryland, October 28, 1771. The tract embraced 120 acres and was divided into 287 lots. The town was located with reference to deep water in the Potomac, and occupied in part the site of the old Naval Observatory. It was sometimes called Funkstown, after its owner.

The L'Enfant and Ellicott Maps.—Preceding and during the surveys already described, a French engineer, Major Peter Charles L'Enfant, was engaged under Washington's direction in planning the future capital. The map which he prepared may be called a paper map—that is, it was a project in which the city was laid out on paper. This, the first map of Washington, is now in the custody of the commissioner of public buildings and grounds, in the War Department. Having become much faded and worn with use, it was a few years since sent to the Coast Survey office, where it was very carefully traced and a photolithographic copy of it prepared.

After the approval of L'Enfant's plan, the next step was to lay out the streets, parks, reservations, etc, upon the ground. This work was entrusted to Major Andrew Ellicott, and his map appears to have been first engraved in 1792. The manner in which the city was laid out is told in a note upon the map itself, which is as follows:

> In order to execute this plan, Mr Ellicott drew a true meridional line by celestial observation, which passes through the area intended for the Capitol; this line he crossed by another due east and west, which passes through the same area. These lines were accurately measured and made the base on which the whole plan was executed. He ran all the lines by a transit instrument and determined the acute angles by actual measurement, and left nothing to the uncertainty of the compass.

Near the intersection of North Capitol and R streets is, or till recently was, a monument, which I have not seen, said to be some fifteen feet high, on land owned by a Mr Beall. I have been unable to secure definite information as to the purpose of this monument or its use. It seems probable that it was a monument erected by Mr Ellicott as an azimuth mark, and its recent destruction is therefore regretable.

The boundary line, as has been seen, was run out in 1791. It was cleared of timber and most of the milestones set during the following year, 1792, and it is probable that during this same year Ellicott produced the general topographic map of the entire District, the date of publication of which is uncertain. The only copy of this map of the District known to me is in the Library of Congress, entitled "Territory of Columbia, drawn by Andrew Ellicott." Its conjectural date, added in pencil, is 1793. This map was republished in 1852, the republication being seemingly a facsimile in all respects, except the omission of the phrase "drawn by Andrew Ellicott." Reduced copies of it have been several times published. Down to the publication of Boschke's map of the District at the outbreak of the war, this topographic map of the District by Ellicott is apparently the only one ever made.

Land Office Surveys.—In the surveying division of the General Land Office is a not very large package of papers relating to surveys by the United States of public lands in the District of Columbia. The ragged and yellow label, written in a large, fair hand, runs thus: "Papers relating to applications to appropriate certain lands in the District of Columbia under the provisions of the joint resolution of Congress of February 16, 1839," etc.

This package contains all the papers in the General Land Office relating to public land surveys in the District of Columbia, the history of which is briefly this: After the settlement of the District of Columbia had progressed for some years or decades, it was found that here and there errors had been made by surveyors in staking out or marking the boundaries of lots, farms, and estates. In some cases a tract might by the terms of its description be counted in two adjoining tracts, and so two people might claim the same tract. In other cases tracts supposed to adjoin were found not to touch, and there would thus be a tract lying between which had no private owner. This tract then belonged to the United States. The person discovering this error naturally wished to acquire possession of this now valuable land. That he might do so, congressional authority was necessary. Accordingly, on February 16, 1839, a joint resolution was passed by Congress permitting purchase under the old Maryland law of 1801, which provided for the sale of "vacancies"—*i. e.*, unoccupied or unclaimed land. Under this provision the General Land Office acted as the local land office for the District of Columbia, and whenever vacancies were discovered and reported a request for survey was presented. A deposit of three shillings and six pence per acre, Maryland money, was required, and an additional charge of four shillings was afterward required to complete the purchase, which thus cost the purchaser seven shillings and six pence, or one dollar, per acre. It is interesting to note that under this law the General Land Office has received applications for and has made surveys of about 60 tracts in the District of Columbia. Perhaps the most noteworthy case was that of the Kidwell bottoms, or Potomac flats, as we now call them.

The Boschke Maps.—Albert Boschke was a German employed in the Coast Survey before the war. He conceived the idea of making a very accurate map of Washington and of the District of Columbia, with the hope of selling to the Government.

He was at the time employed in the drawing division of the Coast Survey, and while so employed organized a corps of surveyors at his own expense to do the fieldwork. This gradually absorbed his time and thought, led to irregular attendance at the office, and finally to his enforced resignation from the survey.

Two maps resulted from his work, one a map of the whole District, the other a map of the city. The map of the District is usually spoken of as the Boschke map. It was engraved upon copper by Mr David McClelland, and was just about to be published—indeed, a few copies or proofs had been printed—when, the war breaking out, the Government seized the map and plates.

The map of the city was produced first and published in 1857. It is interesting from the fact that the houses were drawn from actual tape-line measures in the field and drawn with scrupulous painstaking. It is also interesting as being one of the early pieces of work of the well-known firm of lithographers, Bien & Company, of New York.

The field-work of the District map was based primarily upon a line from the dome of the Capitol to the Naval Observatory. The data was taken from the Coast Survey Report for 1851, and the position of the observatory as there given was assumed by Boschke to refer to the transit circle.

It subsequently appeared that it referred to the station on the roof from which angles had been measured, and his base line was thus in error by about eight feet. This small error is still in the map.

The roads were meandered by two parties, one with transit and chain, the other with a level. Their results being platted, the plats were taken to the field and the contours and other details sketched in.

The Virginian part of the District, it will be remembered, had been ceded back to Virginia in 1846. Boschke's map did not, therefore, include any of the topography in Alexandria county. That which now appears on the so-called Boschke map was added by two Coast Survey officers, Messrs Dorr and Rockwell, in the first year of the war. At the outbreak of the war the United States had no topographic map of the District, the only topographic map existing being the manuscript produced by Boschke. He sold his interest in it to Messrs Blagden, Sweeney, and McClelland. Mr McClelland is an engraver, now seventy-four years old, living in Le Droit park. He engraved the Boschke map, which was executed on two plates. With his partners, he agreed to sell the manuscript and plates to the Government for $20,000. Secretary of War Stanton, not apparently understanding the labor and expense of a topographic map, thought that $500 was a large sum. There was, therefore, a disagreement as to price. After some negotiations, Mr McClelland and his partners offered all the material, copper-plates and manuscript, to the Government for $4,000, on condition that the plates, with the copyright, should be returned to them at the close of the war. This offer also was refused. There then appeared at Mr McClelland's house in Le Droit park a lieutenant, with a squad of soldiers and an order from the Secretary of War to seize all the material relating to this map. Mr McClelland accordingly loaded all the material into his own wagon and, escorted by a file of soldiers on either side, drove to the War Department and left the material. While the war was still in progress, after further conference, Secretary Stanton agreed to refer the question of payment for this property to the Committee on War Claims. That committee recommended a payment of $8,500, and the owners, regarding this amount in cash as worth more than future uncertainties, decided to accept it. Thus all the material became Government property at a cost of $8,500, and the plates, two in number, are now in possession of the War Department. Electroplate copies of them are also in the possession of the Coast

Survey. A subsequent claim for the difference between $8,500 and $20,000, the price asked, was presented to Congress, which decided that the acceptance of the $8,500 settled the claim, and no more has ever been allowed.

United States Geological Survey Map.—In 1885–'86 the United States Geological Survey made a contour topographic map of the District and surrounding country in Maryland and Virginia. This map is a part of the general topographic map of the United States which that survey has in hand. The hill forms are shown by means of contours with intervals of twenty feet. The scale is one mile, approximately, to one inch. Existing maps were used in its preparation so far as they were available, and for the rest the work was done in the field. The method followed was largely that of traversing, the traverse lines being controlled by triangulation.

United States Coast and Geodetic Survey Map.—A very elaborate and detailed topographic survey of the District of Columbia was instituted in 1881. In the District of Columbia appropriation bill for the fiscal year 1880–'81 there was inserted an item appropriating $5,000 "for surveys of the District of Columbia, with reference to the future extension of various avenues to the District line." Under the authority thus given, topographers from the Coast Survey were detailed to execute the work. It was arranged that the map should be on a scale of 1:4800, or 400 feet to an inch. This is a scale of about 13 inches to the mile. The work was planned to be most accurate and detailed, and the relief was to be expressed in contours, with a five-foot interval. The survey thus planned and begun is now completed, and covers the entire District outside the original limits of Washington and Georgetown—that is, it covers an area of 48.2 square miles. Work was in progress during the ten years, 1881–1891, in which there was specifically appropriated for it $65,600. The resulting map sheets are not yet published. Some photolithographic sheets have been issued from time to time, but they do not cover the entire area. The work is being engraved upon copper and printed in four colors—black for culture, blue for water, brown for hill forms, and green for woodland. A few such sheets have been issued, each sheet covering about one square mile. It will be seen that this survey is one of the most detailed, elaborate, and careful pieces of topography that has been executed in this country up to date, and its publication is awaited with interest.* It is proposed to number the sheets consecutively from 1 to 100. If the original District of ten miles square be subdivided into 100 square miles there will be one atlas sheet to each square mile. Beginning at the northern corner of the District and running southeastward, the sheets will be numbered 1, 2, 3, etc, up to 10; thence returning to the northwestern side, the next row will be numbered 11, 12, 13, etc, to 20, and so on to complete the entire District.

The First Meridian.—Old residents of Washington and some of the modern ones also know the term Meridian hill. The story of this name is a story of surveying and thus a part of our theme. A hundred years ago it was the custom of various nations to reckon longitude from their own capitals—a bad custom not yet quite dead. Our grandsires, proposing to follow this practice, gave early attention to establishing a first meridian. Joined to it was the idea of a national observatory and American ephemeris, to the end that the young republic might in these respects as well as in all others be quite free from dependence on foreign nations. The complete story of this first meridian seems to be still unwritten.

On L'Enfant's plan for the Federal city the letter *B* appears on the site of the Emancipation statue in Lincoln park, about a mile east of the Capitol. A marginal note indicates the plan proposed for this place, to wit:

> An historic column; also intended for a mile or itinerary column, from whose station (a mile from the Federal house) all distances of places through the continent are to be calculated.

This appears to indicate that L'Enfant planned to have the primary meridian of the United States pass through a point exactly one mile east of the Capitol. Still this is not certain, as the only evidence discovered is the marginal note just cited. On the same map the longitude of the Capitol is given as 0° 0′, *i. e.*, according to this note the first meridian was to pass through the Capitol, or Congress house, as it was then called. As a first meridian could not at the same time pass through the Congress house and a point one mile east of the Congress house, it seems likely that the eastern one never got beyond the suggestion or proposal on the original plan.

*Since this was written and while this article is in press the Coast Survey has issued a map of the District of Columbia in five sheets. It is a black photolithograph; scale, 1:9600, or 800 feet to an inch.

When in 1791–'92 Ellicott laid off the streets, avenues, reservations (or appropriations, as they were then called), he began by drawing "a true meridional line by celestial observation, which passes through the area intended for the Congress house; this line he crossed by another due east and west, which passes through the same area. These lines were accurately measured and made the bases on which the whole plan was executed."

This line of Ellicott's is probably, perhaps surely, the first meridian laid down on the ground in the District of Columbia, and may have been designed for two purposes: first, to serve locally as a reference or base-line from which to lay out the then imaginary city, and second, to serve as a first meridian from which to reckon longitudes in the very young and very patriotic republic.

Now Meridian hill is not north of the Capitol, but north of the White House, at the head of Sixteenth street, and so we have another meridian to consider.

In the State Department is a letter from Nicholas King, S. C. W. (which I take to mean surveyor city of Washington), to the President of the United States (Jefferson) relative to a meridian line through the President's house. It is dated October 15, 1804, and upon it are two endorsements. The first is "Nicholas King. 15 Oct^{r}. 1804. Meridian Line through the centre of the President's house." The second is "King Nich^{s}. Surveyor's office Oct. 15, 04. rec^{d}. Oct. 15. to be filed in the office of state as a record of the demarcation of the 1st. meridian of the U. S."

This is an important letter,* and as it appears not to have been published, I have appended a copy of it to this paper.

It appears that Mr King, under the direction of a Mr Briggs, laid out a meridian line along Sixteenth street in 1804. Who ordered this work done I do not know; but as Mr King, who ran the line, made a report to President Jefferson, and as this report was sent to the State Department and endorsed to be filed as a record of the demarcation of the first meridian of the United States, I infer that the work was done at the instigation of President Jefferson and for the purpose of marking the initial meridian line from which longitudes were to be counted in the United States.

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*I am indebted to the courtesy of Mr Fred L. Harvey, formerly secretary of the Washington National Monument Association, for calling my attention to and furnishing me with a copy of this letter.

Thus I infer that L'Enfant planned to have the first meridian pass through a point exactly one mile east of the Capitol; that President Jefferson planned to have the first meridian pass through the President's house, about one and one-half miles west of the Capitol, whereas the meridian afterward adopted by Congress was that of the Capitol itself.

The meridian through the President's house was, as already indicated, run out in 1804 by Nicholas King. Setting up his transit at the northern door of the White House and pointing to the star "in the tail of the constellation Ursa Minor at its eastern elongation," he then depressed the telescope to sight a mark at the intersection of Sixteenth and north I streets. This mark was an Argand lamp placed on a very low stand. Over the lamp was a tin cylinder with a slit in it. The offset or distance from this mark westward to the true meridian line was then calculated and very carefully measured, and the meridian "line marked on the head of a post firmly driven into the ground" at the intersection of Sixteenth street with the northern side of north I street. No surface marks now show the place of this historic post. Is it or its decayed remains still in place beneath the pavement or was it removed long ago? The telescope was now elevated and pointed due north "to the top of a hill near two miles north of the President's house, on the lands of Mr Robert Peter, where temporary posts were fixed and the line marked upon them."

Early in September of 1804 Mr King, with the consent of Mr Peter, "planted a small obelisk of freestone, prepared by Mr Blagden, on the height where the stakes (or posts) had been fixed." The apex of this stone was in the true meridian from the center of the northern door of the White House.

The line was extended southward across Tiber creek and two stones planted near the site of the future Washington monument. It was planned to set a stone exactly south of the center of the President's house and exactly west of the center of the Capitol. The surveyor, on reaching this spot and finding the Capitol invisible, prolonged the line and set a stone at the intersection of the meridian and a line due west from the southern end of the old Capitol. This stone was standing when I came to Washington, some twenty years ago; I have seen it many times. It was a rough brownish sandstone or freestone about 10 inches square and 3 to 4 feet high. I do not remember any marks or inscription upon it. It was always pointed out to me as the center of the District. In the recently published centennial history of Washington this is called the *Capitol stone.* It is now gone and its site is unmarked.

After establishing the Capitol stone Mr King measured back toward the White House 175 feet 8½ inches, a distance just one-half of the length of the Capitol as it then existed, and here erected a monument. Of the spot and its mark he says:

It is on the south bank of Tyber creek, and marked by the erection of a small pier, covered by a flat freestone, on which the lines are drawn.

Ex-Commissioner Webb, in his centennial history of Washington, already mentioned, page 28, calls this the *Jefferson stone* or Center stone and describes it, as also its removal in 1872 by order of General Babcock, who seems not to have been aware of its character or history.

It seems probable that this Jefferson stone was removed when grading was in progress and the Capitol stone carefully preserved; that later the relation of these stones, as has been described above, became known to the engineers, who then set a new stone in place of the removed Jefferson stone, and then removed the Capitol stone.

The more or less exact site of the Jefferson stone is now marked by a cut granite stone (or post) planted nearly flush with the ground and marked by a deep cut across, north and south by east and west. It may be seen on the green lawn on the eastern side of and near to the driveway west-northwest from the Monument.

Recapitulating, then, we find that along the meridian line through the White House, run in 1804, were three stone monuments—Meridian stone, Jefferson stone, and Capitol stone, and a wooden post at I street north. The Meridian stone is gone and its site is unmarked. The Capitol stone is gone and its site is unmarked. The Jefferson stone is gone, but its site is marked. Some suitable label or inscription would, however, add greatly to the interest of this mark, which is, as it now stands, meaningless to most people. And, lastly, the forgotten post on I street. Of this we have no present knowledge.

A word now about the stone on Meridian hill. It will be remembered that Commodore (afterward Admiral) Porter had a mansion on the old Peter place, at the head of Sixteenth street. Its main entrance was due north of the main entrance to the

White House. Exactly in line between these doorways, on the lawn south of the house, stood a low sandstone block, on which was placed a brass sun-dial. The stone was carved in cylindrical form on its northern side. This stone, so the story goes, was removed when Sixteenth-street hill was cut down some twenty years ago, and is now doing duty as a carriage step at the corner of Fourteenth and R streets. On talking with the owner of the place at Fourteenth and R streets, however, he denied vigorously that this was the Meridian stone. He described the Meridian stone as similar to the Capitol stone; and Mr King, who set the Meridian stone and the Capitol stone in 1804, also describes them as similar. I infer, therefore, that two stones at the head of Sixteenth street have been called Meridian stone. The original one, still extant, is said to be now serving as a hitching post in front of the Reform school. The carriage step at Fourteenth and R streets is probably a later stone set up as a base or support for a sun-dial, and came to be known as *the* Meridian stone to the exclusion of the original freestone obelisk.

The Center of the District.—It is commonly stated and believed that the Jefferson stone was established at the exact center of the original District, and that the Washington monument, which is less than 200 feet therefrom, practically marks such center. Unless I am mistaken, this is an error, and the center of the original District is nearly half a mile (2,048 feet N. 50½° W.) northwest from the monument.

When Ellicott marked out the District boundary he had to find a true meridian line astronomically. This he did at Jones point, but I do not know of anything to show that he ran this "true meridional line" through the present Washington. It is stated in the recent centennial history that he did, but on what evidence does not appear. It is also stated that this line ran exactly through the middle of the White House and up Sixteenth street, but the surveys now available show that the meridian of Jones point passes west of the State, War, and Navy building and nearly along Eighteenth street.

It seems to have been assumed that because Ellicott *determined* the meridian at Jones point that he *ran* that meridian through Washington, and that the terms Meridian stone, Meridian hill, Meridian hill farm, etc, are derived from his work, whereas the facts seem to show that these names are due to the work of another surveyor, working thirteen years later, under different instructions, on a different problem, and for a quite distinct purpose. In short, the Sixteenth-street meridian, established in 1804, is quite independent of the center of the District and quite independent of Ellicott's survey.

The location of the center of the original District is one proof of this. This central point is at the intersection of the diagonals. The latitudes and longitudes of the four original corners and of the Washington monument enable us to make the following comparison:

	Latitude north.	Longitude west of Greenwich.
Center of District	38° 53′ 34″.915	77° 02′ 27″.745
Washington monument	38° 53′ 22″.02	77° 02′ 07″.78
Difference	12″.895	19″.965

It thus appears that the center of the District is 12″.895 or 1,305 feet farther north and 19″.965 or 1,579 feet farther west than the monument. This locates it on or near C street north, between Seventeenth and Eighteenth streets west. This is the center of the original District.

APPENDIX.

Surveyor's Office, 15th *Octr.*, 1804.

Sir: Being requested by Mr Briggs to assist him in running a true meridian line which should pass through the center of the President's house, and to perpetuate the same, as also the point of intersection by a due west line drawn from the center of the Capitol by fixing permanent marks thereon, and as the pressure of other official engagements prevented his attention to more than ascertaining the meridian line and marking it temporarily, it devolves on me to describe the mode pursued in ascertaining the line and the required intersections, that others may know what dependence is to be placed on their accuracy.

In running the meridian line I acted only in the capacity of assistant, conforming entirely to the instructions of Mr Briggs, and executing with all the care in my power the marking of his temporary line, agreeably to his signals and instructions, in giving which I believe he used all the accuracy of which the instrument was capable.

With a new transit instrument, executed by Voigt of Philadelphia, he ascertained the place of the star, in the tail of the constellation Ursa Minor, on its greatest eastern elongation, and, continuing the vertical circle to the surface of the ground by the instrument, he determined the bearing, in the line of which on a very low stand was placed one of Argand's lamps covered by a tin cylinder, in which a small slit was made for a sight, and the line from the light toward the instrument was drawn upon the stand. Knowing the radius of the circle described by the star, or half the angle formed by its greatest elongations, east and west, and the altitude of the pole, he by calculation deduced the horizontal angle made by two vertical circles, one of which is the meridian passing through the pole; the other through the star's place when farthest east. This horizontal angle being found, and the base line measured from the place of the instrument (the north door of the President's house) to where it is intersected by an east-and-west line from the place of the light or sight used (the north side of north I street), afforded the necessary data for calculating the distance to be measured west from the place of the sight to the true meridian line, which offset was very carefully made and the line marked on the head of a post firmly driven into the ground. The meridian being thus fixed and a point found due north from the place of observation, the line was continued by the instrument at one sight and tested by reversing the telescope at an intermediate station in the line to the top of a hill nearly two miles north of the President's house, on the lands of Mr Robert Peter, where temporary posts were fixed and the line marked upon them, according to the instructions by signal from Mr Briggs at the instrument. From the President's house the line was reversed by the instrument and continued south across the Tyber creek and marked in the same manner on the head of posts driven in the public appropriation called the mall.

Having obtained the permission of Mr Peter, early in September I planted a small obelisk of freestone, prepared by Mr Blagden, in the meridian line north of the President's house, on the height where the stakes had been fixed under the direction of Mr Briggs. The apex is in the true meridian from the center of the north door.

In perpetuating the south line it was deemed best to place the stone where the meridian line should be intersected by a west line from the Capitol. The surface of the ground, however, being unfavorable—the Capitol not being visible at the point of intersection—it suggested the planting an obelisk similar to that on the north line at a point on the meridian west from the south end of the Capitol and where the building was distinctly seen, and from thence find the intersection of the center line by measuring northwards half the length of the Capitol. Although the body of the building was in full view, yet intervening trees prevented my seeing with the necessary distinctness the south end of the Capitol; and I had to find the required point on the meridian by setting off the angle included between the northwest corner of the building and the center of the President's house. This angle I had previously calculated, from the distance, 7,696.8 feet, and the length of the Capitol, 351 feet 5 inches, to be 87° 23′ 6″.8. For the greater accuracy I measured this angle from different parts of the circle of a theodolite, made by Adams, going several times around the instrument and taking the mean as the correct angle. In one instance, however, I found a variation of nearly two minutes in the angular distance of the buildings; in others they would coincide for several observations. I thus ascertained my position and the point on the meridian line from which a line drawn at right angles due east would touch the south end of the Capitol with all the precision the instrument is capable of. Here I planted the obelisk, and measured from the center of it north 175 feet 8½ inches, half the length of the building, for the point of intersection on the meridian drawn through the center of the President's house by a west line from the center of the Capitol. It is on the south bank of Tyber creek and marked by the erection of a small pier, covered by a flat freestone, on which the lines are drawn.

I am, sir, very respectfully yours,

NICH'S KING, *S. C. W.*

THE PRESIDENT OF THE UNITED STATES.

(First endorsement.)

Nicholas King. 15 OCT[r], 1804.

Meridian line through the center of the President's house.

(Second endorsement.)

King, Nich[s]. SURVEYOR'S OFFICE, *Oct.* 15, '04.

Rec[d] Oct. 15.

To be filed in the office of State, as a record of the demarcation of the 1[st] meridian of the U. S.

LIST OF MAPS OF WASHINGTON AND THE DISTRICT OF COLUMBIA, WITH NOTES THEREON

BY MARCUS BAKER

In gathering material for the foregoing notes on surveys and maps of Washington and the District of Columbia various maps have been examined. As no list of such maps is known to be in print, it is deemed worth while to print this list, which may serve as a useful beginning for the future bibliographer. The titles have been prepared by the compiler himself, unless otherwise indicated. The places where the maps were seen is also indicated for those which are not common.

L. C. = Library of Congress.
G. S. = " " Geological Survey.
C. S. = " " Coast and Geodetic Survey.

1791. L'Enfant (Peter Charles). Plan of the city intended for the permanent seat of the Government of t[he] United States. Projected agreeable to the direction of the President of the United States in pursuance of an act of Congress passed the sixteenth day of July, MDCCXC, establishing the permanent seat on the bank of the Potomac. By Peter Charles L'Enfant.

Size, 30 x 45 inches. **Scale,** 4 inches to one mile, or **1:15840.**
Colored photolithograph made by C. & G. S. in 1887 from original in "Office of Commissioner of Public Buildings, D. C."
This is No. 3035*a* of the C. S. catalogue of charts, 1893.

1792. Ellicott (Andrew). Plan of the city of Washington, in the territory of Columbia, ceded by the states of Virginia and Maryland to the United States of America, and by them established as the seat of their government after the year MDCCC. Engraved by Thackara & Vallance, Philada., 1792.

Size, 21 x 29 inches. **Scale,** 100 poles to one inch, or **1:19800.**
Black. Engraved on copper. Original copper plate said to be in possession of the C. & G. S.
This map is No. 3035 of C. & G. S. catalogue of charts, 1893, where its date is given as 1800. Copies seen, L. C. and C. S.

[1792?] Ellicott (Andrew). Plan of the city of Washington, in the territory of Columbia, ceded by the states of Virginia and Maryland to the United States of America, and by them established as the seat of their government after MDCCC.

Size, 17 x 20 inches. **Scale,** 100 poles to one inch, or **1:19800.**
Black. Engraved on copper.
[*In* Maps of the District of Columbia and city of Washington and plats of the squares and lots of the city of Washington. Printed in pursuance of a resolution

of the Senate of the United States. Sm. fol., Washington, printed by A. Boyd Hamilton, 1852.]

This is map No. 3013 of the C. & G. S. catalogue of charts for 1893, where its date is given as 1800. Original copper plate said to be in possession of the C. & G. S.

[1792 ?] **Ellicott** (Andrew). Plan of the city of Washington, in the territory of Columbia, ceded by the states of Virginia and Maryland to the United States of America, and by them established as the seat of government after the year MDCCC. Engraved by Sam'l Hill, Boston.

Size, 17 x 20 inches. **Scale,** 100 poles to one inch, or **1:19800.**

Black. Engraved on copper.

Three copies of this map in L. C. Apparently same as preceding, differing only by the added words, "Engraved by Sam'l Hill, Boston."

[179-?] **Reid** (I.) Plan of the city of Washington, in the territory of Columbia, ceded by the states of Virginia and Maryland to the United States of America, and by them established as the seat of their government after the year 1800. Rollinson, sculp., N. York. Publish'd by I. Reid.

Size, 16 x 21 inches. **Scale,** 100 poles to one inch, or **1:19800.**

Black. Engraved on copper.

Evidently a copy of Ellicott's map. Copies seen, L. C.

[1793 ?] **Ellicott** (Andrew). Territory of Columbia. Drawn by Andw. Ellicott.

Size, 22 x 22 inches. **Scale,** 2 inches to one mile, or **1:31680,**

Black. Engraved on copper.

The only copy of this map known to me is the very yellow and soiled one now in the Library of Congress. It was reproduced in 1852, omitting the words, "Drawn by Andw. Ellicott." It is the *first* topographic map of the District of Columbia, and was the *only* one down to about 1860. All the maps of the District of Columbia I have seen published between 1793 and 1861 appear to have been copied from this one.

1793. Bent (W.) Plan of the city of Washington now building for the metropolis of America, and established as the permanent residence of Congress after the year 1800. B. Baker, sculp.

Size, 10½ x 13½ inches.

Black.

[*In* Universal (The) Magazine. 8°. London, W. Bent, 1793, vol. 93, July, 1793, facing p. 41.]

Copy seen, L. C.

1794. Gotha Almanac. Plan de la ville de Washington en Amerique. Weidner Jun. del. J. G. Klinger, sc. Nov. 1794.

Size, 6 x 8 inches.

Black. Engraved on copper.

[*In* Gothaischer Hof. Kalendar zum nutzen und vergnügen auf des jahr 1795. 18°. Gotha, bey C. W. Ettinger, 1794, p 95.]

1795. Reid, Wayland, and Smith. Plan of Washington. Published by Reid, Wayland, and Smith, 1795.

Not seen. Title from sale catalogue.

1795. Griffith (Dennis). Map of the state of Maryland laid down from an actual survey of all the principal waters, public roads and divisions of the counties therein; describing the situation of the cities, towns, villages, houses of worship and other public buildings, furnaces, forges, mills and other remarkable places; and of the Federal territory; as also a sketch of the state of Delaware; shewing the probable connexion of the Chesapeake and Delaware bays; by Dennis Griffith, June 20th, 1794. Engraved by J. Thackara & J. Vallance. Philada. Published June 6th, 1795, by J. Vallance, engraver, No. 145 Spruce street. Subtitle, "Plan of the city of Washington and Territory of Columbia."

Size, 16 x 16 inches. **Scale,** 200 poles to an inch, or **1:39600.**
Black. Engraved on copper.
Apparently copied from Ellicott's map of the District of Columbia, 1793. Copies seen, G. S.

1798. Dermott (James R.) The Dermott or tin case map of the city of Washington, 1797–8. Prepared by James R. Dermott, who was instructed by the commissioners, June 15, 1795, to prepare a plat of the city. The resulting map was sent to Pres't Adams June 21, 1798.

Size, 54 x 62 inches. **Scale,** about 8 inches to one mile, or **1:7160.**
Black. Photolithograph.
Republished by the C. & G. S. in 1888. It is No. 3035*b* of the C. & G. S. chart catalogue of 1893. Copies seen; G. S.

1800. Weld (Isaac, Jr.) Plan of the city of Washington. Published by J. Stockdale, Picadilly, 16th Sepr., 1798.

Size, 7 x 9 inches. **Scale,** 1¼ inches to one mile, or **1:50688.**
Black. Engraved on copper.
[*In* Weld (Isaac, Jr.) Travels through the states of North America, etc. By Isaac Weld, Jr. 3d ed., in 2 vols. 8°, London, J. Stockdale, 1800, vol. 1, p. 80.]

1802. Moore (S. S.) and **Jones** (T. W.) Plan of Washington to accompany the traveller's guide. No title or scale.

Size, 4 x 6 inches.
Black. Engraved on copper.
[*In* Moore (S. S.) and Jones (T. W.) The traveller's directory, etc. 12°, Philadelphia, M. Carey, 1802, map 23.]

[180–?] King (Robert). A map of the city of Washington, in the District of Columbia, established as the permanent seat of the government of the United States of America, taken from actual surveys as laid out on the ground by Rt. King, surveyor of the city of Washington. Engraved by C. Schwarz, Washn.

Size, 24 x 31 inches. **Scale,** 5¼ inches to one mile, or about **1:12000.**
Black. Engraved on copper.
Has two views: (1) South front of the President's house; (2) East front of the Capitol of the United States. Copies seen, L. C.

1815. Warden (D. B.) Territory of Columbia. Drawn by Andw. Ellicott. Engraved by P. A. F. Tardieu, Paris, 1815.

Size, 11 x 11 inches. **Scale,** 0.97 inches to one mile, or **1:65000.**
Black. Engraved on copper.
[*In* Warden (D. B.) A chorographical and statistical description of the District of Columbia, etc. 8°, Paris, 1816, *ad in.*]
A reduced copy of Ellicott's map. Copies seen, L. C.

1816. Winder (Rider H.) No title or scale.

Size, 10 x 15½ inches.

[*In* Remarks on a pamphlet entitled "An enquiry respecting the capture of Washington by the British on the 24th of August, 1814, with &c. By Spectator (Rider H. Winder). 8°, Baltimore, J. Robinson, 1816.]

A crude diagram of the country between Bladensburg and Mt. Vernon and between Georgetown and Patuxent river. Copies seen, L. C.

1820. Force (Peter). A correct map of the city of Washington, capital of the United States of America. Lat., 38° 53′ N.; long., 0° 0′. Engraved by W. I. Stone, Washn. [1820]. Entered according to act of Congress on the 31th (sic) day of January, 1820, by Peter Force, of the District of Columbia.

Size, 16½ x 21½ inches. **Scale,** 100 poles to one inch, or **1:19800.**

Black. Engraved on copper.

[*In* Force (Peter.) A national calendar for 1820. By Peter Force. 18°, Washn., 1820, *ad fin.*]

Contains views: (1) West front of Capitol; (2) North front of President's house. Two copies in L. C.

1828. Brennan (John). Map of the city of Washington. Published by John Brennan, 1828. Drawn by F. C. De Krafft, city surveyor. Engraved by Mrs W. I. Stone.

Size, 16½ x 21½ inches. **Scale,** about 3.47 inches, equal to one mile, or **1:18200.**

Black. Engraved on copper.

Copies seen, L. C.

1830. Bussard (William). A map of Georgetown, in the District of Columbia, by William Bussard, 1830. Engd. by W. Harrison, Washn.

Size, 24 x 27 inches. **Scale,** 100 yards to an inch, or **1:3600.**

Very ragged, worn, and yellow copy in office of city surveyor. Another copy owned by W. H. Lowdermilk.

1846. McClelland (David). Map of the city of Washington, established as the permanent seat of the Government of the United States of America, 1846. Engraved and published by D. McClelland.

Size, 14 x 17½ inches. **Scale,** 3 inches to one mile, or **1:21120.**

Black. Engraved on copper.

A sub-sketch consists of a reduced copy of Ellicott's map of the District of Columbia of 1793. Scale, 3⅜ inches, equal to 10 miles, or 1:188000. Copies seen, L. C.

1851. Van Derveer (Lloyd). Map of the city of Washington, D. C., established as the permanent seat of the Government of the U. S. of Am. James Keily, surveyor. Lloyd Van Derveer, publisher, Camden, N. Jersey, 1851.

Size, 30 x 42 inches. **Scale,** 6½ inches to one mile, or **1:9750.**

Colored, glazed, on roller.

Contains views of (1) Capitol, (2) President's house, (3) Greenough's statue of Washington, (4) Patent Office, (5) Observatory, (6) Monument, (7) City Hall, (8) General Post Office, (9) Smithsonian Institution, (10) Treasury Department, and (11) Statistics from census of 1850. Also contains sub-sketch of the District of Columbia from Ellicott's map. Copies seen, L. C.

1852. U. S. Senate. Territory of Columbia.

Size, 22 x 22 inches. **Scale,** 2 inches to one mile, or **1:31680.**
Black. Engraved on stone?
[*In* Maps of the District of Columbia and city of Washington and plats of the squares and lots of the city of Washington. Printed in pursuance of a resolution of the Senate of the United States. Sm. fol., Washington, printed by A. Boyd Hamilton, 1852.]
This is a reproduction of Ellicott's map of 1793. Copies seen, L. C., C. S., G. S., and engineer's office, War Dept.

1852. U. S. Senate. Map of the city of Washington, in the District of Columbia, established as the permanent seat of the government of the United States of America. W. J. Stone, sc., Washn.

Size, 20 x 31 inches. **Scale,** 5 3-16 inches to one mile, or **1:12200.**
Black. Engraved on copper.
[*In* Maps of the District of Columbia and city of Washington and plats of the squares and lots of the city of Washington. Printed in pursuance of a resolution of the Senate of the United States. Sm. fol., Washington, A. Boyd Hamilton, 1852.]
This is chart or map No. 3036 of the C. & G. S. catalogue of charts for 1893, where the date of the chart is given as 1863.

1852. U. S. Senate.

Reproduction of Ellicott's map of [1792?], which is No. 3043 of the C. & G S. chart catalogue, 1893.

1857. Boschke (Albert). Map of Washington city, District of Columbia, seat of the Federal government. Respectfully dedicated to the Senate and House of Representatives of the United States of North America. Surveyed and published by A. Boschke, C. E., 1857.

Size, 56 x 60 inches. **Scale,** 500 feet to one inch, or **1:6000.**
Colored. Lithograph of J. Bien, 60 Fulton St., N. Y.
Copyright, 1857, by A. Boschke. Ornamental border and 18 marginal pictures.
An original and excellent map. The best map of Washington, in my judgment, that has ever been made. Copies seen, L. C. and C. S.

1858. Bohn (Casimir). Map of the city of Washington, established as the permanent seat of the government of the United States of America. 1858. Published by C. Bohn. Copyright by C. Bohn, 1858.

Size, 13 x 17 inches. **Scale,** 2 15-16 inches to one mile, or **1:21600.**
Black. Engraved on copper?
[*In* Bohn (Casimir.) Handbook of Washington, etc. 16°, Washington, 1860, *ad fin.*]
This is a reproduction of McClelland's map of 1846. Copies seen, L. C.

1861. Boschke (Albert). Topographical map of the District of Columbia, surveyed in the years 1856, '57, '58 & '59 by A. Boschke. Published by D. McClelland. Blanchard & Mohun, Washington, D. C., 1861. Engraved by D. McClelland, Washington, D. C. Copyright, 1861, by D. McClelland, Blanchard & Mohun, Hugh B. Sweeney and Thos. Blagden.

Size, 40 x 40 inches. **Scale,** 4 inches to one mile, or **1:15840.**
Black. Engraved on copper.
The first contour topographic map of the District of Columbia. An excellent map. The original copper plates seized by the United States in 1861 and now in possession of the War Department. Electroplate copies in possession of the C. & G. S. Copies seen, G. S., C. S., and Morrison's bookstore.

1862. McDowell (General Irvin). Surveys for military defenses. Map of N. eastern Virginia and vicinity of Washington, compiled in topographical engineer's office, at division headquarters of General Irvin McDowell, Arlington, January 1, 1862, from published and manuscript maps corrected by recent surveys and reconnaissances. Engraved on stone by J. Schedler, No. 120 Pearl St., N. Y.

Size, 50 x 67 inches. **Scale,** one inch to the mile, or **1:63360.**
Black. Lithograph.

1862. Colton (G. Woolworth). Topographical map of the original District of Columbia and environs: showing the fortifications around the city of Washington. By E. G. Arnold, C. E. Published by G. Woolworth Colton, 18 Beekman St., New York, 1862. Copyright by Arnold, 1862.

Size, 32 x 33 inches. **Scale,** 2 inches to one mile, or **1:31680.**
Colored. Lithograph.
Topography shown by hachures. Mainly copied from Boschke's map. One of the maps issued by Colton was seized by order of Secretary Stanton, and this is probably the one. Copies seen, L. C.

1867. Carpenter (B. D.) Map of the roads in Washington county, D. C., 1867. B. D. Carpenter, surveyor of Washington county, D. C.

Size, 34 x 40 inches. **Scale,** 4 inches to one mile, or **1:15840.**
Black, with certain roads colored. Lithograph by J. F. Gedney, 393 Pennsylvania Ave., Washington. Copies seen, G. S.

1868. Wyeth (S. D.) Map of the city of Washington, District of Columbia.

Size, 6 x 7½ inches. **Scale,** none.
Purple.
[*In* Wyeth (S. D.) The Federal city, etc. 3d ed., 8°, Washington, D. C., Gibson Brothers, 1868, pp. 34, 35.]
Very crude and poor. Copies seen, L. C.

1868. Johnson (A. J.) Johnson's Washington and Georgetown, published by A. J. Johnson, New York. Copyright 1868.

Size, 13 x 17 inches. **Scale,** 2 9-16 inches to one mile, or **1:24700.**
Colored.
[*In* Johnson's new illustrated family atlas of the world, etc, fol., New York, A. J. Johnson & Co., 1885, map 48.]

1870. Forsyth (William). Plan of the city of Washington, in the District of Columbia, established as the permanent seat of government of the United States, extended to embrace its suburban towns, villages, &c, and the city of Georgetown, and showing original and other valuable data not to be found on any maps heretofore published. Also a diagram of the avenues, showing their true courses and distances, and a plan of Alexandria. By William Forsyth, formerly surveyor of Washington city. 1870. Copyright 1870.

Size, 60 x 68 inches, in six sheets. **Scale,** 500 feet to one inch, or **1:6000.**
Colored, glazed, on rollers. Photolith. by the N. Y. Lithographing, Engraving & Printing Co.; Julius Bien, sup't.
There are said to be two editions of this map Copies seen, city surveyor's office and L. C.

[1872.] **Forsyth** (William). Map of Georgetown, in the District of Columbia, prepared from surveys and other data under an act of the legislature approved Decr. 28th, 1871. Wm. Forsyth, surveyor District of Columbia.

> **Size**, 47 x 56 inches. **Scale**, 200 feet to one inch, or **1:2400.**
> Colored, glazed, on rollers.
> Copies seen, city surveyor's office.

1872. Petersen (A.) and **Enthoffer** (J.) Map of the city of Washington, showing the subdivisions, grades, and the general configuration of the ground in equidistances from 5 to 5 feet altitude. Compiled, with the assistance of the city sur., P. H. Donegan, by A. Bastert and J. Enthoffer. Published by A. Petersen and J. Enthoffer, of the U. S. Coast Survey, 1872. For sale by Philip & Solomons.

> **Size**, 86 x 106 inches. **Scale**, 250 feet to one inch, or **1:3000.**
> Black. Engraved on copper.
> Copies seen, F. W. Pratt, Sun building.

1873. Enthoffer (J.) Map of the city of Washington, showing the progress of buildings up to October 1st, 1873. Compiled by J. Enthoffer, top. engineer. Copyright, 1873.

> **Size**, 22 x 25 inches. **Scale**, 1,000 feet to one inch, or **1:12000.**
> Photograph.
> May never have been published. Has 10-foot contours, and classifies buildings as "houses, shanties, churches." Copies seen, L. C.

1874. Faehtz (E. F. M.) and **Pratt** (F. W.) Sketch of Washington in embryo, viz., previous to its survey by Major L'Enfant. Compiled from the rare historical researches of Dr Joseph M. Toner, who by special favor has permitted the use of his labor and materials for the publication of a grand historical map of this District now in progress by his efforts, combined with the skill of S. R. Seibert, C. E. Compilers, E. F. M. Faehtz & F. W. Pratt, 1874.

> **Size**, 16 x 21 inches. **Scale**, about 3½ inches to one mile, or **1:18500.**
> Black. Photolith. by N. Peters, Washington, D. C.
> [*In* Faehtz (E. F. M.) and Pratt (F. W.) Washington in embryo, etc, fol., Washington, 1874, facing p. 32.]
> Copies seen, L. C.

1882. Ward (Lester Frank). Map of Washington and vicinity. Prepared in the office of the U. S. Geological Survey, 1882.

> **Size**, 24 x 30 inches. **Scale**, about 0.58 inches to one mile, or **1:109000.**
> Black. Photolithograph.
> [*In* Ward (L. F.) Guide to the flora of Washington and vicinity, being Bulletin 22, U. S. National Museum. 8°, Washington, 1882.]

1882. U. S. Coast and Geodetic Survey. Washington and Georgetown harbors, District of Columbia, 1882.

> **Size**, 18 x 29 inches. **Scale**, 4 inches to one mile, or **1:15840.**
> Colored. Photolithograph.
> This is C. S. chart 391*a*, issued July, 1882. Drawn by A. and H. Lindenkohl. Land, buff; water, green, and city, shaded; has 10-foot contours.

1882. Boyd (William H.) Boyd's map of the city of Washington and suburbs, District of Columbia, 1882. Published by Wm. H. Boyd, directory publisher, Washington, D. C. Copyright 1882.

Size, 15 x 18 inches. **Scale,** 1,900 feet to one inch, or **1:22800.**
Black. Photolithograph by Am. Photolith. Co., New York.

1884. Commissioners, District of Columbia. Topographical map of the District of Columbia and a portion of Virginia, compiled under the direction of Major G. J. Lydecker, corps of engineers, Engineer Commissioner, D. C. By Captain F. V. Greene, corps of engineers, 1884. Drawn by W. T. O. Bruff.

Size, 21 x 21 inches. **Scale,** 2 inches to one mile, or **1:31680.**
Black. Lithograph by Julius Bien & Co., New York.
Contour interval, 20 feet. Copies seen, District Commissioners' office and G. S.

1884. Commissioners, District of Columbia. Topographical map of the District of Columbia and a portion of Virginia, compiled under the direction of Major G. J. Lydecker, corps of engineers, Engineer Commissioner of the D. of C., by Captain F. V. Greene, corps of engineers, 1884. Drawn by W. T. O. Bruff.

Size, 41 x 41 inches. **Scale,** 4 inches to one mile, or **1:15840.**
Lithograph by Julius Bien & Co , New York.
A contour map. Contour interval, 20 feet. Culture, black; water, blue; contours, brown. Copies seen, Eq. Co-op. Bldg. Ass'n, 1003 F St., and G. S.

1884. Stewart (James M.) Map of the city of Washington, in the District of Columbia, showing the lines of the various properties at the division with the original proprietors in 1792.

Size, 24 x 32 inches. **Scale,** 5 3-16 inches to one mile, or **1:12200.**
Colored. Lithograph.
Copyrighted by James M. Stewart, Washington, D. C., 1884. F. Bourquin, 31 S. Sixth St., Philadelphia.
Copies seen, Office of Commissioner of Public Buildings and Grounds and real estate office of Weller & Repetti, 400 Pa. Ave. S. E.

1886. U. S. Geological Survey. District of Columbia and adjoining territory, being the Washington sheet of the general topographic map of the United States. Surveyed and compiled by J. D. Hoffman and D. J. Howell in 1885–6, under the direction of Henry Gannett, U. S. Geological Survey.

Size, 19 x 28 inches. **Scale,** about one mile to one inch, or **1:62500.**
Engraved on copper. Printed in 3 colors: culture, black; water, blue; contours, brown. Contour interval, 20 feet.

1886. Warner (B. H.) B. H. Warner & Co.'s map, showing a bird's-eye view of the city of Washington and suburbs. Locating the public buildings and places of interest. Copyright, 1886, by B. H. Warner & Co. Prepared by A. G. Gedney, Post building, Washington, D. C.

Size, 20 x 26 inches. **Scale,** none.
Black. Photolithograph.
Compromise between a view and a map.

1887. Engineer Department, District of Columbia. Map of the city of Washington for use of the engineer department, District of Columbia, 1887.

Size, 38 x 38 inches, in two sheets. **Scale,** about 850 feet to one inch, or **1:10200.**
Black. Photolithograph by Norris Peters, Washington, D. C.
Copies seen, G. S. and District Commissioners' office.

1887. Silversparre (Axel). Map of Washington, D. C., and environs, with marginal numbers and measuring tape attachment for instantly locating points of interest within a radius of twenty miles from the Capitol. Compiled [etc] by Axel Silversparre, C. E. Published by R. E. Whitman, Washington, D. C. Copyrighted, 1887.

Size, 25 x 30 inches. **Scale,** 1,600 feet to one inch, or **1:19200.**
Colored.
Copies seen, L. C. and G. S.

1889. Commissioners, District of Columbia. Topographical map of the District of Columbia and a portion of Virginia, revised and corrected under the direction ef Major Chas. W. Raymond, corps of engineers, Engineer Commissioner, D. C. By Captain T. W. Symons, corps of engineers, 1889. Drawn by W. T. O. Brüff.

Size, 41 x 41 inches. **Scale,** 4 inches to one mile, or **1:15840.**
Colored. Lithograph by Julius Bien & Co., N. Y.
This is a revised edition of the Lydecker-Greene map of 1884. Copies seen, G. S.

1889. Evening Star. Map of the city of Washington, with compliments of the Evening Star. Souvenir of March 4th, 1889. Showing route of inaugural parade.

Size, 17 x 23 inches. **Scale,** about 3 8-10 inches to one mile, or **1:16500.**
Black. Photolithograph by Bell Bros., Washington, D. C.
Copies seen, G. S. and Toner collection in L. C.

1891. Fisher (Thos. J.) **& Company.** Map of the city of Washington, District of Columbia, and adjacent portions of Maryland and Virginia. Prepared and presented with compliments of Thos. J. Fisher and Co., real estate brokers, Washington, D. C. Prepared by W. Kesley Schoepf, civil and topographical engineer, Sun building, Washington, D. C., 1891. Copyrighted, 1891, by Fisher & Co.

Size, 27 x 34 inches. **Scale, 1:27000.**
Black. Lithograph by Bell Litho. Co., Washington, D. C.

1891. Fisher (Thos. J.) **& Company.** Map of the District of Columbia and adjacent portions of Maryland and Virginia, prepared especially for and presented with compliments of Thos. J. Fisher and Co., real estate brokers, Washington, D. C., 1891. Prepared by W. Kesley Schoepf, civil and topographical engineer, Washington, D. C.

Size, 45 x 57 inches. **Scale,** 1,000 feet to one inch, or **1:12000.**
Colored, glazed, on rollers.
E. H. Berry, del. Bell Litho. Co., Washington, D. C. Copies seen, city surveyor's office.

1891. Holtzman (R. O.) Presented by R. O. Holtzman, real estate and insurance broker, Tenth and F streets N. W. Copyright, 1891.

Size, 17 x 19 inches. **Scale,** about 2⅞ inches to one mile, or **1:22000.**
Crude photolithograph.
No title. A real-estate advertising map.

1891. Hopkins (G. M.) Map of the District of Columbia, from official records and actual surveys. Published by G. M. Hopkins, C. E., 320 Walnut St., Philadelphia, Pa., 1891. Copyright, 1891.

Size, 59 x 64 inches. **Scale,** 800 feet to one inch, or **1:9600.**
Colored.

1891. U. S. War Department. U. S. Coast and Geodetic Survey. A. D. Bache, sup't. Map of the ground occupation and defense of the division of the U. S. army in Virginia in command of Brig. Gen. Irvin McDowell, Topographical survey by the party in charge of H. L. Whiting, ass't. U. S. C. S. Field-work executed during parts of June and July, 1861. By F. W. Dorr and C. Rockwell, U. S. C. S. Julius Bien & Co., lith., New York.

Size, 16 x 17 inches. **Scale, 1:47500.**
Culture, black; water, blue; contours, brown; timber, green. Contour interval, 20 feet.
[*In* Atlas to accompany the official records of the Union and Confederate armies, 1861–1865. Published under the direction of the Hon. Redfield Proctor, Secretary of War, etc, fol., Washington, 1891, part 2, plate 6.]

1891. U. S. War Department. Surveys for military defenses. Map of northeastern Virginia and vicinity of Washington, compiled in topographical engineer's office at division headquarters of General Irvin McDowell, Arlington, January 1, 1862. Corrected from recent surveys and reconnaissances under direction of the Bureau of Topographical Engineers, August 1, 1862. Drawn by J. J. Young and W. Hesselbach.

Size, 17 x 27 inches. **Scale,** 2 miles to one inch, or **1:126720.**
Colored. Lithograph by Julius Bien & Co., New York.
[*In* Atlas to accompany the official records of the Union and Confederate armies, 1861–1865. Fol., Washington, 1891, part 2, plate 7.]

1892. Van Hook (J. C. & C. G.) Map and guide to Washington, D. C. Compiled and published by J. C. and C. G. Van Hook, National Union building, 918 F St. N. W., Washington, D. C., 1892.

Size, 18 x 25 inches. **Scale,** 3¾ inches to one mile, or **1:16900.**
Colored. Photolithograph by A. B. Graham, Washington, D. C.

1892. District of Columbia National Guard. Map of the District of Columbia and vicinity, showing the principal points of interest, including the present condition of the defenses of Washington. Compiled from the latest maps and from original surveys and reconnaissances by the engineering platoon of the Engineer Corps, D. C. N. G. F. L. Averill, C. E., first lieut., com'd'g platoon, 1892. Copyright, 1892, by F. L. Averill.

Size, 20 x 25 inches. **Scale,** about 1½ inches to one mile, or **1:10000.**
Black. Photolithograph by A. B. Graham, Washington, D. C.

1892. Howell (David Janney). Index map to Washington county plans, District of Columbia. From official records, by D. J. Howell, civil engineer and landscape architect, National Union building, Washington, D. C. Under act of Congress approved Jan'y 24th, 1891, by authority of Commissioners, D. C. Matthew Trimble, assessor, January 1st, 1892.

Size, 47 x 55 inches. **Scale,** 800 feet to one inch, or **1:9600.**
Colored. Photolithograph by Bell Lith. Co., Washington.

1893. Fisher (Thos. J.) **& Company.** Map of the District of Columbia and adjacent portions of Maryland and Virginia. Prepared especially for and presented with compliments of Thos. J. Fisher and Co., real estate brokers, Washington, D. C., 1893. Prepared by W. Kesley Schoepf, civil and topographical engineer, Washington, D. C. Copyrighted, 1893.

Size, 56 x 69 inches. **Scale,** 4⅞ inches to one mile, or **1:13000.**
Colored, glazed, on rollers.

1894. Coast and Geodetic Survey "District of Columbia. Surveyed between 1880 and 1892. Published Sept., 1894. The contour interval is 10 feet. The datum plane is 0.807 feet above half tide level of the Potomac river."

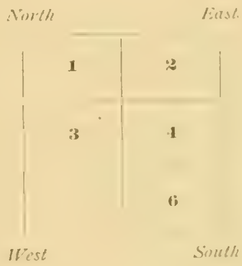
Size of each sheet, 25 x 34 inches. **Scale,** 800 feet to one inch, or **1:9600.**
Black. Photolithograph. In five sheets.

This is the first published map resulting from the careful and detailed surveys mentioned on pp. 158, 159. It shows in great detail all the present District, except the city.

The sheets have two series of numbers as follows :

No. 3061 = Sheet No. 1.
No. 3062 = " No. 2.
No. 3063 = " No. 3.
No. 3064 = " No. 4.
No. 3066 = " No. 6.

And are distributed as shown in the annexed cut.



[1894.] **United States Coast and Geodetic Survey.** Topographical map of the District of Columbia. Sheet No. 1. Scale, 1:4800. The contour interval is 5 feet. The datum plane is 0.807 feet above half-tide level of the Potomac river.

Size, 15 x 16 inches. **Scale,** 400 feet to an inch, or **1:4800.**

Engraved upon copper by Evans and Bartle, Washington, D. C. Printed by the Norris Peters Lith. Co., Washington, D. C.

In four colors, viz., culture, black; drainage, blue; contours, brown, and woodland, green.

The above is one sheet of the very elaborate map begun by the Coast Survey in 1880. It covers one square mile, and 100 such are required to cover the original District of Columbia. Under the scheme of numbering now adopted the District is divided into 100 squares by lines parallel to its boundaries. The northeastern row of ten sheets is numbered from the northern corner to the eastern corner 1 to 10; the second row, 11 to 20; the third, 21 to 30, and so on. Some 30 to 35 of these sheets are said to be now engraved, but none are published. The compiler has seen proofs of sheets 1, 2, 22, and 32.

Another series of sheets preceded the above described. This other series consists of photolithographs, black, made from drawings by J. A. Flemer and E. H. Fowler. The method of designating them has been changed from time to time, leaving the whole in confusion. Sheets have been designated "Section No 10 W.," "Section D, Sheet No. 1," and also by numbers, such numbers not agreeing with these now in use. These sheets are 15 by 18 inches, and about 15 of them have been issued.

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VOL. VI, PP. 179-238, PL. 10-14 DECEMBER 29, 1894

THE

NATIONAL GEOGRAPHIC MAGAZINE

THE FIRST LANDFALL OF COLUMBUS

BY

JACQUES W. REDWAY, F. R. G. S.

In examining the evidence concerning the first landfall of Columbus on the shores of the American continent, but little attention has been given heretofore to the evidence that might be found in early maps. Most critics have attempted to solve the problem by plotting the course either forward or backward as might seem most expedient. A few historical writers have been content to brush aside all evidence save that contained in the log book, trusting to logical inference where positive evidence is wanting.

But logical inferences are of value only when there is something like unanimity of agreement, and thus far, with respect to the landfall, they have resulted, not in unanimity of agreement but in diversity. By such inferences Washington Irving fixed upon Cat island; Muñoz believed it to be Watling; Navarrete held it to be Grand Turk; Becher, Parker, Murdoch and Markham clewed sails off various parts of the coast of the present Watling; Captain Fox kept the anchors fast to the catheads until the squadron crept into a lee bight on the south side of Samaná, and Varnhagen let go those same anchors off the reefs of Mariguana.

At the present time, however, but three islands are seriously considered—Mariguana, Watling and Samaná—and the opinions having the most weight are those of trained seamen. In the following pages I have endeavored to discuss the merits of the two prevailing opinions from a geographic standpoint, making use not so much of a modern chart as of the evidence contained in certain maps of the fifteenth and sixteenth centuries.

There is but one source from which information concerning the first landing-place can be obtained, and that is the log book. Ever since navigation of the sea began it has been the custom to keep this official record of the voyage with the utmost fidelity, for a falsely kept log is an abomination that nowadays will subject the master of the vessel to the severest penalties. In his private log book, the only one whose contents are now known, Columbus admits that he understated the daily run of the caracca *Santa Maria*, but he says that he thus falsified his quasi-official log in order to keep a mutinous crew in subjection. The deception practiced on his crew, however, was a subterfuge that could have misled no one but an ignorant sailor; it could not have deceived the brothers Pinzon, the masters of the two caravels, for they were quite as skillful navigators as Columbus. The private log must have been reasonably correct, therefore, or it would have been exposed by the enemies of the Admiral.

Unfortunately, this document has disappeared and it cannot now be found. All we know of its contents is contained in an abridged and interpolated copy made by that grand old soldier-priest, Las Casas. From the date of October 10, however, the log seems to have been copied in full, and mainly in the *ipsissima verba* of the Admiral.* The interpolations, however, are generally apparent; but, good, bad or indifferent, about the only knowledge we possess is contained in this abridged log, and whatever conclusions one may reach concerning the locus of the landfall and the courses between Guanahani and Cuba, it must stand or fall accordingly as it agrees or disagrees with Las Casas' abridgment. The map of Juan de la Cosa affords no tangible evidence; Columbus' letter to Luis Santangel contains no allusion to the matter.

One might think that with the log and a good chart the estab-

*Apparently Señor Castelar, in his serial article published in the Century Magazine, 1892, has not appreciated the fact that only a part of the log is in the words of Columbus. He quotes freely from Columbus, seemingly oblivious to the fact that much of the material quoted is not the language of Columbus, but that of Las Casas.

lishment of the squadron's course would be an easy matter, but unfortunately this is not the case. At that time there was no instrument sufficiently precise to establish a ship's position to within two or three degrees.* Moreover, in the entire log book there are but one or two references to latitudes, and these are not exact enough to establish anything. Still another difficulty in the way is the variation of the compass. At that time a variation was known to exist, but, a few declinations excepted, no values had been determined. Columbus, indeed, found that his declination was changing, but he did not establish any values.† A change of twenty degrees or more in declination, during the voyage, even if the Admiral had allowed for it, would have made the retracing of the course a difficult matter.

The fact that Columbus did not write well in the Spanish language adds to the difficulty also. He did not punctuate, and many of his sentences are so ambiguous that it is impossible to tell their meaning. For instance, in the journal of Sunday, October 14, he says: "At the break of day I commanded the gig of the ship and the boats of the caravels to be [lowered] and went along the island in a north-northeasterly course to see the other part which was to the other part of the east." ‡ This particular passage is so perplexing that at least three different points of Watling island have been selected as the first anchorage.

Within a few years research has narrowed the six islands above named to the three already noted—Watling, Mariguana, and Samaná. Watling island was first proposed by Muñoz, but it is very uncertain that the Watling island of Muñoz is the one at present bearing that name. On the contrary, if the maps of Sayer (1792), Jacobsz (1621) and the so-called map of Vallard (1547) are worth anything as evidence, the Watling island of Muñoz lay to the southeast of the island at present bearing the name Watling. In fact, this island had the relative position that Samaná now occupies.

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* Vasco da Gama used to go ashore and rig a cross-staff on the beach when he wished to find his latitude.

† At the port of Gomera, at the time Columbus sailed, the declination was about 20° E.; at the crossing of the thirty-fifth meridian it was not far from 16° W. At Guanahani it could not have been more than two or three degrees. The agonic, or line of no declination, now passes within a few miles of Samaná.

‡ See note on page 184 for the quotation from the log book.

In his day, Las Casas says that the island which the natives called Guanahani and Columbus renamed San Salvador, was known by the name of Triango. After a diligent search, however, I find no map bearing this name earlier than the third decade of the sixteenth century. This is the famous Weimar map, but unfortunately on this map the names both of Guanahani and Triango appear, the latter an islet a little to the eastward of Guanahani. Both names also appear on several other maps published during the next fifty years, and in the map of Sebastian Cabot (1544) an island, Triangulo, is found bearing the same relative position that Triango holds on the Weimar map. The name also appears on the maps of Gutierrez (1550) and Santa Cruz (1560). The name "Triangulo ou Watling" occurs on an anonymous map in the collection of R. and I. Ottens.* On this map Guanahani also occurs as a separate island.

In 1856 Captain Becher, Royal Navy, discussed the question exhaustively, taking the ground that the present Watling † was the locus of the landfall. His researches forever put an end to any lingering belief that Cat island was the San Salvador of Columbus. His views have been ably supported by the late R. H. Major, Lieutenant Murdoch, United States Navy, and more recently by Captain William H. Parker, formerly of the United States Navy. Captain Parker combines the qualities of a trained seaman with those of a critical scholar. He spent many years in the West Indies and in Spain, and having had access to all papers and documents bearing upon the question, stands in the ranks of the foremost authorities.

Mariguana or, more properly, Mayaguana island has been pointed out by Varnhagen as a probable site of the landfall. It lies in an east-and-west direction, and its shores are broken by spits and coves: but Varnhagen not only ignores the fact that on leaving Guanahani the squadron sailed to the southwest; he omits from his thesis the Admiral's declaration that on the morrow he should sail to the southwest. Varnhagen lays the course due west and anchors the squadron on the windward side of Acklin island (!)

In 1880 Captain Gustavus V. Fox, United States Navy (in 1861 Assistant Secretary of the Navy), published a critical review of

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*Nova Tabula Exhibens Insulas Cuba et Hispanolani. Amsterdam. (I am unable to give the date. There is a copy in the British Museum.)

† Named from a pirate of the seventeenth century.

the various monographs bearing upon the subject. At the same time he offered a carefully prepared array of evidence in favor of Samaná or Atwood Cay. Owing to the fact that it was published in a government report,* the monograph did not then receive the attention it deserved, and for ten years it was popularly unknown; lately, however, it has commanded much interest. In his Discovery of America, Mr John Fiske adopts Captain Fox's views, and Mr Henry Harrisse, though rather inclining to Acklin island, practically admits that Captain Fox has come nearer to the truth than any other critic.

From the nature of the case it is evident that the question cannot be settled without the aid of the trained seaman. It is equally evident that the problem comes within the domain of the geographer, the cartographer and the historian. No solution will be satisfactory, therefore, that does not meet the conditions imposed by each of these sciences. Several historical papers that have recently appeared have been mercilessly riddled because of their failure to comply with the conditions demanded by the navigator. The sailor, on the other hand, is not always beyond criticism in discussing questions belonging to history or to cartography. Herr Cronau,† a historical writer, for instance, who, in 1890, took the trouble to visit the Bahama islands, declares that he had no difficulty in identifying Riding rocks, on Watling island, as the spot where Columbus landed. Here is a statement that for vernal simplicity has scarcely an equal in historical literature. Had he divided the entire coast of the Bahama islands into five-mile stretches, he could have identified sixty per cent. of them with equal facility. Neither Becher nor Parker succeeded in accomplishing such a wonderful feat, and Herr Cronau has the credit of it all to himself. It may be casually added, however, so very like one another are stretches of coast that, in spite of lighthouses and profiles, scarcely a day passes that masters and pilots of long experience are not deceived. Indeed, there are but few harbors that have not either a "false" entrance or a "false" namesake. Herr Cronau also asserts that Watling island is the only one answering to all the

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* Report of the United States Coast and Geodetic Survey, 1880, Appendix 18.

† In a summary of Herr Cronau's paper, published in the Magazine of American History, March, 1892, President C. K. Adams, of Madison University, endorses this view.

distinctive features enumerated by original authorities, and that "in following the course from Watling there is no difficulty in identifying all the islands at which the fleet stopped." Such a statement is simply ridiculous; if it were true, all dispute about the matter would have ended long ago.

This writer also makes much of the assertion that the island contained a large interior lake. As a matter of fact, however, Columbus makes no such assertion. He says there was a large lagoon in the middle; but a lagoon is one thing and a lake is quite another.* Even Captain Becher falls into this error, a piece of carelessness for which Captain Fox takes him to task. Herr Cronau also criticises Kettell's translation of the passage in which Columbus states that, with the boats of the ships, he took a north-northeasterly course to see the other side.† He translates this perplexing passage, "I skirted along the coast towards the north-northeast in order to explore the other part of the island, namely, that which lies to the east." Now this may, or it may not be what Columbus meant; it certainly is not what he wrote, and Herr Cronau's guess is no better than that of any other student.

Mr Clements R. Markham in reviewing the question does himself injustice by a few expressions which are certainly ill-chosen. In a very scholarly article he says, concerning the first landfall: "If the materials from the Journal were placed in the hands of any midshipman in Her Majesty's navy, he would put his finger on the true landfall in half an hour." Such a statement as this most certainly will not do. Could the question be so easily settled as all this, it would not have been a bone of contention for more than a century. Furthermore, Mr Markham says: "It is obvious that, if we trace these bearings and distances backwards from Cuba they will bring us to an island that must necessarily be the Guanahani or San Salvador of Columbus. This is the sailor's method."‡

But what sailor has yet been able to accomplish this problem so suitable for a royal middy's recitation exercise? Where on the coast of Cuba is the place at which the Admiral landed? How much and in what direction was the squadron carried out

* "Y una laguna in medio muy grande." Log book, October 13.

† En amaneciendo mandé aderezar el batel de la nao y las barcas de las carabelas, y fue al luengo de la isla, en el camino del nornordeste, para ver la otra parte, que era de la otra parte del Leste. Log book, October 14.

‡ Proceedings of the Royal Geographical Society, September, 1892.

of the course by the winds, by the tides, by the swift currents of the West Indian seas? What was lost or gained in latitude and departure in all the many times the vessels were standing off and on? Of all the places in the West Indies at which the squadron anchored, but one, Fort Navidad, is known. Here the caracca *Santa Maria* was wrecked, and forty-two men picked from the crews were left to guard the stockade built from the wrecked vessel. The impression obtains that Puerto Nipe was the first place in Cuba at which the squadron touched. Navarrete takes this view, and so do Captains Becher and Parker. As a matter of fact, there is not a scintilla of evidence to establish such a statement. The Admiral states specifically that there were but twelve fathoms of water in the harbor in which the squadron anchored. But in the roadstead of Puerto Nipe there is a depth of from twenty to thirty-five fathoms, while in the gut through which it opens into the sea there are nearly twice twelve fathoms of water; in the deepest part there are about forty fathoms. Now an estuary into which several mountain torrents are pouring might possibly silt itself up from thirty-odd fathoms to twelve; it could not well scour itself out from twelve fathoms to thirty. Moreover, the course from Islas de Arenas to Puerto Nipe would have been two or three points east of south, but according to the log Columbus lay the course south-southwest, and the westerly current would have carried him still farther westward. Had Messrs Becher, Markham, and Parker considered Puerto Padre as the first anchorage on the coast of Cuba there would have been fewer inconsistencies to explain away.

And this brings me to a statement in Mr Markham's interesting paper that I wish chiefly to consider. He says:

When we warmly applauded the close reasoning of Major's paper we supposed that the question was at length settled; but as time went on arguments in favor of other islands continued to appear, and an American* in high official position even started a new island, contending that Samaná was the landfall. But Fox's Samaná and Varnhagen's Mayaguana must be "ruled out of court" without further discussion, for they both occur on the maps of Juan de la Cosa and Herrera, on which Guanahani also appears. It is obvious that they cannot be Guanahani and themselves at the same time; and it is perhaps needless to add that they do not answer to the description of Guanahani by Columbus and meet none of the other requirements.

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*Captain Gustavus V. Fox.

Now, if Samaná must be dropped without discussion because it appears on a map on which Guanahani also appears, Watling island must also be dropped for the same reason, for it appears with Guanahani on the map of R. and I. Ottens, and on at least half a score of other maps, probably contemporaneous, that the author has examined in the British Museum.

But at the risk of being "ruled out of court" myself, I shall attempt to show that not only can Samaná be Guanahani and itself, but also that for one hundred years or more Samaná was Guanahani and itself at the same time. In the first place, let us look at the map of la Cosa* (see plate 10). On this map it will be observed that the name Samaná may apply to any one of three islands. It is about as near to Guanahani as either of the others, though it is hardly possible to decide upon which it is intended to apply. Incidentally it may be noted that the island which la Cosa marks Haiti is not the one at present bearing the name. That name, in fact, has been transferred to the island Columbus named la Española. Moreover, the transference of names on early maps was by no means an uncommon thing. If Johann Schöner had not carelessly transferred the name "Parias" from the Spanish main to Mexico, instead of putting the rightful "Lariab" there, it is doubtful if the northern part of the western continent would have been called America. An inspection of a very few maps of the sixteenth century will show that the transference and reduplication of names was made in a wholesale manner.

The map of Herrera (see figure 1), upon which Messrs Major and Markham lay so much stress, furnishes but little evidence not found in the map of la Cosa, and although nearly one hundred years later, it is hardly more than a copy of the latter. The most notable difference is in the shape of Guanahani. The east-and-west position by which the Admiral describes it and which it has on la Cosa's chart has been changed to a north-and-south trend. Furthermore, it is no longer northeast of the island of Someto, but almost due north. The island of Samaná on the map of Herrera has the same distance and bearings from Someto that Guanahani has on the map of la Cosa. Just why Messrs Major and Markham place so much confidence in the map of

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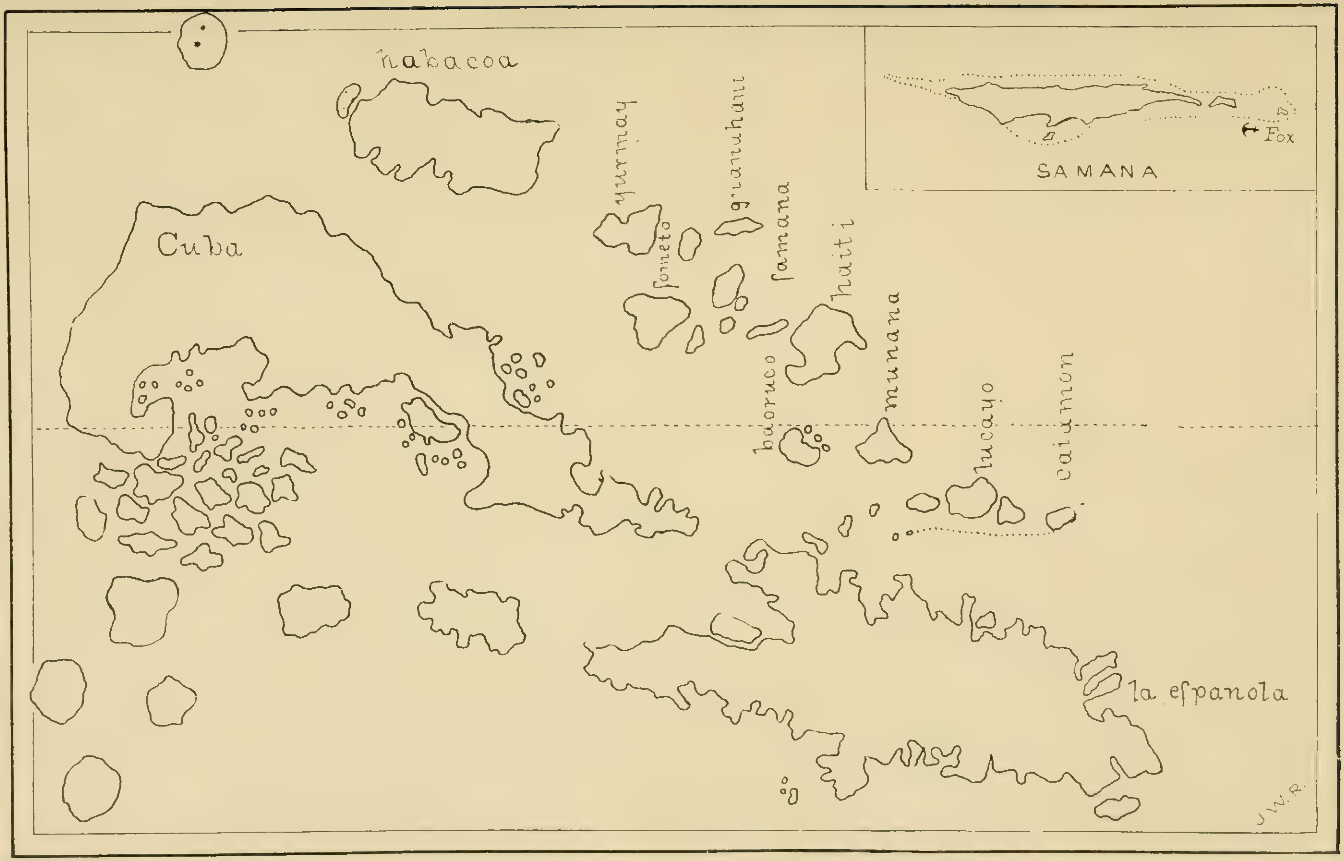
*The critical part of this map has been traced by the author, copying not only the outlines as found, but inserting their names also, each in the place it occupies on the original.



A PART OF THE MAP OF JUAN DE LA COSA—1500—WITH VIGNETTE OF SAMANA, FROM A MODERN CHART.

Herrera one cannot readily comprehend. Herrera was neither a cartographer nor a sailor. In his time he was the historian of Columbus, but he had none of the material that enabled Navarrete to speak *ex cathedra*, and Navarrete discards Watling island.

Among the maps in the British Museum is one of more than ordinary interest; it is not an original but its fidelity to the original is attested. It bears the inscription, "*Mappa Munde Peinte sur Parchemin par Ordre de Henri II, Roi de France.*" It

FIGURE 1.—*A part of the Map of Herrera—1601—with Vignette of Watling Island from a modern Chart.*

is generally referred to the third decade of the sixteenth century, but from features about it that it is not best to discuss here the author is inclined to place the date about forty years later. At all events it antedates the map of Herrera by thirty years—possibly by seventy years. So far as can be learned, neither its genuineness nor its authenticity has been questioned. The draftsman had a delightfully unique way of conventionalizing the coast outlines. There are several other maps extant coast-charted in the same manner. This feature is therefore not only a quaint and artistic conventionalism; it becomes a valuable ear-mark in identifying the date of certain maps.

On this map (see plate 11) it is interesting to note the appearance of the name "Bahames" and "Guanima," the Cat island of modern maps. I have seen no map of earlier date on which these names occur. But the most important feature is the fact that here, at least, Samaná is itself and Guanahani also. Of the placing of both names to the same island there can be not a shadow of a doubt. Compared with the map of la Cosa, the outlines of Guanahani are geometrically too similar to admit questioning; moreover, its position next to Mayaguana cuts off any further doubts as to its identity. It is the Samaná of today, and the islands to the southwestward are the group comprising Acklin and Crooked islands.

Now the question as to which island the name Samaná belonged has evidently perplexed more than one cartographer. Captain Fox, in his researches, noticed this, and his only error lies in the fact that he did not appreciate the importance of his discovery. The same perplexity led many cartographers to apply the name to the group now comprising Crooked and Acklin islands. Captain Fox gives a list of maps in which the name dodges back and forth from the Crooked group to the present Samaná. Most of these have been examined and verified by the author. Among other maps bearing on the subject are the following, which also include many of those mentioned by Captain Fox.

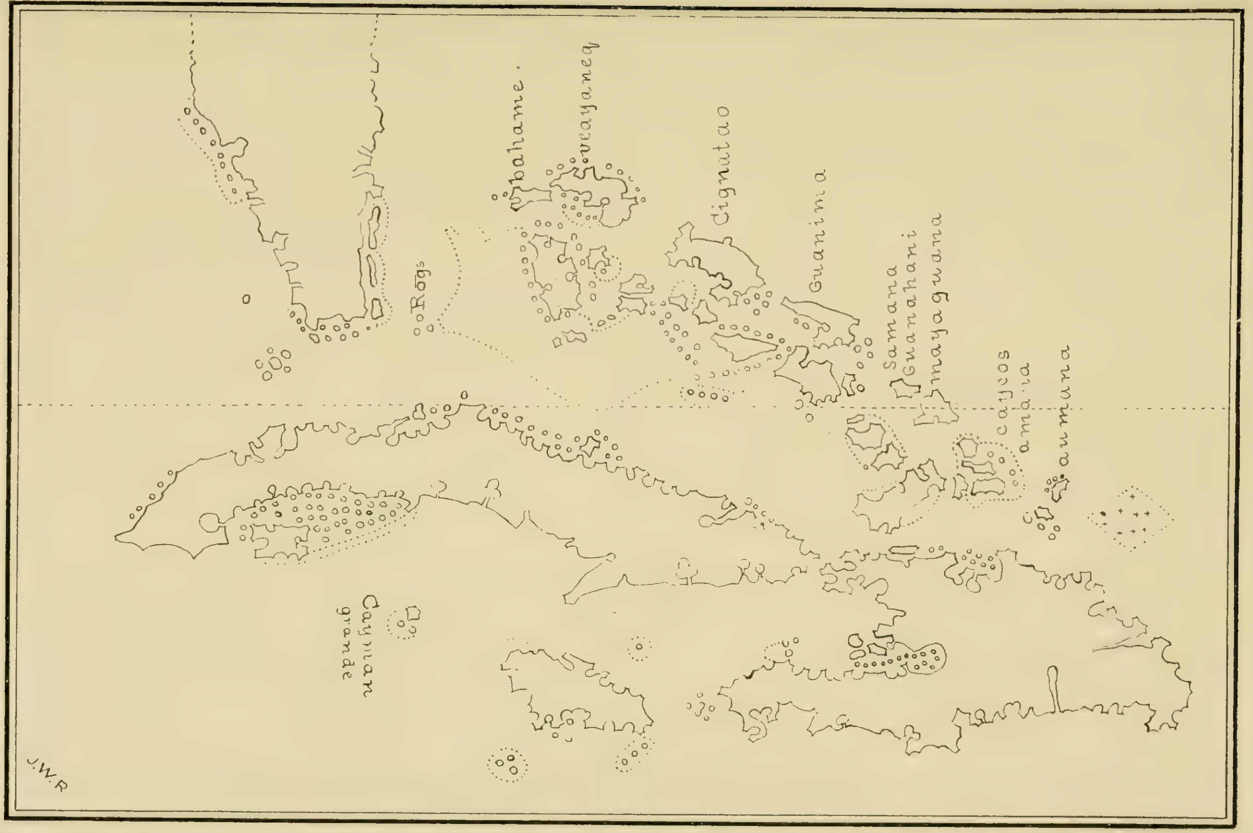
Carte de l'Amerique corrigée et augmentée, etc, P. Bertius, Amsterdam, 1610: The island next Mayaguana is named Trianga. Its position, therefore, is that of Samaná. The name is the one Las Casas said that in his time Guanahani bore.

Theatrum Orbis Terrarum, Abraham Ortelius, Antwerp, 1572: Guanahani appears in the position it occupies on the map of Henry II. Samaná is applied to Crooked group. On a map by the same author, 1590, Samaná appears next to Mayaguana.

Map of North America; John Senex, Charles Price, John Maxwell, geographers: The present Crooked group is marked Samaná or Krooked. Guanahani is a separate island.

An Accurate Map of North America; also all the West Indies, Eman Bowen, geographer to His Majesty, 1733: Crooked, Fortune, Acklin and Samaná form one group. To the northeast, in the position of the present Samaná, is Atwood's Key. This name is also given to Samaná, and it is carried today on the official charts of the United States.

Americæ sive quartæ orbis partis, nova et exactissima descriptio, Diego Gutiero *et al.*, cosmographio, 1562: On this map Samaná appears next to Mayaguana.



MAPPA MUNDE PEINTE SUR PARCHEMIN PAR ORDRE DE HENRI II, ROI DE FRANCE—1532.

Atlas Historique, Henri-Abeah, Amsterdam, 1738: Crooked group is here named I. Samaná.

Eylanden van West-Indien (date and place not given): Guanahani and Samaná appear on this map attached to islands near Mayaguana.

Cartes Geographiques, d'Anville, 1731–1794: The present group is marked "Samaná ou Krooked."

The West India Atlas; Thomas Jeffreys, geographer to the king: The present Samaná is marked "El Terrigo or Atwood's Key, the Samaná of the French." Southwest is the Crooked group, one island of which is marked "Samaná or Crooked island."

Map of the Bahamas, Delisle and Buache, 1744: On this map Guanahani appears under the name "Isle Nova."

Map of the West Indies, N. Vischer, Amsterdam, 1740: Guanahani appears under the title "Samaná or Rum island."

This list might be considerably extended, but the quotations are sufficient to show that the name "Samaná" has been a sort of homeless waif, having several times been transferred. The draughtsman who made the Henry II map evidently believed that Samaná and Guanahani were one and the same island, or he would not have so marked it; but because it was a supernumerary, other cartographers attached it to the Crooked group. So we have Juan de la Cosa's map, on which it is doubtful whether Guanahani is itself or not; the Henry II map, on which Guanahani is certainly itself and Samaná at the same time, and a score or more of later maps on which "Samaná" is applied to the Crooked group. It will be observed, moreover, that Jeffreys retains the name in both places, calling Crooked island "Samaná" and the other "the Samaná of the French"; but when finally the name "Crooked" was exclusively applied to the island at present bearing the name, "Samaná" was put back in its old place. It had previously belonged to an island lying northwest of Mayaguana, and it was put back there. In other words, if the testimony of these maps is worth anything, *Guanahani, El Terrigo, Trianga, Atwood Cay, Isle Nova and Samaná are one and the same, and that one is the Guanahani of Columbus.*

Beyond a few observations concerning the second island at which the squadron landed, it is not within the province of this paper to attempt tracing the course to Cuba. It is believed by the writer that the identification of the second island is the chief factor to the locating of the first. Sometime during the 14th of October, Columbus sailed southwestward for the largest island, which he thought to be about five leagues distant. He reached the island after dark, for in the record of the 15th he says:

> I had been standing off, and on this night, fearing to come close to the shore to anchor, for I could not know whether the coast was free from shoals, and intending at dawn to clew up sails; and as the island was over five leagues ahead, rather, seven, and the tide detained me, it was noon when I reached said island; and I found that the side of the island, which is toward the island of San Salvador, runs north and south and is five leagues in length, and the other, which I followed, extends east and west and contains more than ten leagues; and, as from this island I saw another larger one to the west, I clewed up sails, for I had gone all that day until night, because I could not have gone to the western cape, to which I gave the name of the island of Santa Maria de la Concepcion, and about sunset I anchored near said cape.*

This second island Columbus asserts to have a north-and-south side sixteen and an east-and-west side thirty-two miles in length. Now Crooked and Acklin islands—they are practically one †—conform exactly to this description, and there is not another island in the Bahama archipelago that does. The north-and-south side of Crooked island is thirteen; the east-and-west side is twenty-nine miles; the distance from Samaná to the north-eastern point of Crooked island is twenty-three miles—22.3 the log says. An expert sailing master could not come nearer the truth today than did the Admiral. There is but one discrepancy, namely, the Admiral's assertion that the side of the island toward Guanahani is the east (Norte Sur) side. As a matter of fact it is the north (Leste Oueste) side that lies off Guanahani. Whether or not during the night, while standing off and on, the

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* Habia temporejado esta noche con temor de no llegar á tierra á sorgir antes de la mañana por no saber si la costa era limpia de bajas, y en amaneciendo cargar velas. Y como la isla fuese mas lejos de cinco leguas, antes será siete, y la marea me detuvo, seria medio dia cuando llegué á la dichia isla y fallé que aquella haz, ques de la parte de la isla de San Salvador, se corre Norte Sur, y hay en ella cinco leguas, y la otra que yo segui se corria Leste Oueste, y hay en ella mas de diez leguas. Y como desta isla vide otra mayor al Oueste, cargué las velas por andar todo aquel dia fasta noche, porque aun no pudiera haber andado al cabo del Oueste, a la cual puse nombre la isla de la Santa Maria de la Concepcion, y cuasi al poner del sorgí acerca del dicho cabo. . . .

† The narrow gut that separates them is hardly more than a tidal swale or kill, not more than four or five feet deep at high tide. It is invisible from the deck of a passing vessel.

steersmen had worked the vessels so far to the eastward that they were off the east instead of the north coast, is a matter of conjecture. I am free to admit the objection and do not attempt to explain it away by guesses. The same objection obtrudes itself just as strongly in the consideration of Watling island. In spite of this objection, however, there is not another island that for shape, dimensions, distance and direction so fully meets the requirements of the log as does Crooked island.*

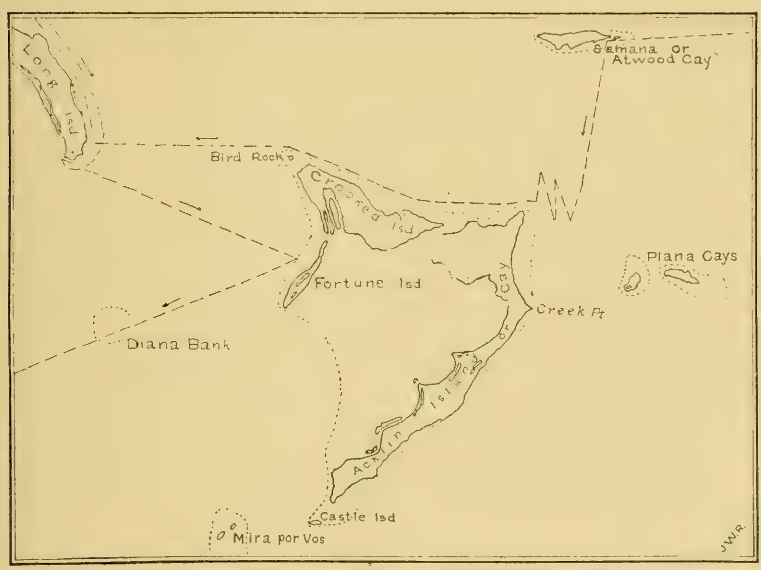

FIGURE 2.—*Modern Map of Samaná, Crooked and Acklin Islands.*

Let us now examine the claims of Watling island. The only land visible from Watling that lies southwestward is Rum Cay. Its distance from Watling is twenty-three miles, and the course and distance conform to the requirements of the log, but Rum Cay is only five miles in extent on its eastern and eight miles along its northern shore. Several writers have endeavored to show that the squadron passed to the northward of Rum Cay without anchoring there at all, basing their arguments on the

* The force of this statement is apparent when one compares the size, outlines and relative bearing of the islands, as shown in figure 2, with the log. On this map is also shown the route in accordance with Captain Fox's views.

statement, "I looked for the largest island and determined to make for it." Now there is only one other neighboring island southwest of Watling, and that is Long island. Moreover, no part of Long island is visible from Watling. Not only is it invisible from the masthead, but it is about twice the distance given in the log; still more, neither its shape nor its dimensions conform to the description in the log. Even the careful Captain Becher incorrectly translates the passage "*cargué las velas, por andar todo aquel dia fasta la noche*," saying, "I made sail, continuing on until night," etc. But *cargar las velas* means to shorten sail—not to crowd on more canvas. Major errs in translating the same passage, saying, "I started for the purpose of sailing," etc. Captain Fox notices these errors and translates the passage correctly. Indeed, there can be no question about it, for it is the recognized nautical expression in the Spanish language for the act which in English is to "clew up."

Just why Watling island should have received the sanction of so many authorities it is difficult to understand, unless it is the fact that this island has two rather large interior lakes; but, under any circumstances, lakes are about the most transitory features of the earth's surface, and the lagoon of low, sandy shores is almost ephemeral; it is found today, and tomorrow it has disappeared. The storm which throws up a spit or walls in a cove today will just as readily undo its work tomorrow. After a lapse of four hundred years the presence or absence of a lagoon counts for nothing.

It is freely admitted that in the foregoing paragraphs the positive identification of Samané as the first landing-place has not been made. It is believed, however, that material evidence has been added to the question. It is hardly necessary to say that the testimony of any one map counts for but little; but the case is different when we take the consensus of many maps, and in future researches undoubtedly early maps will play a part second only in importance to the log. In closing this paper, therefore, it is suggested that thorough and systematic search for evidence among early maps be made. In the past such search has always been highly fruitful in its results; there is no reason why it should not be equally fruitful in the future.

JAPAN

BY

D. W. STEVENS

COUNSELOR OF THE IMPERIAL LEGATION OF JAPAN

(*Extract of Address presented before the Society October 19, 1894**)

The restoration of 1868 found Japan in a disordered and impoverished condition. The assumption by the Emperor of the imperial power and the relegation of the Shogun to private station were not the results of a sudden emeute or of a hastily planned revolution. The seeds of discontent had been long sown—the fruit was long in maturing. Japan had been closed to the world for centuries; but no people can be shut off completely from knowledge of the rest of mankind, or from contact with the ideas of a progressive age. The government of the Shogun was a feudal despotism, a system as complete as any that ever existed in the middle ages, surviving apparently unimpaired to the last half of the nineteenth century. It was a government which had served a good purpose at one time, for it had quelled and pacified warring factions and had given the nation much needed rest under a wise, if a severe, rule. But its day of usefulness was past; those who controlled it saw the threatening dawn of a new era, and their wisdom became cunning, their severity, tyranny. It may be safely asserted that the Shogunate would have fallen in any event, from internal feuds and dissensions; but strangely enough the death blow to its power was that event of which we Americans are so justly proud—the conclusion of the Perry treaty. It was this dawn of daylight from the outer world which showed intelligent Japanese how thoroughly out of touch their country and, above all, their form of government was with the spirit of the age. It was then that the little band of reformers who were chiefly instrumental in

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*The Editors regret that space will not permit the publishing of this address in full.

bringing about the great change of '68 began their work. They were aided in a measure by the cry of opposition to foreign intrusion which the conclusion of treaties with western powers immediately aroused. There are conservatives in all countries, and the Japanese conservatives of that day formed the Joi or anti-foreign party. Like skillful politicians, those who were seeking the destruction of the illogical and unwieldly dual government availed themselves of this, as well as of all other forms of discontent and opposition, in order to better accomplish their purpose. The facts of history will bear me out in the assertion that, like wise statesmen, they permitted it to have no share in their policy when they themselves came into power.

Glance at the first acts of the Emperor when he assumed the exercise of all those prerogatives of which his ancestors had been deprived for more than three centuries and tell me, if you please, whether the men who guided and directed the counsels of the youthful sovereign were visionary schemers or practical statesmen; whether they were merely lucky speculators trading upon borrowed ideas, or whether they were men who understood their country and their countrymen and cherished a hopeful but not an unreasonable or an illogical ambition for both?

One of the first acts of the Emperor was to issue an edict abolishing the laws against foreign religions and their propagation among the Japanese.

The daimiyos or feudal chiefs surrendered their fiefs to the crown and accepted in lieu the bonds of the government at amounts, it should be added, much less than the value of their original holdings. This, it must not be forgotten, was an entirely voluntary act of self-abnegation.

The samurai or military class, whose privileges, rigorously secured and jealously guarded, made them the real masters of Japan, especially in times of domestic disorder, like their chiefs, the daimiyos, accepted capitalized pensions instead of the regular support to which their fealty and their service had entitled them; and I should add that the dangers to be apprehended from the discontented and turbulent members of this powerful class thus thrown out of employment, and in many cases sadly impoverished, were anticipated and guarded against by the passage and enforcement of a law which has proved itself the highest form of statesmanship. I refer now to the conscription law, by which every Japanese, rich and poor, high and low, is obliged to serve in the army for a certain period, and thereafter for a certain further time to hold himself in readiness for such service. The wisdom of such a law, in view of a possible uprising of the samurai, was signally proved by the serious outbreak which occurred in Japan in 1877. The result of that rebellion set at rest forever the question of rule by a military class in Japan.

The reorganization of the whole fabric of the public administration was naturally the first care of the imperial government. The departments were all established upon a new and an effective basis. Foreign advisers were employed to assist in the work, and no effort or expense was spared to create a system which would be at once modern, practical and economical.

Time will not permit and it would weary you to recount all that was done. A few instances will serve to illustrate the whole.

The government recognized the importance of education to themselves and to the masses. A complete system of educational institutions was established in every part of the empire, beginning with primary schools in every hamlet, through middle, normal and other more advanced institutions, up to the university in Tokio. Hospitals were endowed, and especial attention was paid to education in medicine and surgery. Nor was any distinction made between the sexes, but schools were established for the education of women as well as of men. This system has been steadily followed throughout, with only those changes which experience has shown to be advisable and beneficial. There are also a number of private educational establishments in Japan, many of which hold a deservedly high rank. Some of these are denominational, established in the first place by foreign missionary bodies, but now exclusively under Japanese control, while others are secular, the result of the labors of men of high scholarly attainments and conspicuous executive ability.

In all public works the government has taken an active and an earnest interest. The establishment of railway and steamship lines, of telegraph and post-roads, and, in short, of all those facilities which increase the comfort and convenience of the nation, have been their constant care. The telegraph and postal systems are equal to those of most countries, while as to railways an increase from 18 miles in 1873 to almost 2,000 miles in 1894 may fairly be regarded as a good result even in this country of phenomenal railway developments.

Nor should it be forgotten that a great deal of the progress which Japan has made in every direction has been due as much to private enterprise as to government direction. The railway and steamship lines, for example, are almost exclusively under the control of private corporations. The government has, of necessity, taken the initiative in many things, but oftentimes it has been merely to set an example which has been readily and aptly followed.

There is another phase of Japanese development which is well worthy of notice. I refer now to the newspaper press. The Japanese, like the ancient Athenians, and, may I add, like modern Americans, are a people who delight in hearing new things. It need hardly be added that the press came to them, as it comes so often to us, to supply "a long-felt want." Its development has been little short of marvelous, and now it flourishes like the green bay tree, from the scholarly periodical, the didactic weekly, the political daily, down to the penny dreadful, for whose columns nothing short of murder and sudden death are fit matter. Many able, intelligent and patriotic men are enlisted in the ranks of the press in Japan, and they already exercise a potent influence upon public opinion and the conduct of public affairs. The government has deemed it necessary to establish regulations for the control of the press—a system more alien to American than to European ideas, but one which experience has shown is necessary to the public welfare, and to that proper distinction between liberty and license to which a youthful but an energetic and a powerful institution like the press of Japan might on occasion be oblivious.

The inhibitions of the press regulations are plain and precise. Their object is clearly stated, the preservation of public peace and morals, and restraint from interference with affairs of state where secrecy is a necessity, such as diplomatic negotiations and the like. The penalties they provide—suspension, fine, and minor imprisonment—are not severe. The heaviest penalty of all, the total suspension and confiscation of the paper, has never been inflicted.

In attempting to describe the changes through which Japan has passed and the effect which they have had upon the development of the country's resources and the increase of national wealth it has not been possible to omit some mention of the political transformation which has been so notable a feature of her recent history. The one stands to the other in the relation of cause to effect, and what the future may have in store for Japan depends not a little upon the harmonious development of the governmental system which was adopted when the empire emerged from its seclusion.

On March 14, 1868, the Emperor, in the presence of the court nobles and feudal lords, made solemn oath that from that time forth the government and the people should unite in the development of the national power, and that the administrative affairs of the nation should be decided by public deliberation; that encouragement should be given to all the pursuits of life; that all abuses and evil practices should be abolished and the equitable principles of nature should be the guiding star of the nation; that wisdom should be sought in all the countries of the world, and whatever was good and right should be adopted to strengthen the basis of the national and the imperial power.

The solemn obligation thus voluntarily assumed by the ruler of a country whose predecessors had exercised despotic power furnishes the keynote to all that Japan has since accomplished. It clearly foreshadowed not alone the changes which immediately followed, but the consummation of all those changes which took place when in 1890 the Emperor established a constitutional form of government. It will thus be seen that this final result was achieved not on the impulse of the moment or in consequence of any political exigency, but in conformity with a plan adopted from the beginning. That plan was consistently held in view and systematically followed from the outset. The statesmen who under the imperial will guided Japan's destinies then, some of whom are still the trusted advisers of the emperor, wisely decided that the immediate establishment of parliamentary institutions was not practicable; but steps were taken to pave the way for such institutions by extending the rights and privileges of the people, most notably by the creation of the prefectural and other local assemblies, which exercise a certain degree of control over local affairs. These and other similar institutions were designed to educate the people in the practice of self-government, and they were in active operation a number of years before the first imperial diet was opened.

After the resignation of the Shogun in 1868 that office was abolished and a council of state was created, to which the Emperor confided the direction of public affairs. Several changes in the formation of this council followed, until in 1885 the present executive system was adopted. It consists of a cabinet and a privy council. The former, presided over by the prime minister, is composed of the ministers in charge of the executive departments, who are directly responsible to the Emperor for the management of their offices. The functions of the privy council are purely advisory.

The different prefectures into which the empire is divided are under the charge of governors, appointed by the Emperor upon the recommendation of the minister for home affairs. In each prefecture there is, as I have already stated, a local assembly, which coöperates with the governor in the management of local affairs.

The imperial diet is composed of two houses, a house of peers and a house of representatives. The former body consists of members who hold office as a hereditary right; of a certain number who are elected by the different orders of nobility which are not entitled to seats in the house, and of a certain number appointed by the Emperor.

The members of the house of representatives are elected directly by the people. A property qualification governs the exercise of the electoral franchise.

This, in brief, is the executive and legislative system now in force in Japan. When everything is taken into account, it may be said to have worked smoothly and efficiently. Since the adoption of the constitution and the establishment of the diet there has at times been a great deal of political excitement, but throughout every storm of this kind there has been no attack upon the privileges of the people, no thought of an assault upon the fundamental law. The constitution has been scrupulously observed, and each struggle between the executive and the legislative branches of the government has been carried on within the lines defined by that instrument. Such contests are inevitable where men strive for political supremacy. In Japan they afford a useful vent for political passions, and when, in time, party principles are more clearly enunciated and party lines more sharply drawn, there is no reason to believe that parliamentary government in Japan will not achieve all that was hoped for it. The fact that in Japan, even from ancient times, a system of local self-government in town and village and rural district was conceded by the government and jealously retained by the people affords perhaps the brightest augury for the success of self-government in Japan.

The systematization and codification of the laws of Japan was one of the first cares of the government after the restoration. It was their wish to adapt them as nearly as possible to western models. All cruel and unusual punishments have been long since abolished, and Japan has today a body of codified law based upon the best models. All of the codes are in successful operation, with the exception of the civil code, which has already been promulgated, but has for some time been undergoing revision at the hands of a commission of experts and will soon be put in operation.

In equal measure the judicial organization of the empire has been made the subject of careful study and thorough reform. In 1872 the Japanese judiciary was made independent of the other branches of the government, and courts were established presided over by judges who performed no other functions.

Ten years ago a system of competitive examination for appointment to judgeships was introduced, and has ever since been in successful operation. The constitution itself provides that jurisdiction shall be exercised by the courts of law according to law; that the organization of the courts shall be determined by law; that the judges shall be appointed from among those who possess the proper qualifications according to law, and that no judge shall be deprived of his office except for misconduct and by due process of law. A statute passed for carrying these constitutional guarantees into effect and providing for a comprehensive and complete reorganization of the courts of justice has been in operation for more than four years.

GEOGRAPHY OF THE AIR

Annual Address by the Vice-President

GENERAL A. W. GREELY

(*Presented before the Society November 2, 1894*)

The broadening fields of human knowledge have changed their very name in the evolution that has been wrought in manner, means and extent of learning, research and study. We no longer say *science*, but instead *the sciences.* From time to time, as the aggregations of fundamental data and accompanying discussions have become too divergent for easy comparison or too abundant for individual assimilation and reception, they have been divided and subdivided first into branches and eventually into separate sciences.

It is only within the early part of the present century, however, that associations have formed for the study of geographic problems. and yet more recent is the claim and belief that geography is no longer an unappreciated handmaid of history or geology, but rather an able-bodied member of the scientific brotherhood.

At this time, then, it is fitting that the general subject of geography should be very briefly reviewed, especially with reference to its proper place among the sciences, its enlarged scope in the great universities of the world, and the radical transformation in methods of study that makes it a science rather than an accomplishment.

It is twenty years since Germany, first of the great nations, awoke to the value of sound geographic study. Previously taught perfunctorily as an adjunct to history, geography was at that time honored in one of its great universities by a separate chair. Such were the results from this field of research, previously neglected by the other sciences, that other universities speedily followed the example, and at present fourteen of the twenty-one German universities have professors of geography, with annual salaries running as high as two thousand dollars. Now the tendency to separate history and geography is general, and this latter science is not only compulsory in Germany, but is recognized as of equal value to history, natural science, physics and chemistry.

Geography has assumed similar importance in France, Belgium and Italy. The last-named country, besides imposing proficiency therein as essential to the degree of Ph. D., has established twelve professorships at its great seats of learning. The conservative universities of Great Britain, viewing modern tendencies with distrust, slowly yielded to the inevitable, and while Cambridge decided some ten years since that, among other universities, teachers to be appointed there should be one in geography, yet it is only within a few years that Cambridge and Oxford have formally appointed geographic readers or lecturers.

Formerly the field of geography was unduly restricted by associating it with geology or history—a practice happily waning. Now the pendulum swings to the other extreme, and there is on the part of some enthusiasts a tendency to unduly extend its limit so as to encroach on the domain of other branches of science. The separate sciences necessarily overlap, and no sharp line of division can be drawn that will find universal acceptation.

In my opinion, geographic science should be restricted to the surface of the earth, with its superincumbent or attached objects and attendant atmospheric phenomena, which are to be considered, both in their interrelations with the earth and with each other. The evolution of the earth's surface pertains to geology, but the distribution over the surface of the earth of inorganic matter, whether in the shape of agricultural soils or other forms, with industrial possibilities, pertains to geography. Similarly the distribution of existing faunas and floras is geographic as far as these in any way affect mankind, while their classification and detailed study are botanical, biological or zoölogical. In like manner other physical sciences either touch or overlap that of geography, the same class of data pertaining to different branches, according to its interrelation with man or its bearing on non-geographic sciences.

There is no question that geography, when properly taught, is not only a discipline for the mind, but it also furnishes its students with a body of information both interesting and valuable.

In its comparative branches it trains and stimulates the intellectual faculties; by its contact with nature it develops the powers of observation and reflection, and in its investigations it offers endless opportunities for promoting clearness of expression and logical methods of conclusion. For professional men its stores of knowledge regarding other nations and countries broaden the mind. To merchants the knowledge it affords is indispensable when changed conditions oblige them to seek foreign outlets for their wares. Its utility is even more apparent to statesmen and legislators, whose actions control the destiny of a nation, which, through their geographic ignorance or knowledge may be led into humiliating and unfavorable concessions or may reap material advantages at favorable opportunities. To the tiller of the earth it offers material advantages in its afforded knowledge regarding the influences of elevation, exposure and soil, as shown in the natural vegetation or cultivated crops of various countries. To the investigating scientist it presents a wealth of unsurpassed material, almost untouched, it may be said, relative to the distribution of permanent and transitory fauna and flora, and in regard to its ethnographic data and sociologic conditions, so often affected by man's dependence on the resources of the soil.

It has been objected that the addition of another science to the already overladen course of our great universities is to be deplored, since even now time fails for a complete course. This was a valid objection a quarter of a century since, before the authorities of the great educational institutions of the world came to realize that the field of human knowledge had so broadened that the scientist of the future must be a specialist. Now the initiation of selective courses gives opportunity for additional departments of science, hitherto neglected or ignored. As man is the dominating spirit of the earth, so the study of man is the highest and noblest of all pursuits. Time was when the dead languages and ancient history—the forgotten speech and vain actions of vanished nations—were the heights of secular scholastic ambition, but with advanced civilization there inevitably developed a necessity of formulating and mastering such of the natural sciences as minister to the growing physical needs of mankind. The struggle between the humanities and the natural sciences is practically past, each maintaining its fruitful field of usefulness. We have come now, however, to another age, to a higher stage of civilization, where the brotherhood of man is practically established, upon a low plane, be it granted, so that the lowest tribes and highest communities are inextricably united. As an illustration consider the barbarous and lately cannibalistic tribes of the Congo basin, sixteen years ago unknown to the world; five years later their future destiny deliberated on and in a measure decided by a congress of fourteen great nations. Yet again, and only a year since, the vast industries of this great nation, with their involved financial interests, almost completely paralyzed in a single week by the telegraphic announcement of an order passed by the board of council of a country held by many to be yet heathenish.

These conditions emphasize the already assumed importance, which, it may be added, will steadily increase, of such branches of science as illustrate the interdependence of the humanities and natural sciences. In other words, of the interaction which takes place between man and his physical environment.

One of the most important phases of geographic knowledge is that pertaining to commercial interests. Indeed, so indefinite, unsatisfactory and inaccessible have been the fundamental data on which rest the success of extensive enterprises that, in default of authoritative geographic departments in the great universities of the world, the business portion of large commercial communities have been obliged to organize bureaus of information or commercial geographic societies for the purpose of collecting the widely separated data pertaining to their special department of commerce. In the United States the lack of such data has very materially retarded the development of its foreign export trade—a condition of affairs so obvious and regrettable that the general government has been constrained to attempt a remedy for the evil by initiating and continuing its valuable and highly appreciated series of consular reports. Unfortunately, however, many of our consuls enter upon their duties in various stages of ignorance as to the underlying principles of commercial geography and commerce as represented by widely separated and dissimilar countries. It requires a mind trained in geographic research to treat the important and various aspects of commercial geography. The successful performance of such duties involves a knowledge of the leading industries of each country; technical familiarity with the raw material used; thorough knowledge of such factors as the method and cost of native labor; local customs; trade restrictions; facilities for transportation; hindrances and advantages of trade routes; navigation conditions, such as port dues, canal charges, lighterage, etc; custom duties, both export and import; local trade methods; the character of currency and the peculiarities of exchange. As an illustration of the value of information on the last-named point may be mentioned Stanley's dismay at finding gold coin the only money recognized at Zanzibar, while his gold sight bills on London or Calcutta were negotiated as a favor at the enormous discount of twenty per cent. It may be said that elsewhere in Africa the friends of the white metal predominate, since in Abyssinia the Maria Theresa dollar (or five-franc piece) of a certain date—1789, I believe—is the only current money, a fact which seriously threatened the success of the Abyssinian campaign until the British government supplied Austrian silver to its supply department.

The extent of geographic science necessitates its division into distinct branches, which, by common consent, include, first, mathematical; second, physical, and, third, political geography. Among other suggested divisions are classical, climatological, historical, etc, which, in my opinion, are inadvisable, except as strictly subordinate divisions for special purposes. Other various and suggested divisions of economic, commercial, industrial, hydrographic and climatological should, in my opinion, be combined to form a fourth branch to be known as economic geography.

Mathematical geography concerns the figure, size and motion of the earth, its delineation on charts, and the determinations of its localities by astronomical methods. Research and instruction in connection with this branch should bear especially on the technology of geography, on the principles and methods of cartography, and on such instruments, methods, etc, as are indispensable to the correct determination of positions.

Political geography considers the earth as divided into separate countries or states, the various methods through which these states subsist and exist as independent or subordinate governments, together with the affiliations and repugnances shown in their intercourse with other states. Under political geography should be studied the existing laws, moral institutions, social organization and modes of government of different countries, together with their domestic and foreign policies, with the ensuing results at home and extraneous influences abroad.

Physical geography sets before us the characteristics of the surface of the earth, and in its entirety presents a concrete idea of the wonderful fitness of the earth for man's habitation and workshop. It includes the distribution of the animal, vegetal and mineral kingdoms; the atmospheric phenomena; the limits, forms and movements of land and water and their interrelations.

The broad field of physical geography is of extreme practical importance as furnishing a vast array of knowledge not only interesting in itself, but also as furnishing the fundamental bases on which necessarily rest the ultimate conclusions of economic geography in its efforts for the perfect evolution of man's material interests. The course and degree of permanency of the great currents of air and sea, the intensity and variation of the important factors of climate, the distribution of rain and snow, the prevalence of storms, the diversifications of land surfaces and ocean beds, the extent and relation of navigable waters and practicable roads, the habitat of faunas and the distribution of floras useful to mankind, and the ethnographic characteristics of different nations and races are the most important subjects that it furnishes for study and consideration.

Economic geography—which may be said to be the comparative treatment of the political and physical branches—owing to its practical bearings, is the most important part of this science, since it illustrates where, when and how the latent resources of the earth may be most advantageously exploited for the benefit of mankind. It involves a knowledge of the natural resources of different regions, of transportation routes, of natural elements that militate against or are favorable to special pursuits or industries, and of numberless social conditions that may affect the initiation, development or continuance of any material enterprise.

In economic geography efforts should be made to supplement the accumulated data of political and physical geography by special study of soil, climate, trade routes, mineral and vegetal deposits and aggregations, transference and acclimatization of plants and animals, raw industrial materials, industrial appliances, financial methods, trade restrictions, race prejudices or peculiarities, and other elements calculated to assist in the practical solution of the problem of bringing the producer and consumer into such relations as will insure the greatest possible benefit to the world. Problems of this character offer endless and attractive means of cultivating the intellect, since the powers of thought are necessarily exercised and the faculties of observation stimulated.

Ten years ago our Commissioner of Education was asked by the Royal Geographical Society to give information setting forth the condition of geographic science and its appliances in the higher institutions of learning in the United States. The information sought was promised, but not furnished. The answer as regards nearly every college or university might well have been paraphrased from a stock army story of the officer who was directed to report on the morals and manners of an Indian tribe he had visited. He tersely said: "Morals they have none and their manners are disgusting." So scientific geographic instruction until lately has been practically *nil* and its appliances obsolete and deficient, as far as the United States is concerned.

It should not be understood that geographic research, or even genius, has been wanting in the United States. The clear-cut ideas, keen researches, vivid portrayals and lucid reasonings of Guyot have done much to raise the level of physical geography. The most striking contribution by the United States to the geographic benefit of the world was that where, as Humboldt said, a new science was created through the genius of Maury, whose discriminating mind gave the original impulse to that special branch of geographic science now known as oceanography. His invaluable system of charts first delineated together as a unity great ocean currents, constant and variable winds, regions of storm and calm and the known whaling grounds. Few appreciate the enormous practical outcome of Maury's labors, which have saved to mankind tens of millions of dollars through the shortened voyages of its commercial transports, which in tens of thousands, weave and reweave across the seas the web of commercial intercourse essential to human progress and prosperity.

More frequently the reverse side, that of geographic ignorance, has presented itself to the attention of man, with its inevitable train of futile enterprises, wasted efforts and ruined fortunes. Now it is an expensive governmental experiment, foredoomed to non-success with its enforced and hasty generalizations, based on insufficient or incorrect data; again it is a commercial enterprise, a great canal, an industrial scheme, a commercial venture, initiated under geographic conditions that forecast inevitable failure. If it is not an official, squandering tens of thousands of dollars in accumulating for building purposes steam saw-mills and bodies of skilled wood-workers in a treeless region abounding in building stone, it is a host of moneyed individuals buying worthless land on prophesied possibilities, which a cursory knowledge of economics or even physical geography would authoritatively disprove.

A word relative to what many have thought to be the practical if not the whole of geographic work, explorations and their direct or indirect result. Chancellor's voyage to the White sea reaped millions from the Muscovy trade for England. Hudson, Cook, Bering and others made voyages and discoveries that resulted in equally important additions to the wealth of the civilized world. Explorers by the score have affected the course of trade and influenced the onward march of human progress. I have already alluded to the astounding results flowing from Stanley's African work, which, from the nature of circumstances, can never be paralleled. There will be results of no small value from geographic field explorations in the near future, but it may be admitted, as a whole, that the days of great results from geographic discoveries are practically past.

We must turn, then, to the higher field of geographic research, in which comparison and analysis play the most important part. Recall that from a handful of dried plants the botanist Hooker outlined the extent and general physical conditions of an unknown land; that the geologist Heer in a few score fossil plants read the riddle of wondrous climatic changes that the arctic regions have experienced, and that a geographer forecast the great plateau of interior Africa years before its existence was demonstrated to the satisfaction of the world.

Even higher studies, those of economic geography, await the magic influence of scientific treatment to yield fruition of tremendous import to the future, by forecasting the tendencies of industrial progress as affected by the development and transition of the centers of production of the raw materials, and their interrelations with the great centers of population.

Such fields offer most promising results to investigating scientists, and among those who will reap reputation therefrom let us hope there will be many from the ranks of the members of the National Geographic Society.

SIR FRANCIS DRAKE'S ANCHORAGE

BY

EDWARD L. BERTHOUD

The Elizabethan era was the dawn of the birth of the supremacy of the English navy, which was destined in the seventeenth and eighteenth centuries to sweep the seas of Spanish, Dutch and French navies and destroy the commercial monopoly of Spain in the new world.

Foremost among the English to attack the attempted monopoly of Spain in the Americas and the East Indies were Drake and Cavendish, who, with what today seem ridiculously insufficient armaments, shook Spanish pride and conceit, and captured the fabulous wealth they yearly sent in galleons to the mother country.

In 1577, under the auspices of England's queen, a silent partner and sharer in the expected booty, Sir Francis Drake sailed from England to raid the Spanish colonies of North and South America.

Sir Francis Drake was one of the boldest buccaneers and navigators that ever sailed from England; he was every inch a sailor. Of infinite bravery, skill and self-reliance, he sallied out to shear the golden fleece so long the sole monopoly of Spain.

Judged today by the standard of present accepted morality, Drake's naval campaign was but a shade above piracy. It was conquest and plunder, with no pretension to discovery or commerce. What it achieved was merely incidental in his plans of occupation—a mingling of chivalric bravery with a modicum of religious fervor. One Fletcher, a clergyman, was his chaplain and exhorter, but was not a very zealous workman in the vineyard of the Lord. Fletcher and one Pretty have both left an elaborate account of Drake's "res gestæ," which in main facts correspond tolerably well.

Sir Francis Drake (whom Fletcher calls our Admiral), having raided and plundered the west coast of South America and of

Central America and Mexico from Chili to Guatulco, capturing ships, towns and great treasures of gold, silver and plate, spreading a reign of terror in that whole region, reached at last the port of Guatulco, a haven a short distance west of Tehuantepec.

At Guatulco * Drake, knowing that the whole power of Spain was now aroused and on the *qui vive* in the South sea, and that the return route by the straits of Magellan was too dangerous and uncertain, both on account of difficult navigation and certain attack from Spanish fleets, boldly resolved to return to England by the Pacific ocean, the Moluccas and East Indies, and the cape of Good Hope, a longer but a safer route. Leaving Guatulco well loaded with plunder, Drake sailed northwestward instead of westward, his true course, some 500 leagues in longitude, and to June 3 1,400 leagues in all, "until we came into 42° north latitude," † but Pretty says 43° of the pole arctic.‡

Although Fletcher and Pretty differ somewhat in their account, both agree that the cold for them was intense, after their long cruise in the tropics. Pretty says, "our men being pinched with the same, complained of the extremity thereof," while Fletcher pithily says, "they seemed to be in the frozen zone."

On June 5 our militant chaplain says: "Wee were forced by contrary windes to runne in with the shoare, and so cast anchor in a bad bay." Here the cold continuing and, as Fletcher calls them, "vile, thick and stinking fogges prevailing," § they were unable to remain, but were forced to go no farther north.

Curiously enough, at this point of his narrative Fletcher seems to have had his mind or his memory much affected, probably by the aforesaid "fogges," for in the next paragraph he gravely tells that this bad bay was in the height (latitude) of 48° north, not far from the entrance of Puget sound into the Pacific ocean. So if Fletcher is correct in his statement as to the latitudes gained, then from June 3 to June 5, 1579, Drake had sailed in three days 6° of latitude, or over 400 miles, or, taking Pretty's estimate of 5°, some 350 miles; but when they concluded to leave this locality and return southward, they followed the coast, which he says was reasonably plain, yet the hills were covered with snow.

* World Encompassed, by Fletcher.

† Op. cit.

‡ Pretty's narrative or journal.

§ World Encompassed.

Thus, returning with "propitious windes," our clerical narrator tells us it took them to June 17, 1579, to reach on the coast the parallel of 38° 30′ north latitude, "a convenient and fit harbrough," as Fletcher calls it.

We can say here that Fetcher's bay, with the "vile, stinking fogges," which he says was in 48° north latitude, must be considered as an error made by him in place of 43° latitude.

Greenhow, in his discussion on the Oregon question years ago, comments on the discrepancy of time between Drake's rapid journey northward and the twelve days' time it took the Admiral to sail back to the 38° 30′ point with favoring wind.

Prior, in his Collection of Voyages, a well known English work, plainly says Drake went to 43° north latitude, then sailed back south to 38° latitude.

That this is no surmise on our part as to wind and weather, Fletcher himself says the bay was a most uncomfortable spot for them, and they were driven south to find a better place of anchorage.

After carefully comparing Fletcher's and Pretty's narratives, it is evident Drake landed somewhere on the coast of California, but where, is the point of discussion. When, however, we consider the cold and frost experienced by them, the confusion of latitudes given, their northing and abrupt return, we cannot give much weight to their latitudes, taken in the storms and fogs that beset that coast, and that their observations and dead reckoning were not even close approximations, nor can we believe such a magnificent bay and harbor as that of San Francisco could have been so slightingly mentioned by him in the way he narrates, so that the "fit and convenient harbor and fair bay" could not be the bay of San Francisco.

Bryant, in his History of the United States, discusses the probable location of Drake's harbor on the coast of California, and gives from Hondius a map of his anchorage, which has a strong resemblance to Bodega bay and Romanzoff point, now known as Bodega head.

Winsor's Narrative and Critical History of the United States enters largely and interestingly into this subject—a résumé of the arguments advanced on this mooted point—adding to the hitherto scanty cartography of Drake's discovery a copy of Dudley's map, the Arcano del Mare. Dudley's map we think but little elucidates the question. It indicates certain bays and islands between the 38° and 39° north latitude, one of which is called the bay of Saint Michael, the other Porto di Nueva Albion, which, aside from their approximation to the 38° and 38° 30′ latitude, require constructive imagination to call Bodega bay and the port of San Francisco.

Professor Hale, in Winsor's Narrative and Critical History, hints that it may all be the work of Dudley's imagination.

The map of the coast of California, derived from Father Acosta's work, in Angel's Mémoires Geographiques, curiously resembles Dudley's map in several respects. Bahia de Pinos can be taken to represent Monterey bay, and Cabo de San Francisco as point San Pedro; then follow islands that by a farther stretch of imagination can be supposed to represent the Farallones, while the Bahia de las Islas on the same lines represents the supposed San Francisco bay, if such was supposed to exist in the sixteenth century; but is Cabo de San Francisco a name imposed on that headland after or before Drake's voyage? We hope that Professor Davidson will throw some light on that name in his farther promised collation of Viscaino's survey; but Acosta's map is of date anterior to Viscaino's exploration. We were inclined first to consider the group of islands between Cabo de San Francisco and Punta de Sardine as representing Cabrillo's discoveries, but their distance from Monterey bay and their position toward cape Mendocino seem to preclude this theory.

Now, Fletcher says expressly: "From the height of 48° [43°], in which wee now were, to 38° wee found the land by coasting along to be but low; . . . in 38° 30′ we fell with a convenient and fit harbrough, and June 17 (1579), came to anchor therein, where we continued until July 23d."*

San Francisco bay is in latitude 37° 46′ north. Bodega bay is in 38° 30′ north. It is singular, in view of what Fletcher says, that their anchorage was in 38° 30′; that a bay south of Drake's most southern return journey should be selected as the point where Drake landed and took possession. Drake coasted to 38° latitude, near to point Reyes; he, finding no place of suitable anchorage or to land, returns northward again and anchors in Bodega bay, a most convenient point to refit, where a few days after he indulges (more Anglicano) in the antics of a regal crowning more befitting the Neptunian masquerade of a jolly set of

*Op. cit..

tars and successful buccaneers laden with plunder, than the honors of a sober discovery, while the inane farce of taking possession for the crown of England disregarded the prior rights of Spanish discovery many years before Drake's landing.

Fletcher, who enters in some detail as to what took place during their residence in the bay, says, on page 64: "This country our general named Albion," etc. Another reason for the "act of possession" was evidently Drake's idea that by it he reaffirmed England's denial of Spain's monopoly, founded on the absurd bull of Pope Alexander sharing the eastern and western hemispheres between Spain and Portugal, a partition scouted by both France and England. The absurdity of the "act of possession" by Sir Francis Drake was in later years repeated in numerous localities on this globe with signal advantage to England.

In this manner the poor ignorant aborigines of Africa, Asia, and America have found themselves invested with the honors of allodial possession, duly transferred to England by the magic of treaties. These, with the claims of first discovery conveniently at hand, backed by presents of cast-off clothing, rum, theatrical crowns and medals of Britannia, formed the foundation for future seizure and annexation.

July 23, 1579, Drake left his anchoring ground, the Indians taking a sorrowful farewell, signaling with fires the departure of the buccaneers.

Fletcher now tells us "that not farre without the harbrough did lye certain isles (we called them the isles of Saint James), having on them plentiful and great store of seals and birds, with one of which we fell July 24th, whereon we found such provision as might completely serve our turn for awhile."*

These islands, called by Fletcher the Saint James, are undoubtedly the Farallones, yet it took them one day's sail to reach them from their anchorage. We can hardly think it would take a day to sail from Drakes bay or San Francisco harbor to reach these outlying islets. The preponderance of locality and distance seems to point to Bodega bay as Drake's harbor.

It does not seem possible that in their desultory sailing up and down the coast they would have sailed right into San Francisco bay without hesitation or difficulty in finding it.

Then, again, it seems they discovered the Saint James islands only when they left the coast of California. Could they have

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*Loc. cit.

ignored them when in June they sailed along the coast and entered the bay? On the theory that they stopped in Drakes bay near point Reyes, they were in sight of the Farallones. If they had sailed into San Francisco harbor on June 17, 1579, they passed between Drakes bay and the Farallones and could not fail to see or notice them.

A discussion on the values of the latitudes given in the course of the desultory navigation of Drake along the coast of California will not be made here. We leave it to the eminent hydrographer, Professor George Davidson, who has most clearly and sagaciously worked out the devious and puzzling questions involved, from the explorations of Cabrillo and Ferrelo, and he alone is competent to sit in judgment over the positive value of Drake's nautical astronomy.

We have elaborated our theory as founded on conditions and physical facts given by the authorities consulted, while we have accepted the latitudes as closely correct when they are applied to the point discussed, when it can be shown they agree with the landmarks described.

From the survey of Viscaino in 1601–1603 until late in the eighteenth century, the coasts of upper and lower California and Oregon were little known or studied. Serious changes took place after 1620, when map-makers began to consider California an island, an error perpetuated to the middle of the eighteenth century. On Duval's map of 1682, California is represented, and Canada is shown as bordering on California, port San Francisco is in about 40° north latitude, and the Rio del Norte is emptying into the Vermillion—most fanciful and unreal cartography founded on the worst errors of former explorers.

Engel, and others quoted by him, suggested in the last century that the discrepancies between the sixteenth century Spanish explorations and those brought out in the eighteenth century might be ascribed to changes in coast configuration. The shallowing of the sea along the coast, the formation of islands and reefs, were sufficient to account for changes in topographic and hydrographic features.

We are unable to either affirm or deny the possibility of such changes in the 350 years since Cabrillo's exploration, yet we cannot forget that California and the region around San Francisco has been subjected to violent and oft-recurring seismic convulsions, which have elevated the region around San Francisco many feet above the present Pacific level; and that these convulsions are still far from dormant is yearly witnessed by earthquake shocks, a state of high internal tension which might obliterate that magnificent bay.

Consulting the account of Admiral Viscaino's survey of the coast of California as given in Father Venegas's History of California:*

The Capitana and tender had no sooner left the harbor of Monterey than they had a favorable wind, which, lasting till the twelfth day, carried them beyond port St Francisco. But the day after, which was the 7th January, the wind shifted to the northwest, but blowing an easy gale, still made some way, and the tender, concluding there was no necessity for standing in for the shore, continued her voyage. The Capitana, thinking they were in company, did not shew any light, by which means in the morning they had no sight of each other, and the general (Viscaino) in the Capitana returned to port San Francisco to wait for the tender. . . . Another reason which induced the Capitana to put into Puerto Francisco was to take a survey of it and see if anything was to be found of the San Augustin, which in the year 1595 had, by order of his majesty and the viceroy, been sent from the Philippines by the governor to survey the coast of California under the direction of Sebastian Rodriguez Cermenon, a pilot of known abilities, but was driven ashore in this harbor by the violence of the wind. Among others on board the San Augustin was the pilot Francisco Volanas, who was also chief pilot of this squadron (Viscaino's). . . . And the general was desirous of putting in here to see if there remained any vestiges of the ship and cargo.

The Capitana came to an anchor behind a point of land called la Punta de los Reys.

We consider that this quotation most signally proves that port San Francisco was what is now known as Drakes bay, and that Sebastian Viscaino anchored at the northwestern corner, under Punta de los Reyes; and if we accept Acosta's map as published previous to 1580, then it would appear that port San Francisco is a name given to it by the Spaniards, and in no manner connected with Sir Francis Drake's anchorage or the subsequent dubbing of San Francisco bay as the bay of Sir Francis Drake.

* Venegas's History of California, pp. 288, 289, ed. 1757.

NOTE ON THE HEIGHT OF MOUNT SAINT ELIAS

BY

PROFESSOR ISRAEL C. RUSSELL

Owing to the wide variations in the reported height of mount Saint Elias, it has been facetiously remarked that the mountain must be undergoing remarkable changes. Now that the accurate measurements of Messrs McGrath and Turner, of the United States Coast and Geodetic Survey, have furnished reliable data for comparison, it is important to note that the height of the peak probably does vary, and that future measurements, although as refined as those just mentioned, may not agree with them.

At first glance it might be thought that the snow falling on a lofty range would be blown off from the ridges and peaks and accumulated to a great thickness only in the depressions. It is now known, however, from abundant observations that this is not the case, but instead drifts form in a peculiar manner on even the most exposed summits, so as to materially increase their height. As I have previously attempted to describe,* the drifts on mountain peaks frequently have the form of a sharp pyramid, set eccentrically on their summits. This is the case on mount Saint Elias. The snow pyramid which gives the mountain its exceedingly sharp tip is certainly not less than 200 feet high, and I should not be surprised if, when the top is reached, the snow would be found to be 300 or 400 feet deep. The height of the pyramid depends on the snowfall, on the direction and force of the wind, on eddies in the air currents caused by the shape of the summit, and on avalanches. Every storm remodels the pyramid in the same manner that snow-drifts at lower elevations change their shapes, and the great avalanches which start from its northern face must affect its height. Still the resulting form, so far as is known, is always an unsymmetrical pyramid, with its steepest slope to the north. Changes in the height of the pyra-

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* Nat. Geog. Mag., vol. iii, 1891, p. 143.

mid are not caused by melting, for the reason that under present climatic conditions the snow near the summit of the mountain does not melt during summer, but at an elevation exceeding about 13,500 feet is always dry and light and resembles the finest meal.

The conditions on which the snow pyramid on mount Saint Elias depend are so variable that it is not reasonable to suppose that its height remains the same at all seasons or from year to year. What the variations may be will perhaps be determined by future measurements of the elevation of the mountain

GEOGRAPHIC NOTES

BY

CYRUS C. BABB

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*THE ANTARCTIC CONTINENT**

Résumé of Exploration Work.—The first expedition into the Antarctic area was made in 1567 by Alvaro Mendaña, a Peruvian. In 1598 the South Shetland islands, a group south of cape Horn, was discovered by the Dutch, and in 1606 the New Hebrides group was discovered by a second Peruvian expedition.

La Roche, a Frenchman, in 1672 reported the discovery of an island now known as South Georgia island. France in 1772 sent out M de Kerguelen, who sighted land in latitude 49° S. and longitude 69° E. He thought he had discovered the Antarctic continent, but a second expedition the next year showed it to be only a barren island, which now bears his name.

The great English captain, James Cook, was the first, however, to do any serious work in this section. In 1773 he first crossed the southern circle, and the next year he reached latitude 71° 10′ S. in longitude 106° 54′ W. He describes the region as intensely inhospitable, beset with thick fogs and heavy storms, and the ports along the coast, if there were any, as being filled with ice of a great thickness. He also believed that it would be impossible to attain a higher latitude, and it is a fact that his record has been surpassed by only two other men—that is, Captain James Weddell and Sir James Clark Ross.

After Cook came Smith, Palmer and Bransfield in 1819 and 1820, and during this latter year also Bellingshausen, a Russian, attained a latitude of 70° S. in longitude 1° 30′ W., discovering Alexander and Peter islands. Powell discovered the South Orkneys. Cook's record was broken in 1823 when Weddell reached latitude 74° 15′ S. in longitude 34° 17′ W. Here he found an

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* See The Geographical Journal, London, 1894; also the Royal Scottish Geographical Magazine, Edinburgh, 1894; also Antarctica, by General A. W. Greely, Cosmopolitan, July, 1894.

open sea with many whales surrounding his ship and the waters covered with birds.

Biscoe in 1831 landed on Adelaide island, discovering also Graham and Enderby lands. Balleny discovered Balleny islands and Sabrine land. The Frenchman D'Urville sighted Adélie land in 1840, but he was unfortunate in being preceded by only a few days by Wilkes, who, in charge of the expedition from our own country, skirted the shore of this continent through 60° of longitude. He was unable to make a landing, owing to the immense ice cap which, descending from the shore, extended for several miles into the sea. It presented a perpendicular face 100 to 200 feet above the level of the sea, and was unbroken by indentations for the entire length along which he coasted. Later Dallman discovered Kaiser Wilhelm islands and Bismarck strait.

The most successful and the most important expedition to the Antarctic was that of the *Erebus* and *Terror*, under the command of Sir James Clark Ross, between the years 1839 and 1843. He thrice crossed the Antarctic circle. In January, 1841, Victoria land was sighted, consisting of mountain ranges varying from 7,000 to 15,000 feet in height. Along this shore he coasted southward for 500 miles, until his way was intercepted by a perpendicular wall of ice 200 feet in height extending in an east and west direction. Immediately in front of him the volcanic cones of mounts Terror and Erebus arose 10,800 and 12,400 feet in height respectively. The latter at the time of visit was in active eruption, and one can imagine what a magnificent sight it must have been to those men to see an immense mountain peak, located in a vast wilderness of ice and snow, belching forth fire, lava, and smoke. The ice barrier capping this Antarctic continent Ross coasted for 300 miles, until he had to make his way out, owing to the closing in of winter.

The next season this intrepid explorer repeated his last year's trip, but with not so much success. He reached a latitude, however, of 78° 10′ S. In the third season, in 1842–'43, Ross visited the regions south of cape Horn in the vicinity of Erebus and Terror bay. He could not follow Weddell's course, owing to the closing in of heavy pack ice.

The next expedition of importance was that of Her Majesty's ship the *Challenger*, which visited these regions in 1874. Little geographic work as commonly understood—that is, the discovery of new lands—was done. Her investigations were more confined to a study of the deeper regions of the sea. Very valuable scientific results were obtained, however, and through her soundings and dredgings and in connection with previous discoveries, Dr Murray has been able to outline the Antarctic continent.

In the fall of 1892 an expedition, consisting of four steam whalers, was fitted out from Dundee, Scotland. The Royal Geographical Society well equipped them with scientific instruments, such as chronometers and meteorological instruments, and the surgeons on board of two of the vessels, the *Balæna* and the *Active*, were selected on account of their general scientific training. An account of this expedition may be found in the Scottish Geographical Magazine for February, 1894. The two ships, the *Active* and the *Balæna*, left the Falkland islands December 11, cruising about in search of whales until January 2, when they had reached a latitude of 67° S. On January 6, 1893, a landing was made on a beach of Erebus and Terror bay, where a few specimens of seaweed and moss were found and preserved. No whales of value, as the true whalebone whale, were seen, but of the southern finner and the common hunchback large numbers were encountered. Specimens of the bottlenose and two other species were captured, possibly the *Orca capensis* and the *Globiocephalus*. Seals were plentiful and a good catch was made in a short time, four species being observed, apparently identical with those described by Ross, but it is doubtful whether the true fur-seal was found.

There was a Norwegian sealer, the *Jason*, in the same vicinity this season. She collected on Seymour island, in Erebus and Terror bay, a number of fossils, which have since been determined as belonging to the lower tertiary.*

In September, 1893, another Norwegian steam whaler, the *Antarctic*, sailed from Tönsberg, Norway, for the southern regions. She was sent out by Commander Svend Föyn. Her sailing master is Captain Leonard Christensen; she is barque-rigged; tonnage, 226, and carries eight whale-boats. Meteorological and other observations are to be made. Last season, in the vicinity of Kerguelen islands, 1,500 seals were caught inside of eight days, no fur-seals, however, being found. At these latter islands the vessel visited Royal sound, where a colony of 59 persons was found, consisting of Europeans, Chinese and Indians. She

* Geographical Journal, January, 1894, p. 11.

then sailed for Australia and arrived at Melbourne on February 27, 1894. This November she will attempt to enter the Antarctic circle in the vicinity of Victoria land.

Finally the last expedition at this date, consisting of the Norwegian whalers *Jason*, *Castor* and *Hertha*, has contributed considerably to our topographic knowledge of Antarctica.*

On December 6, 1893, Captain C. A. Larsen, in the ship *Jason*, attained a latitude of 68° 10′ S. in longitude 60° W., and one of the other vessels reached latitude 69° S. and in a more western longitude. These men have therefore attained a higher southern latitude by four degrees in these longitudes than any previous explorers. New lands were discovered and a number of active as well as extinct volcanoes were sighted.

Large numbers of seals were seen and captured, belonging principally to the *Graasel* and *Fiskesel* species. Few whales were captured; species seen were as follows: *Blaahvale*, *Finwale*, *Knarhval*, *Minkevale* and the *Rethvale*.

On December 1 land was sighted in 65° 43′ S. latitude and 56° 57′ W. longitude and the name of cape Frammes was given to the headland. The land appeared to be high, covered with snow and ice, and stretched in a north and south direction. Many high snow-covered peaks were seen in the interior, and the name of mount Jason was given to one of the more eastern and nearer peaks. The lower slopes of this mountain were free of ice and snow, but it was found impossible to land, owing to the immense ice barrier which extended from the land into the sea for a distance of several miles.

In latitude 66° 42′ S. and longitude 61° 50′ W. high land was sighted, to which was given the name of Foyn land. It consists of four hills, their northern and eastern slopes being free of snow and forming a conspicuous landmark, especially on approaching from the north. Captain Larsen sailed southward for a distance of 300 miles along this ice barrier until on December 6 he attained his highest southern latitude. Further progress in this direction was prevented by the winter ice. On their return several islands were discovered and named Weather, Robertson, Christensen and Seal islands. A landing was made on Christensen island and the greater part of it was found to be free of snow. To the northwest of this island a small volcanic island

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* The Voyage of the *Jason* to the Antarctic Regions: The Geographical Journal, London, October, 1894, pp. 333-344; 1 map.

was sighted, to which was given the name of Lindenberg. Captain Larsen says in his journal:

> This volcano had the shape of a sugar-loaf and was of considerable height. The ice was melted for a considerable distance around it. It presented a remarkable aspect, as around the top and on the slopes there were funnel-like holes, from which a very black and thick smoke issued from time to time, covering the top itself. In short, it was in full activity.

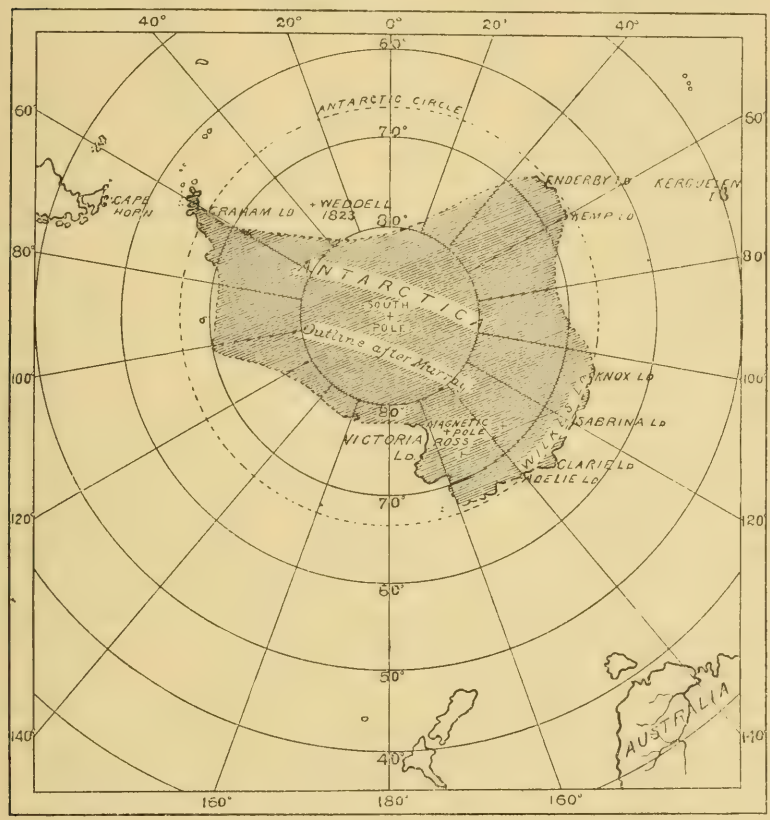

FIGURE 3.—*The Antarctic Continent.*

The Antarctic Continent.—Figure 3 is a map of the Antarctic continent according to Murray. He estimates the area as nearly 4,000,000 square miles, or a continent with a greater area than Australia. According to Ross, the rocks of Franklin, Cockburn and Possession islands are of volcanic origin, and in his dredgings to the east of Victoria land volcanic rock was found, but with some fragments of gray granite.

D'Urville, at Adélie land, found a precipitous shore, with elevations from 2,000 to 3,000 feet. The rocks of the neighboring islands were granites and gneisses. Wilkes found on an iceberg in the same vicinity large bowlders of red sandstone and basalt, with smaller gravels, stones, clays and mud. The dredgings of the *Challenger* produced from the great ocean basins volcanic débris, but as the Antarctic continent was approached quartz and granite fragments were found, and in the highest latitudes reached the dredgings consisted mainly of fragments of diorites, granites, mica schists, sandstones, limestones, and earthy shales.

In the reports of the expeditions previous to those of the Dundee and Norwegian whalers the rocks of the islands to the south of cape Horn are described as of volcanic origin. Dr Bruce, of the *Balæna*, reports the finding of metamorphic and sedimentary rocks in his soundings.

Captain Larsen, of the ship *Jason*, as above stated, collected from Seymour island during his first trip, in 1892, a number of fossils which have been determined as belonging to the lower tertiary. In November of the next year he landed on the same island, but at a different place, and says:

> When we were a quarter of a Norwegian mile from shore and stood about 300 feet above the sea the petrified wood became more and more frequent, and we took several specimens, which looked as if they were of deciduous trees; the bark and branches, as also the year rings, were seen in the logs which lay slanting in the soil. The wood seemed not to have been thrown out of the water; on the contrary, it could never have been in the water, because, in the first case, we found petrified worms, while there were none in the second. At other places we saw balls made of sand and cement resting upon pillars composed of the same constituents. . . . The beach is flat and consists of white sand.

It would seem, therefore, that Antarctica was a true continental area, having the fundamental continental gneiss, with later fossil-bearing sandstones and limestones.

The primary object of Ross's expedition was for the purpose of making magnetic observations, and in this he was very successful, sailing to within 160 miles of the south magnetic pole. He furnished more trustworthy evidence on the meteorological and magnetic conditions of Antarctica than all the preceding and succeeding expeditions put together.

At the time of the reading by Dr Murray of his valuable paper before the Royal Geographical Society, Dr Neumayer, a German scientist, contributed an article showing the desirability, even the necessity, of observations in this section before the theory of the earth's magnetism could be finally settled.*

The very important problem of the figure of the earth, together with a number of other geodetic questions, cannot be solved without fuller knowledge of this area.

MAGNETIC OBSERVATIONS IN ICELAND, JAN MAYEN AND SPITZBERGEN IN 1892 †

The May and June number (1893) of the Annuaire of the French Meteorological Society contains an account by M Th. Moreaux of the magnetic observations made in Iceland, Jan Mayen island, and Spitzbergen, in the year 1892, by the officers of the transport *la Manche.*

The secretary of the French navy, at the instance of the minister of public instruction, sent, under command of Captain Bienaimé, the steamer *la Manche* to Jan Mayen and Spitzbergen for scientific purposes, supplementary to a supervision of the Iceland fisheries, which was the ordinary duty for the ship.

The magnetic observations, participated in by several officers, were tabulated and reduced by Lieutenant Exelmans. In Iceland the northern and southeastern shores were ice-bound and the eastern coast nearly unattainable; consequently observations were made upon the northwestern coast at Reykiavick, Dyre, Isa and Patrix fiords.

At Jan Mayen the pier and bench-mark erected by the international Austrian expedition (1882–'83) were found intact. Here, as in Iceland, the soil is magnetic, and around the building sheltering the pier was found a fine blackish sand, arising from rock disintegration, which affected very strongly the magnetic needle.

At Spitzbergen several series of determinations were made at Research bay on the spot where Bravais observed in 1839. Bad weather and heavy sea prevented them from landing at cape Thorsden, the Danish magnetic station of 1882, but they succeeded in making observations under favorable conditions, however, in la Manche bay, about 7 miles from the Swedish observatory. In addition, observations were made at sea at 21 separate points in the vicinity of Iceland, in order to verify the opinion,

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*The Renewal of Antarctic Exploration, by John Murray: The Geographical Journal, London, January, 1894, p. 37.

† Translated and condensed by General A. W. Greely.

generally accepted among the Iceland fishermen, that in these waters the actual direction of the compass varies from 20° to 30° from the calculated direction. These observations indicated that the calculated values are never more than three degrees in error.

By comparison with former observations, it was found that the average secular variation of the declination is — 10′ at Jan Mayen (1882–1892) and at Spitzbergen (1839–1892), — 7′ at Reykiavick (1836–1892), and — 8′ at Bergen (1858–1892).

The secular variation of the inclination and intensity is much less clearly defined. The inclination, for example, appears to have diminished only nine minutes at Reykiavick since 1876, and is now increased at Jan Mayen and Spitzbergen, according to the observations of 1892. The tendency of this variation may seem natural, taking into consideration the distribution of isoclynics in the North Polar ocean; but, on the other hand, we know that different inclination compasses do not give identical results; and again, that to make magnetic observations in volcanic lands strictly comparable it is necessary that observers should occupy exactly the same point, and even under these conditions it is uncertain whether the influence of the rocks has not been modified in the meantime.

The following table gives the result of the land observations:

1893.	Station.	Latitude.	Longitude.	Declination west.	Inclination.	Horizontal component.
June 13	Reykiavick	64°. ?	24°. W. ?	36° 43′.0	76° 17′.9	0.1319
May 24–25	Dyre fiord	65°.9	25°.8 W.	38° 33′.0	78° 8′.7	0.1157
May 28	Isa fiord	66°.1	25°.6 W.	40° 22′.0	....	0.1216
June 4	Patrix fiord	65°.6	26°.4 W.	41° 57′.0	....	0.1179
July 27	Jan Mayen	71°.0	10°.8 W.	28° 19′.2	79° 14′.9	0.0979
August 2	Spitzbergen (R. B.)	77°.5	12°.2 E.	12° 3′.8	80° 01′.8 *	9.0920
August 8	Spitzbergen (C. M. B.)	78°.5	13°.7 E.	10° 3′.7	80° 43′.9	0.0888

* 79° 49′.0 August 1 and 80° 7′.0 August 3.

A NEW LIGHT ON THE DISCOVERY OF AMERICA

This was the title of a paper by Mr Yule Oldham, read at the meeting of the British Association for the Advancement of Science, last August, at Oxford. He says:*

A glance at the map of the Atlantic ocean will show the three easiest points of access: (1) North America by means of the convenient stepping-

* Scottish Geographical Magazine, September, 1894, page 471.

stones, Iceland and Greenland; (2) Central America, with the help of the steady northeast trade winds; (3) Brazil, in South America, which is not only the nearest point to the Old World, but has the additional advantage of winds and currents tending in its direction. There can be little doubt that America was visited by Norsemen about A. D. 1000, by the first route. Tradition and the records of some early maps, which show some large land masses as far west of the Azores as these are west of Europe, seem to indicate that the second route had been possibly utilized early in the fifteenth century, but the third and easiest was not available till the west African coast as far as cape Verd had been discovered. It was in 1445 that cape Verd was for the first time rounded by one of the exploring expeditions despatched from Portugal by the indefatigable Prince Henry. There is good reason to believe that only two years later Brazil was reached. There is at Milan a remarkable manuscript map, dated A. D. 1448, drawn by Andrea Bianco, of Venice. On this map are shown for the first time the result of the Portuguese discoveries as far as cape Verd, but in addition there is drawn at the edge of the map, southwest from that cape, in the direction of Brazil, a long stretch of coast line labeled "Authentic island," with a further inscription to the effect that it stretches "1,500 miles westward." Antonio Galvano, in "The Discoveries of the World," published in the middle of the sixteenth century, says that in A. D. 1447 a Portuguese ship was carried by a great tempest far westward until an island was discovered, from which gold was brought back to Portugal. As Bianco's map of A. D. 1448 was made in London, it is likely that it represents information about this voyage obtained in Portugal, where Bianco probably called on a voyage from Venice to England. The conclusion to be drawn is that South America was first seen in the very year in which Columbus is believed to have been born, by one of the Portuguese explorers despatched by Prince Henry the Navigator. In the discussion of this paper the author's conclusions were challenged by several gentlemen on the ground that its argument was purely conjectural, and that if such a discovery had been made it would have been known to Columbus and other geographers of the day.

MONOGRAPHS OF THE NATIONAL GEOGRAPHIC SOCIETY

The Board of Managers has the pleasure of announcing that it has made arrangements for the publication of a series of science manuals on the physical features of the United States. The principal object of the publication is to render accessible to every public school in the United States, at a nominal price, accurate and properly correlated information upon the geography of our country, and expressed in simple, untechnical language. Various members of the Society have agitated this question for some time past, and it resulted that in last June, President Hubbard called a meeting of certain geographers to meet Major J. W. Powell and Professor W. M. Davis of Harvard University and listen to their views upon this subject.

The teacher of geography in this country at the present time has great difficulty in finding information on their subject, especially comprehensive accounts of their home geography, outside of their text-books. A certain amount may be found in reports of geological surveys, state and national, and in scientific journals, but they are generally written in such a technical style that little benefit can be derived from them.

From a suggestion made by Professor Richard Lehmann at the second German Geographical Congress at Halle in 1882 a central commission for the scientific geographic study of Germany was formed. Various publications have appeared under the direction of this commission, including a guide to geographic study and a bibliography of geographic literature. The more important of their results are included, however, in the special volumes on investigation of German geography and ethnology, now reaching seven volumes.*

Our Society will somewhat modify the German plan in that the monographs will be prepared more especially for the teachers of our public schools. It is also the intention of introducing into the series a large number of maps, diagrams and illustrations. Arrangements have been consummated with the American Book Company of New York to publish this series and to bring it to the attention of the school teachers of this country. The plan involves the preparation of material for a physiographic description of the country by districts. The following are some of the subjects and authors proposed:

The elements of physiography, by Major J. W. Powell, director of the Bureau of American Ethnology; The tidal marshes and beaches of the Atlantic coast, by N. S. Shaler, professor of geology, Harvard University; Niagara falls and its history, by G. K. Gilbert, United States Geological Survey; The New England hills, by W. M. Davis, professor of physical geography, Harvard University; The southern Appalachian system, by Bailey Willis, United States Geological Survey; Mount Shasta, by J. S. Diller, United States Geological Survey; The lake region of the northwest, by Professor I. C. Russell, University of Michigan.

Among other proposed subjects are the flood plains of the Mis-

* Forschung en zur deutschen Landes-und Volkskunde.

souri, the Atlantic coastal plain, the Colorado canyon, the Great Plains, the high plateaus of Utah, the valley of California, and the extinct volcanoes of the West.

If this project is successful, the idea is to extend the scope, involving the issue of monographs on the relation of geography to other subjects, types of weather in different parts of the country, rainfall, the storms of the United States; the ocean, including the tides and currents of our shores; the relation of geographic form and historical development; the relations of resources, industries and population, etc.

IMPORTANT ANNOUNCEMENT CONCERNING ESSAYS

The subject of the Essay in competition for the *Gold Medal and Geographic Certificates* of the NATIONAL GEOGRAPHIC SOCIETY, for the year 1895, will be the River Systems of the United States.

The Geographic Gold Medal of the NATIONAL GEOGRAPHIC SOCIETY will be awarded to the best essayist of the entire country, while the second essayist will receive a certificate of honorable mention. The best essayist of each state will receive a certificate of proficiency from the Society.

1. Essays, not exceeding 2,000 words in length, will be received only from such public schools as announce their intention to compete by May 31, 1895.

2. Essays must be entirely composed by the student, who must certify on honor that he has not received aid from any person.

3. The two best essays from each school shall be passed on by a committee of the NATIONAL GEOGRAPHIC SOCIETY in order to select the best essay for each state and for the United States.

4. No certificate shall be awarded unless, in the opinion of the judges, the essay offered possesses sufficient merit to justify such award.

5. ESSAYS MUST BE WRITTEN BY THE END OF THE SCHOOL YEAR IN 1895, AND BE SUBMITTED TO THE NATIONAL GEOGRAPHIC SOCIETY NOT LATER THAN JULY 15, 1895.

One of the most important aims of the NATIONAL GEOGRAPHIC SOCIETY is to stimulate and make more practical the study of geography, particularly with reference to America. The Society therefore seeks the coöperation of all educational workers in making its labors more efficient and general. To this end, gifts for medals and scholarships are solicited, and identification with the Society by membership and personal effort is suggested.

The Society already comprises among its active workers a considerable number of geographic scientists, who have given liberally of their time and efforts with a view of stimulating public interest in geographic education. The Society is a working one, and in its efforts to exercise an educational influence over the whole of the United States, feels justified in asking liberal support from public-spirited citizens. The Society numbers nearly eleven hundred members, and has active representatives in every state and territory.

All members are earnestly requested to take a special interest in this subject and to bring it to the attention of the school superintendents and teachers in their vicinity. Additional circulars may be obtained of the committee as given below.

General A. W. Greely, United States Army, Dr T. C. Mendenhall, President Worcester Polytechnic Institute, and Professor W. B. Powell, Superintendent of Public Schools of the District of Columbia, constitute the committee charged with the award of the prizes for 1895.

The Committee on Prizes also desire to announce that in connection with the essays submitted to the Society last year on the river systems of the United States that Miss Cora Combs, of the high school at Chariton, Iowa, received honorable mention on the unanimous recommendation of the judges.

LAWS OF TEMPERATURE CONTROL OF THE GEOGRAPHIC DISTRIBUTION OF TERRESTRIAL ANIMALS AND PLANTS*

ANNUAL ADDRESS BY VICE-PRESIDENT

DR C. HART MERRIAM

The tendency of animals and plants to multiply beyond the means of subsistence and to spread over all available areas is well understood. What naturalists wish to know is not how species are dispersed, but how they are checked in their efforts to overrun the earth. Geographic barriers are rare, except in the case of oceans, and since even these were formerly bridged at the north, another cause must be sought. This has been found in the group of phenomena commonly hidden under the word climate, and nearly a century ago it was shown by Humboldt that temperature is the most important of these climatic factors.

In the northern hemisphere animals and plants are distributed in circumpolar belts or zones, the boundaries of which follow lines of equal temperature rather than parallels of latitude. They conform in a general way, therefore, with the elevation of the land, sweeping northward over the lowlands and southward over the mountains. Between the pole and the equator there are three primary belts—Boreal, Austral and Tropical—each of which may be subdivided into minor belts and areas. In the United States the Boreal and Austral regions have each been split into three secondary transcontinental zones. The Boreal are known as the *Arctic*, *Hudsonian* and *Canadian*; the Austral as the *Transition*, *Upper Austral* and *Lower Austral*. The subordinate faunas and floras need not be here considered.

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* The present abstract of the principal results of an investigation carried on under the Department of Agriculture is here published by permission of the Honorable J. Sterling Morton, Secretary of Agriculture. The temperature data have been furnished by the United States Weather Bureau, a branch of the Department of Agriculture. A preliminary announcement of results was made by the author before the Philosophical Society of Washington May 26, 1894.

The area of overlapping of Boreal and Austral types is confined in most parts of the country to the narrow Transition zone, but along the Pacific coast it reaches all the way from southern California to Puget sound. This Pacific coast strip has always proved a stumbling-block to students of geographic distribution of life in America, but has now become the means of verifying the fundamental laws governing this distribution, as shown later.

But while the boundaries of the several zones rarely coincide with absolute mechanical barriers, being fixed in the main by temperature, difference of opinion prevails as to the period during which the temperature exerts its restraining influence, and no formula for the expression of the temperature control has been heretofore discovered. None of the temperature data computed and platted on maps as isotherms are available in locating the exact boundaries of the zones, because these isotherms invariably show the temperature of arbitrary periods, such as months, seasons and years—periods whose beginning and ending have reference to a particular time of year rather than a particular degree or quantity of heat. Thus the temperature for July, which is by far the most important of those commonly shown in isotherms, bears an inconstant relation to the hottest part of the year. In certain localities the four hottest weeks may fall within the month of July, but in other localities they cover the period from the middle of June to the middle of July; in others from the middle of July to the middle of August, and in others still from the early part of August to early September. Similarly, the isotherms showing the mean annual temperature fail to conform to the boundaries of the life zones, although in the far south they may be nearly coincident. The mean summer temperature is obviously inapplicable because of the varying length of the season in different localities.

Several years ago I endeavored to show that the distribution of terrestrial animals and plants is governed by the temperature of the period of growth and reproductive activity, not by the temperature of the whole year; but how to measure the temperatures concerned was not then worked out. The period of growth and reproductive activity is of variable duration, according to latitude, altitude and local conditions of each particular locality. In the tropics and a few other areas it extends over nearly the whole year, while within the Arctic circle and on the summits of high mountains it is of less than two months' duration.* It is evident, therefore, that while in the tropics there may be a close agreement between the mean annual temperature and the life zones, in the north the widest discrepancy exists between them.

At one time I believed that the mean temperature of the actual period of reproductive activity in each locality was the factor needed,† but such means are almost impossible to obtain, and subsequent study has convinced me that the real temperature control may be better expressed by other data.

For more than a century physiological botanists have maintained that the various events in the life of plants, as leafing, flowering and maturing of fruit, take place when the plant has been exposed to a definite quantity of heat, which quantity is the sum total of the daily temperatures above a minimum assumed to be necessary for functional activity. The minimum used by Boussingault and early botanists generally was the freezing point (0° C. or 32° F.), but Marie-Davy and other recent writers believe that 6° C. or 43° F.‡ more correctly indicates the temperature of the awakening of plant life in spring. In either case the substance of the theory is that *the same stage of vegetation is attained in any year when the sum of the mean daily temperatures reaches the same value*, which value or total is essentially the same for the same plant in all localities. This implies that the period necessary for the accomplishment of a definite physiological act, blossoming for instance, may be short or long, according to local climatic peculiarities, but the total quantity of heat must be the same. The total amount of heat necessary to advance a plant to a given stage came to be known as the *physiological constant* of that stage. Linsser believed this law to be fallacious and maintained that the physiological constant of any particular stage of vegetation was *not the sum total* of heat acquired that time, but the *ratio* or proportion of this sum to the sum total for the entire season. Thus Linsser's physiological constant is the *ratio* of the sum of the mean daily temperatures at the time when any particular stage of vegetation is attained to the sum total for the

*See N. Am. Fauna, No. 3, September, 1890, pp. 26, 27, 29–32; also Presidential Address, Biological Soc. Wash., vol. vii, April, 1892, pp. 45, 46.

† I began work on this line about fifteen years ago and continued at intervals for ten years before convinced of its impracticability.

‡ The exact equivalent of 6° C. is 42°.8 F.

year. This formula was based on the belief that plants of the same species living in different places arrive at the same phase of development by utilizing the same proportion of the total heat which they receive in the course of a season.

Students of geographic distribution may dismiss this phase of the inquiry as not pertinent to the problem in hand, for we are concerned with the physiological constant *of the species itself*, not of any stage or period in its life history. But what is the physiological constant of a species, and how can it be measured? If it is true that the same stage of vegetation is attained in different years when the sum of the mean daily temperatures reaches the same value, it is obvious that *the physiological constant of a species must be the total quantity of heat or sum of positive temperatures required by that species to complete its cycle of development and reproduction.* The difficulty in computing such sums is in fixing the end of the period during which temperature exerts its influence upon the organism. In the case of plants this can be done by direct observation of a particular individual or crop, in connection with careful thermometric readings covering the whole period of vegetative activity, and data of this sort have been actually recorded by certain European phenologists, but I am not aware that an attempt has been made to correlate the facts thus obtained with the boundaries of the life zones. Since, however, all forms of life are affected by temperature and it is manifestly impracticable to ascertain by direct observation the total quantity of heat necessary to enable the various species of mammals, birds and reptiles to complete the annual cycle of reproduction, and since the areas inhabited by definite assemblages of animals and plants have been found to be essentially coincident, it is evident that a more generalized formula is necessary. If the computation can be transferred from the *species* to the *zone* it inhabits—if a *zone constant* can be substituted for a *species constant*—the problem will be well nigh solved. This I have attempted to do. In conformity with the usage of botanists, a minimum temperature of 6° C. (43° F.) has been assumed as marking the inception of the period of physiological activity in plants and of reproductive activity in animals. The effective temperatures or degrees of normal mean daily heat in excess of this minimum have been added together for each station, beginning when the normal mean daily temperature rises higher than 6° C. in spring and continuing until it falls to the same point at the end of the season. The sums thus obtained have been platted on a large scale map of the United States,* and isotherms have been run which are found to conform in a most gratifying manner to the northern boundaries of the several life zones, as may be seen on comparing a reduced copy of this map (see plate 12) with a map of the life zones (see plate 14). The latter, it may be observed, is identical, save a few corrections in minor details, with the third edition of my Bio-geographic map of North America (prepared a year ago and published in the Annual Report of the Secretary of Agriculture for 1893).† While the available data are not so numerous as might be desired, the stations in many instances being too far apart, still enough are at hand to justify the belief that *animals and plants are restricted in northward distribution by the total quantity of heat during the season of growth and reproduction.*‡

The isotherm indicating a sum total of 5,500° C. (10,000° F.) coincides with the northern limit of distribution of Transition zone species, agreeing in the main with the dividing line between the two primary life regions of the northern hemisphere—Austral and Boreal. But in areas where extensive overlapping of Austral and Boreal types occurs, as along the Pacific coast from southern California northward to Puget sound, it will be observed that the isotherm in question points, as elsewhere, to the northern limit of Austral types and bears no relation whatever to the southward limit of Boreal types. It is evident, therefore, that the southward range of Boreal species, and perhaps of others also, is regulated by some cause other than the total quantity of heat. This cause was believed to be the mean temperature of the hottest part of the year,§ for it is reasonable to suppose that Boreal species in ranging southward will en-

* Gannett's "Nine-sheet contour map," published by the U. S. Geological Survey.

† The only changes worth mentioning are the introduction of the Tropical along the lower Colorado valley, the extension of the Tropical across the peninsula of Florida, and the extension of the Transition along the Pacific coast strip.

‡ In the case of certain sensitive species another factor enters into the problem, namely, *killing frosts*, for a few species are excluded by the occurrence of frosts from areas having a sufficient total quantity of heat for their needs.

§ This was indicated by mean summer temperatures platted from time to time during the past fifteen years, but the length of the period was never satisfactorily ascertained.

counter, sooner or later, a degree of heat they are unable to endure. The difficulty is in ascertaining the *length of the period* whose mean temperature acts as a barrier. It must be short enough to be included within the hottest part of the summer in high northern latitudes, and would naturally increase in length from the north southward. For experimental purposes, and without attempting unnecessary refinement, the mean normal temperature of the six hottest consecutive weeks of summer was arbitrarily chosen and platted on a large contour map of the United States, as in the case of the total quantity of heat. On comparing a reduced copy of this map (plate 13) with the zone map (plate 14) it appears that the isotherms conform to the southern boundaries of the Boreal, Transition and Upper Austral life zones, and that the isotherm of 18° C. (64°.4 F.) agrees almost precisely with the southern boundary of the Boreal region. The coincidence is indeed so close as to justify the belief that *animals and plants are restricted in southward distribution by the mean temperature of a brief period covering the hottest part of the year.*

If the isotherm of 18° C. (64°.4 F.) for the six hottest consecutive weeks (see plate 13) is compared with that of 5,500° C. (10,000° F.), showing the sum of positive temperatures (see plate 12), it will be observed that the two are coincident in the main except in a few localities. The principal discrepancy is along the Pacific coast from Puget sound to southern California. In this strip maps 12 and 13 not only fail to agree, but are fundamentally different, showing that no constant relation exists between the mean temperature of the six hottest consecutive weeks and the total of heat for the season. The mean temperature of the hottest part of the year from about latitude 35° northward along the coast is truly boreal, being as low as the mean of the corresponding period in northern Maine and other points well within the Boreal zone. The mean of the six consecutive hottest weeks at several points on the coast of California is as follows: At Eureka, on Humboldt bay, 13°.5 C. (56° F.); * at San Francisco, 15°.5 C. (60° F.); at Monterey and Ventura, 17°.5 C. (63°.5 F.).† Strange

* In the following mean temperatures, fractions smaller than one-half a degree are ignored.

† Santa Barbara, between Monterey and Ventura, has a slightly higher mean (67° F.), which is explained by its situation on a low, narrow coastal plain facing the south, with a range of mountains immediately on the north.

as it may seem, San Francisco has a lower normal mean temperature during the hottest part of the year than Eastport, Maine, the mean at Eastport being 16° C. (61° F.). On the other hand, the sum of positive temperatures (the normal mean daily temperatures above 6° C.) at San Francisco is more than 10,000° Fahrenheit higher than at Eastport, being 11,290° C. (20,360° F.) at the former and only 5,470° C. (9,880° F.) at the latter locality. At no point in the Pacific coast strip is the sum of the positive temperatures known to fall below 7,330° C. (13,600° F.), and it reaches 8,200° C. (14,800° F.) at Tatoosh island, off cape Flattery, the extreme northwestern point of the United States. Even at cape Flattery, therefore, the total of heat for the season is 260° C. (500° F.) greater than at Eastport, Maine, though the latter is the more southern locality and has the higher mean summer temperature.

The data at hand for the Pacific coast strip are amply sufficient to demonstrate two important facts: (1) that the temperature of the summer season, the hottest part of the year, is phenomenally low for the latitude and altitude—so low, indeed, as to enable Boreal types to push south to latitude 35°; (2) that the total quantity of heat (the sum of the positive temperatures) for the entire season is phenomenally high for the latitude—so high, indeed, as to enable Austral types to push north to Puget sound. The total of heat is even greater at Puget sound than at Philadelphia, Pittsburg, Cleveland, Indianapolis, Keokuk, or Omaha, though five hundred miles north of the latitude of these places. In other words, the mean temperature of the hottest part of the year is sufficiently low for Boreal species, while the total quantity of heat is sufficiently great for Austral species.

It is evident, therefore, that the principal climatic factors that permit Boreal and Austral types to live together along the Pacific coast are *a low summer temperature combined with a high sum total of heat.* The temperature is remarkably equable throughout the year; it never rises high for any length of time, and killing frosts are rare.

The study of the accompanying maps was the means of leading me, *first*, to the explanation of the anomalous distribution of species on the Pacific coast, where for a distance of more than a thousand miles a curious intermingling of northern and southern forms occurs; and, *second*, to what I now conceive to be the true theory of the temperature control of the geographic distribution of species.

The fundamental laws here developed, phrased for the northern hemisphere, may be briefly formulated as follows:

(1) *The northward distribution of animals and plants is determined by the total quantity of heat—the sum of the effective temperatures.*

(2) *The southward distribution of Boreal, Transition zone, and Upper Austral species is determined by the mean temperature of the hottest part of the year.*

Zone Temperatures.

Boreal Zones.—The distinctive temperatures of the three Boreal zones (Arctic, Hudsonian and Canadian) are not positively known, but the southern limit of the Boreal as a whole is marked by the isotherm of 18° C. (64°.4 F.) for the six hottest consecutive weeks of summer. It seems probable, from the few data available, that the limiting temperatures of the southern boundaries of the Hudsonian and Arctic zones are respectively 14° C. (57°.2 F.) and 10° C. (50° F.) for the same period.

Transition Zone species require a total quantity of heat of at least 5,500° C. (10,000° F.), but cannot endure a summer temperature the mean of which for the six hottest consecutive weeks exceeds 22° C. (71°.6 F.). The northern boundary of the Transition zone, therefore, is marked by the isotherm showing a sum of normal positive temperatures of 5,500° C. (10,000° F.), while its southern boundary is coincident with the isotherm of 22° C. (71°.6 F.) for the six hottest consecutive weeks.

Upper Austral species require a total quantity of heat of at least 6,400° C. (11,500° F.), but apparently cannot endure a summer temperature the mean of which for the six hottest consecutive weeks exceeds 26° C. (78°.8 F.). The northern boundary of the Upper Austral zone, therefore, is marked by the isotherm showing a sum of normal positive temperatures of 6,400° C. (11,500° F.), while its southern boundary agrees very closely with the isotherm of 26° C. (78°.8 F.) for the six hottest consecutive weeks.

Lower Austral species require a total quantity of heat of at least 10,000° C. (18,000° F.). The northern boundary of the Lower Austral zone, therefore, is marked by the isotherm showing a sum of normal positive temperatures of 10,000° C. (18,000° F.). A formula expressing the temperature-control of its southern boundary has not yet been found.

Tropical species require a total quantity of heat of at least 14,400° C. (26,000° F.); and, since the Tropical Life region is a broad equatorial belt, it is probable that both its northern and southern boundaries are marked by the isotherm showing a sum of normal positive temperatures of 14,400° C. (26,000° F.).

An interesting fact respecting the relative values of the zones is brought out by the isotherms showing the total quantity of heat necessary for each. It appears that the Transition and Upper Austral zones are not of equal value, but that together they are the exact equivalent of the Lower Austral zone.

Regions.	Zones.	Governing Temperatures.			
		Northern limit. Sum of normal mean daily temperatures above 6° C. (43° F.).		*Southern limit.* Normal mean temperature of six hottest consecutive weeks.	
		C.	F.	C.	F.
Boreal	Arctic	....	....	10° *	50° *
	Hudsonian	....	....	14° *	57°.2 *
	Canadian	....	....	18°	64°.4
Austral	Transition [1]	5,500°	10,000° [4]	22°	71°.6
	Upper Austral [2]	6,400°	11,500°	26°	78°.8
	Lower Austral [3]	10,000°	18,000°	....	....
Tropical	....	14,500°	26,000°	....	....

* Estimated from insufficient data.

[1] The Transition zone comprises three principal subdivisions: an eastern or Alleghenian humid area, a western arid area, and a Pacific coast humid area.

[2] The Upper Austral zone comprises two principal subdivisions: an eastern or Carolinian area and a western or Upper Sonoran area.

[3] The Lower Austral zone comprises two principal subdivisions: an eastern or Austroriparian area and a western or Lower Sonoran area.

[4] The Fahrenheit equivalents of Centigrade sum temperatures are stated in round numbers to avoid small figures of equivocal value.

Secondary Causes Affecting Distribution.

It is not the purpose of the present essay to discuss the secondary causes affecting distribution. At the same time it seems desirable to contrast for a moment the influence of humidity, which is by far the most potent of the secondary causes, with that of temperature, which has been shown to be the primary controlling cause. Humidity governs details of distribution of numerous species of plants, reptiles and birds, and of a few species of mammals, within the several temperature zones. Thus the palmetto, the green chameleon, the chuck-wills widow and the ricefield mouse inhabit humid parts of the Lower Austral zone (the Austroriparian area), while the mesquite, the leopard lizard, the sickle-billed thrashers and the four-toed kangaroo rats find their homes in arid parts of the same zone (the Lower Sonoran area).

That humidity is less potent than temperature as a controlling factor in distribution may be shown in several ways. The numerical evidence I have given on a previous occasion.* Equally convincing is the circumstance that many genera restricted to particular conditions of temperature range completely across the continent, inhabiting alike the humid and arid subdivisions of their respective zones; but no genus restricted to particular conditions of humidity ranges north and south across the several temperature zones.

Humidity and other secondary causes determine the presence or absence of particular species in particular localities *within* their appropriate zones, but temperature predetermines the possibilities of distribution; it fixes the limits beyond which species cannot pass; it defines broad transcontinental belts within which certain forms may thrive if other conditions permit, but outside of which they cannot exist, be the other conditions never so favorable.

Explanation of Maps.

The temperature maps show the isotherms that conform to the boundaries of the life zones and the data on which they are based. The spots show the actual positions of the temperature stations.

In map 12, showing the distribution of the sum of effective temperatures, the isotherms conform with the northern boundaries of the life zones (as shown on map 14) as follows: The isotherm of 14,500° C. conforms with the northern boundary of the Tropical; of 10,000° C. with that of the Lower Austral; 6,400° C. with that of the Upper Austral, and 5,500° C. with that of the Transition.

In map 13, showing the normal mean temperature of the six hottest consecutive weeks, the isotherms conform with the southern boundaries of the life zones (as shown on map 14) as follows: The isotherm of 18° C. with the southern boundary of the Boreal; of 22° C. with the southern boundary of the Transition, and 26° C. with the southern boundary of the Upper Austral.

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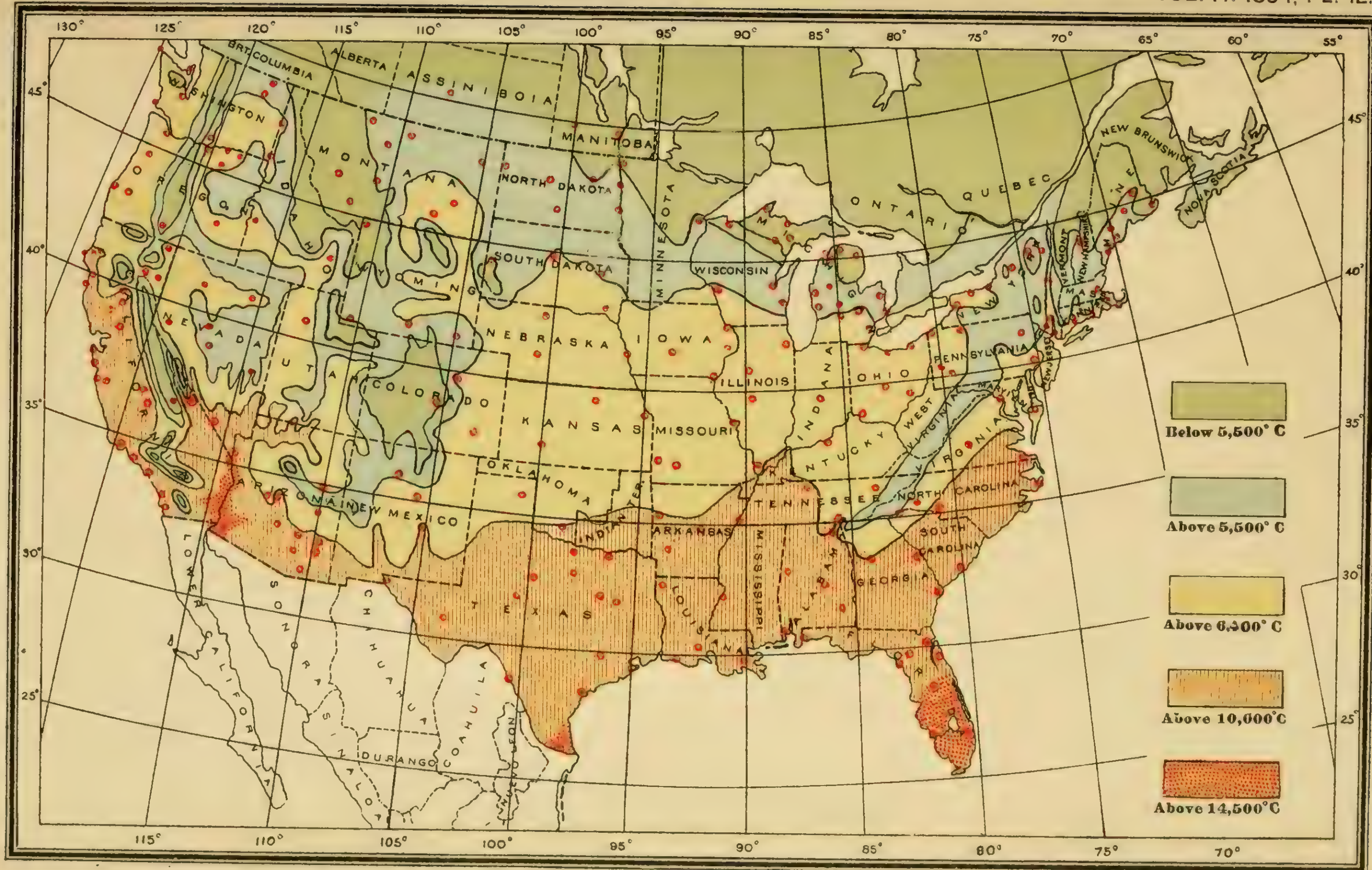
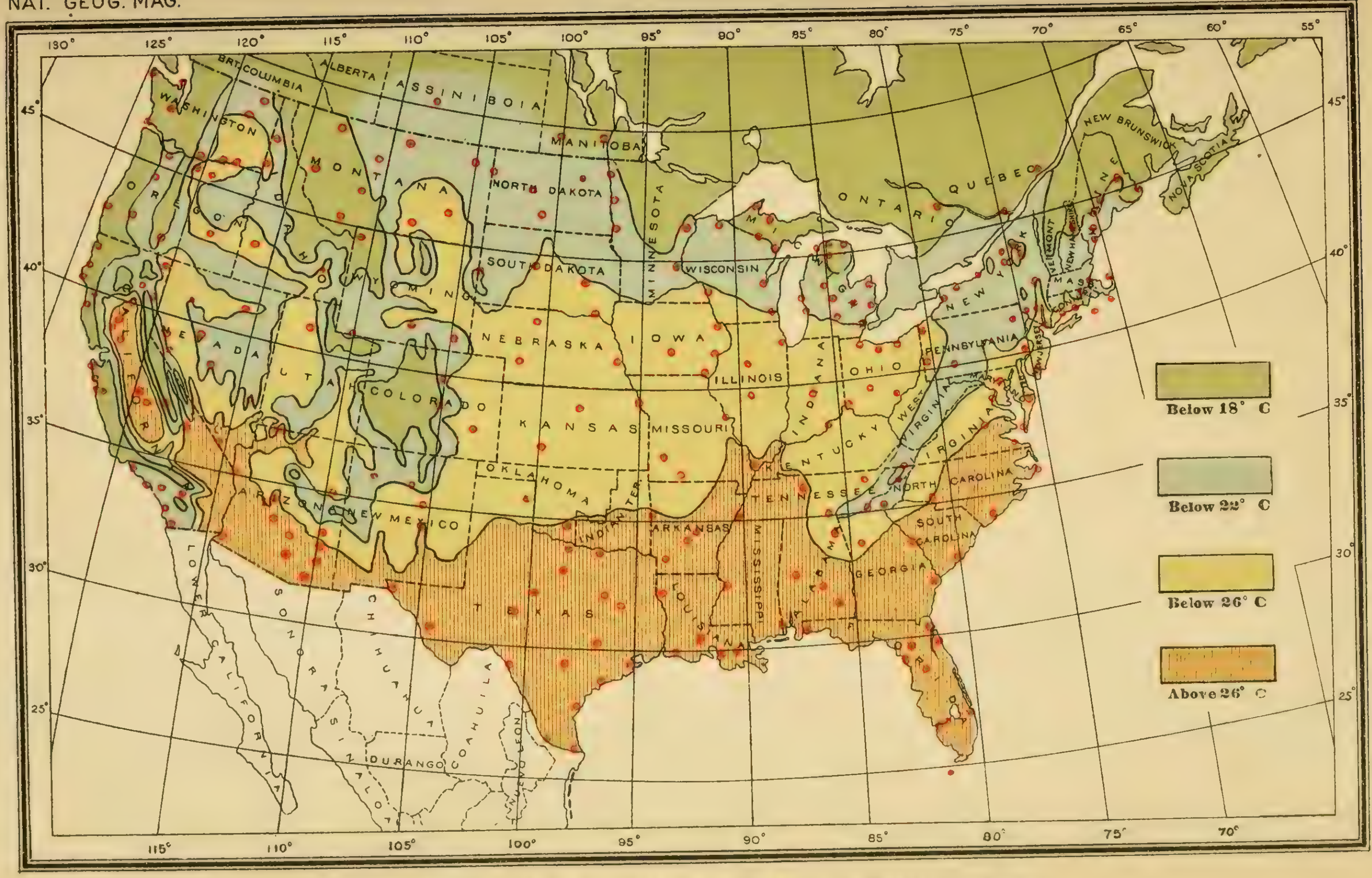
* Presidential Address, Ibid., pp. 47–49.

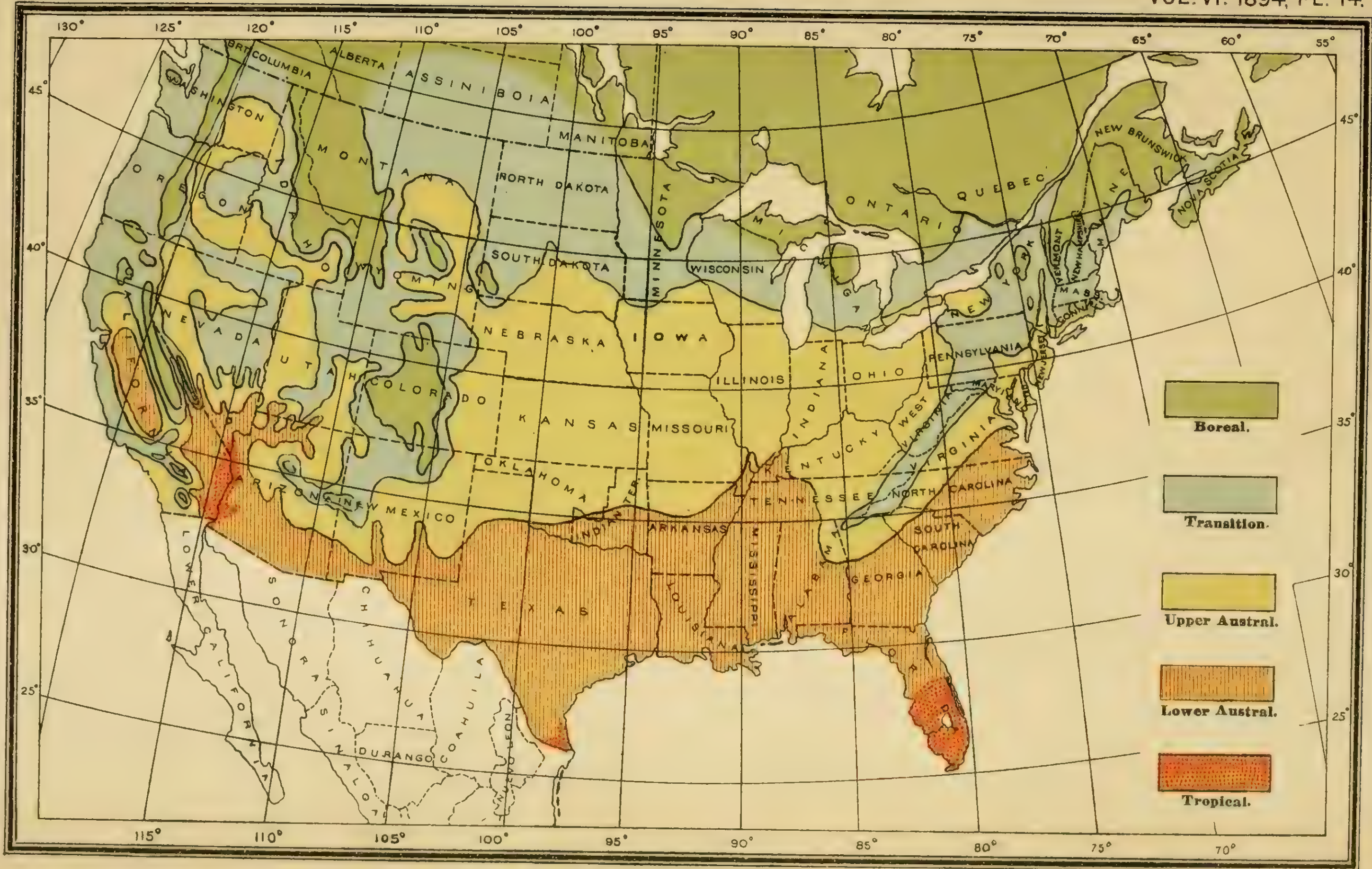


DISTRIBUTION OF THE TOTAL QUANTITY OF HEAT DURING SEASON OF GROWTH AND REPRODUCTIVE ACTIVITY.

[SUM OF DAILY MEAN TEMPERATURES ABOVE 6° C.]



MEAN TEMPERATURE OF HOTTEST SIX CONSECUTIVE WEEKS OF YEAR.



LIFE ZONES OF THE UNITED STATES.

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THE

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OREGON

ITS HISTORY, GEOGRAPHY, AND RESOURCES

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UNITED STATES SENATOR FROM OREGON

WASHINGTON

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OREGON: ITS HISTORY, GEOGRAPHY, AND RESOURCES

BY

JOHN H. MITCHELL

UNITED STATES SENATOR FROM OREGON

(Address delivered before the Society March 29, 1895)

In whatever aspect considered, the subject of this address is fruitful in suggestion. Whether it be viewed in respect to the derivation and signification of the name Oregon as originally applied to the territory and later to the state; to the manner in which and through what title that territory became a part of the domain of our common country; or in reference to its location, nationally and internationally considered; to its vast extent; its geographic formation; its grand mountains; its magnificent rivers; its fertile valleys; its unrivalled scenic beauties; its capabilities of production; its trade; its commerce; its brave, stalwart, pioneer people; its social and political institutions—in whichever of these aspects the subject is viewed, it is pregnant with historic interest, full of material for discussion and thought.

Let us consider, in the first place, the manner in which what was formerly known as "Oregon territory" became a part of the public domain of the United States, the nature of the title under which we hold, its extent territorially, and then briefly its general characteristics, and particularly some of the more prominent geographic features and resources of the present state of Oregon.

While making no pretensions as an historian, I confess I am still less a geographer; therefore what I shall have to say this evening will perhaps be more historical than geographic in its nature and would perhaps be more appropriate before an historical than a geographic society.

Discovery and Acquisition of Title.

The Oregon of today, though one of the American states, clothed with all the attributes of that sovereignty which attaches to statehood, is widely different in respect to territorial extent, as also in very many other respects, from the Oregon of a century ago. Although the present state of Oregon includes within its boundaries an area of 30,000 square miles more than that included in the whole of the six New England states, it is but a fraction less than one-fifth in size of the original Oregon territory as claimed at first by Spain and subsequently by the United States. Out of that territory, after losing about 200,000 square miles by compromise, has been carved three great states and a large portion of a fourth, namely, Oregon, Washington, Idaho, and a part of Montana.

The history of the various titles under which our government asserted claim to the territory of Oregon in the prolonged diplomatic contest with Great Britain for the supremacy is interesting in the highest degree. Our title was of a triple character:

First. Discovery and settlement by Spain, to which title we succeeded.

Second. Discovery in our own right in 1792, followed by scientific exploration and actual settlement.

Third. Cession from France of the Louisiana territory.

For nearly three centuries prior to 1790 Spain had been making claim, on account of alleged discovery, to all of Oregon territory extending from the forty-second degree of northern latitude not only to 54° 40′ but to the sixty-first parallel, and extending from Pacific ocean eastward to the central heights of the Rocky mountains. It was in dimensions a vast empire. Its geographic extent was about 760 miles from north to south and about 650 from east to west, embracing an area of about 494,000 square miles, or seven and one-half times greater than all of the six New England States put together, two and one-half times as large as the whole of Spain and more than 50,000 square miles more than all of Spain, France and Portugal combined.

This claim of Spain dated back 277 years prior to 1790, or 382 years ago, the inceptive right being based by some on the alleged discovery of the Pacific ocean by Balboa in 1513, when he assumed possession of it as a private sea in the name and for the benefit of the Spanish crown; but this claim had slight grounds, indeed no really good grounds of support, though it was greatly strengthened from time to time by the navigation of its coasts and the occupation of its territory by Spanish navigators, Maldonado in 1528 and Farrelo in 1543. In 1592 San Juan de Fuca, a Greek navigator in the Spanish service, entered the strait bearing his name, which now separates the United States from the British possessions. He then for a time supposed he had discovered the great northwestern passage connecting the two oceans. In 1774 the navigator Captain Juan Peres sailed from San Blas January 25, landing first on the northeastern coast of Queen Charlotte island near the fifty-fourth parallel. Humboldt says he was the first of all European navigators to anchor in Nootka sound, in latitude 49° 30′. This he named Port San Lorenzo; four years later it was by Captain Cook called King George's sound. Heceta, a Spanish navigator, visited and landed on the coast in 1775, and Galiano and Valdes in 1792; that they explored the entire Oregon coast, and even farther northward, is an historical fact which cannot be questioned.

Prior to 1790 the claim of Spain to this vast territory was not seriously disputed by any power, although Great Britain had been feebly making a claim scarcely less ancient though based on a more fragile and less defensible title. This claim on the part of Great Britain rested originally (although subsequently that source of title was virtually abandoned) on the acts, familiar to all, of Sir Francis Drake, the English buccaneer and filibuster, who, in 1577, with five armed vessels, had sailed from England, with the connivance of Queen Elizabeth, ostensibly for a voyage to Egypt, but in fact on a filibustering expedition against Spain. Two years later (in 1579), having reached the waters of the Pacific ocean through the strait of Magellan, his fleet encountered storms, reducing it to one schooner of an hundred tons burden and his naval force to sixty men. Just how far Drake sailed northward along the California and Oregon coast is a matter of doubt, some historians asserting he went as far as 42°, others 43°, and some as far as 48°. All agree, however, that, having encountered storms, he returned to the thirty-eighth parallel and landed in a bay, now supposed to be either the present bay of San Francisco or the bay of Bodega, where, as one historian tells us, he accepted from the savages of the far west, in the name of Queen Elizabeth, "coronation, scepter, and sovereignty."

Great Britain, however, in her prolonged contest with the United States, placed no reliance on the acts of Drake, but based her claim first on the alleged discovery of the Oregon territory by Captain Cook in 1778 and subsequently on alleged discoveries by Captain Mears in 1788 and by Captain Vancouver in 1792, 1793, and 1794. It was claimed, moreover, that Great Britain was the first to acquire what was termed "a beneficial interest in those regions by commercial intercourse."

Resting on these respective titles, that of Great Britain certainly lacking in every respect all those essential elements which constitute a real foundation for a valid claim to sovereignty, these two great rival powers, Spain and Great Britain, came into contention over their respective claims to and in this vast territory in 1790, resulting in what is known in history as "the Nootka convention." The claim of England was then hardly one of sovereignty, but rather, as she asserted, "an indisputable right to the enjoyment of a free and uninterrupted navigation, commerce and fishing, and to the possession of such establishments as they should form, with the consent of the natives of the country, not previously occupied by any European nations."

In the assertion of these alleged rights on the part of Great Britain and of the Spanish contention on the part of the Spanish crown, the conflicting and rival claims to sovereignty were attempted to be upheld, as one historian tells us, "by an occasional visit by vessels, temporarily trading with the natives, some fishing, and a few shanties." The Spanish authorities, however, denying the rights asserted by Great Britain, seized and confiscated her vessels and other property employed in the assertion of her claims to occupation, if not indeed to sovereignty. It was this conflict which resulted in the Nootka convention of 1790.

That Great Britain gained nothing by the terms of that treaty in respect to her alleged rights, either as to sovereignty, tenancy, or commerce in any of the countries bordering on the Pacific ocean, is conceded by all historians. That her claims, both as to discovery and prior occupation, submitted to that convention were absolutely baseless as against those of Spain or any other power must be conceded. Even should we concede all that has ever been claimed by the most ardent English historian in respect to the achievements of Sir Francis Drake and others, it amounts to nothing as against the Spanish claim; and so in reference to the alleged discovery by the British captains, Cook, Mears, and Vancouver, for the evidence is conclusive that this same coast had been navigated and the land discovered more than 260 years before by the Spanish navigator Maldonado (1528). If, then, Great Britain gained nothing in her claim, either as to sovereignty or occupancy, by the Nootka treaty of 1790, as she did not, she certainly had no right to complain.

When this treaty was submitted to the British Parliament it was denounced by the opposition as a cowardly surrender. "Nothing has been gained," said Mr Charles Fox, "but, on the contrary, much has been surrendered;" and, speaking further, Mr Fox said: "Our right before the convention (whether admitted or denied by Spain was of no consequence) was to settle any part of South or Northwest America not fortified against us by previous occupancy, and we are now restricted to settle in certain places only and under certain conditions. Our rights of fishing extended to the whole ocean, and now it is limited and not to be exercised within certain distances of Spanish settlements. Our right of making settlements was not as now a right to build huts, but to plant colonies, if we thought proper. In renouncing all right to make settlements in South America we have given to Spain what she considered as inestimable and have in return been contented with dross." But whatever rights Great Britain had by virtue of the Nootka treaty of 1790 were lost, totally destroyed, when in 1796 Spain declared war against Great Britain, as it is a principle of public law that a declaration of war destroys all treaties between the belligerents.

The claim of Spain to the whole of Oregon territory south of the sixty-first parallel was acknowledged by the Russian government, the only power holding claims which conflicted with Spain. In 1790 complaints had been made to the Russian court against Russian subjects for invading the Spanish territory south of 61° of northern latitude. To this complaint the Emperor of all the Russias, through the proper channel, replied in these words:

"The Emperor assures the King of Spain he is extremely sorry that the repeated orders issued to prevent the subjects of Russia from violating in the smallest degree the territory belonging to another power should have been disobeyed."

This was a clear and unequivocal recognition of the sovereignty of Spain to all territory south of the sixty-first parallel.

The contention on the part of the government of Great Britain that whatever rights the United States acquired in the Oregon territory in virtue of the treaty with Spain, known as "the Florida treaty," in 1819, subject to certain rights of Great Britain as to alleged joint occupancy with Spanish subjects existing in virtue of the "Nootka treaty" of 1790, was completely annihilated, first, by Secretary Calhoun in 1843, and subsequently, by Secretary Buchanan in 1845. They demonstrated two propositions: First, that not only had Great Britain acquired no rights of sovereignty in virtue of the treaty of 1790 with Spain, but by that treaty the sovereignty of Spain was directly conceded; for the only rights fully recognized to Great Britain in the treaty were that her subjects should not be disturbed in landing on the coasts in places already occupied for the purpose of carrying on trade with the natives. Second, that the treaty of 1790 was abrogated by the declaration of war of Spain against Great Britain in 1796; that by that war it fell to the ground and was never resurrected, and therefore every right which Great Britain had in virtue of its provisions vanished. In their discussion the principle of public law that war terminates all subsisting treaties between the belligerent powers was discussed with great ability. It was clearly shown that the only exception to this general rule is in case of a treaty *recognizing* certain sovereign rights as belonging to a nation which had *previously existed*, independently of any treaty engagement; that is, those rights which the treaty did not *create*, but merely *recognized*, cannot be destroyed by war between the governments constituting parties to the treaties. The treaty of peace, for instance, between this country and Great Britain in 1783, wherein Great Britain acknowledged that the United States was "free, sovereign and independent," is of this exceptional character—a right *recognized*, but not *granted* by treaty, and hence a right which cannot be destroyed by war.

The claim of Spain to the territory of Oregon—that is, the territory lying on the Pacific ocean north of the forty-second parallel and extending to 54° 40′—did not rest alone on discovery and settlement, but also as being embraced within and a part of the ancient Louisiana ceded by France to Spain in 1762 and by a secret arrangement re-ceded to France in 1800, then ceded by France to the United States in 1803 (known as "the Louisiana purchase"). Whatever claim, therefore, Spain had to the Oregon territory in 1800, prior to her cession to France, in virtue either of discovery and settlement, on the one hand, or by cession from France as part of the ancient Louisiana, on the other, vested in the United States by the Louisiana purchase. That Spain, therefore, was the real and sole sovereign owner of the whole of Oregon territory as against Great Britain there can be no doubt, and the United States succeeded to all the rights which Spain ever had—first, by the cession from France in 1803 and, second, by virtue of the Florida treaty and cession from Spain in 1819.

Americans the first actual Discoverers of Oregon.

Whatever may be said as to discovery, tenancy, occupation, exploration and settlement of that vast region of the mighty west lying north of the forty-second parallel, or whatever may be the character of those claims on the part of any country, the glory of the actual discovery, of the real scientific exploration and actual settlement, belongs to America, to the United States; and on that high, unimpeachable title, irrespective of all others, has our country ever stood and can forever stand in its claim to the territory of Oregon.

The first real assertion of sovereignty in all that vast region occurred when, on May 11, 1792, Captain Gray, of Boston, an American citizen and navigator, a naval officer during the revolutionary war, master of the merchant ship *Columbia*, discovered and entered the great river of the west. He ascended its waters a distance of twenty-five miles from its mouth, remaining there nine days, and named it "Columbia" in honor of his ship, planted the American flag on its shores and took possession of the country in the name of the United States. Indefatigable were the efforts of Great Britain to wrest this honor from the United States, and in support of this effort all manner of claims were from time to time set up.

Suspicion had been entertained for many years, perhaps a century prior to 1792, in the minds of Spanish and English navigators that a large river emptied somewhere into the waters of the Pacific, and the English navigators Mears and Vancouver had been instructed by their respective governments to make every effort to discover it. They spent months in the years 1791 and 1792 in this effort, but without result. "Mears," says one historian, "failed to find the mouth of the supposed river when he was led to explore for it in the straits of Fuca, and made permanent record of his failure in the two titles he left there—cape Disappointment and Deception bay." The same historian, in speaking of Vancouver, says: "Vancouver scrutinized that coast for about 250 miles, and so minutely that the surf has been constantly seen from the mast-head to break on its shores. Thus he failed to discover the mouth of the Columbia, mistaking evidently the breakers on its fearful bars for coast surf."

This entry was made in his journal April 29, 1792, only twelve days prior to the date when Captain Gray made the great discovery; and yet, because the English navigator Vancouver subsequently sailed farther up the river than did Captain Gray, the latter directing him how to find the entrance, Great Britain insists that he and not Captain Gray was the discoverer of the Columbia, and that all the rights which attach to such discovery belong to England and not to the United States.

In discussing this phase of the Oregon question Professor Twiss, of Oxford University, in an elaborate paper, said: "Captain Gray's claim is limited to the mouth of the river."

The historian Barrows, in commenting on this character of reasoning, very pertinently says: "Thus the discovery of a river is made a progressive work by English claimants, as if one should discover the Mississippi at New Orleans, another at Memphis, another at Cairo, another at the mouth of the Missouri, and so on to the falls of Saint Anthony; as if the discovery of a lost cable were progressive as the separate links of the chain are hauled on board." "If," says the historian, "this had not been said by plenipotentiaries we should call it puerile."

Mears not only did not discover Columbia river, but, on the contrary, he expressly declared there was no such river emptying into the Pacific ocean. "We can now safely assert," said he in his report, "that there is no such river as that of Saint Roque, as laid down on the Spanish charts." And, as if to emphasize the failure of his expectations, he named the promontory lying north of the inlet where he had expected to discover it "cape Disappointment," and the inlet itself "Deception bay," names by which they have been known ever since.

The Exploration of Lewis and Clarke.

Gray's discovery and the purchase of Louisiana territory were quickly followed by scientific exploration on the part of the government of the United States, as also by settlement on the part of its citizens.

The expedition of Lewis and Clarke, organized before and sent out immediately after the consummation of the Louisiana purchase, was one of the most daring, difficult, dangerous, and, at the same time, successful of the expeditions of which history, either of this or of any other country, gives record.

There seems to be some difference in statements of historians as to the number composing that expedition. According to Barrows, it consisted of twenty-eight persons in all—Lewis and Clarke, nine young Kentuckians, fourteen United States soldiers, two Canadian voyageurs, and one negro, the body servant of Captain Clarke. According, however, to the probably accurate notes of Dr Coues to his new edition of the history of that expedition, it consisted of forty-five men from Missouri to the Mandan country, and of thirty-two, including Lewis and Clarke, thereafter across the continent, the others returning from that point, as was the original program.

Captains Lewis and Clarke were commissioned by President Jefferson "to explore the river Missouri and its principal branches to their sources, and then to seek to trace to its termination in the Pacific some river, whether the Columbia, the Oregon, the Colorado or any other, which might offer the most direct, practicable water communication across the continent for the purposes of commerce."

The time occupied by these courageous men in consummating the important and hazardous duty assigned them by their government was two years, four months and nine days, and during this time they traveled more than nine thousand miles through an unbroken and trackless wilderness. The start was made May 14, 1804, from their camp on the Mississippi, near the mouth of the Missouri, and returning they reached St. Louis September 23, 1806. They discovered the headwaters of the Missouri and of the Columbia, and followed the waters of the latter until they landed at cape Disappointment, at the mouth of the Columbia, in Oregon, November 15, 1805. They remained there in camp until March 23, 1806, when they commenced the ascent of the Columbia in their canoes on their return trip.

The hardships experienced by these brave men and by the courageous pioneers, men and women who in the next half century followed in their footsteps and braved the innumerable dangers and hardships of the far west, have never been, nor can they be, fully depicted by either pen or tongue. To them are the people of America greatly indebted, for they have hewn out with willing hands, borne on stalwart shoulders, and set with stability in its everlasting resting place, the foundation stone of one of the grandest pillars upon which in part rests today the superb superstructure of American development and American civilization. How strangely pathetic is the history and how peculiar are the vicissitudes surrounding the lives of some men! Captain Meriwether Lewis, after passing through all the untold hardships and perils of that memorable expedition, returned to serve a brief time as governor of the northwestern territory, and then to find a lonely grave in the forests of Tennessee, either as a *felo de se* or as the victim of the hand of an assassin; just which, history has never definitely determined.

Not only by succession to every right which both France and Spain had to this territory, either in virtue of occupation or otherwise; not only by the right of sovereignty which attaches to the discoverer of a new country, nor yet by those rights which follow in the wake of scientific exploration, did the government of the United States rest its claim to the territory of Oregon; but added to all these is that other accumulated right, which is the result not merely of occupancy, but of *actual settlement.* The law of nations recognizes a wide distinction between those rights which attach to mere *occupancy* and those which attach to *actual settlement.* The natives of this territory in their wild, uncivilized state are mere occupants, mere tenants; they are not settlers. The Hudson bay trappers and traders, who invaded Oregon territory in pursuit of peltries and furs, were mere occupants, similar in all respects in the light of the law in regard to territorial rights which result from such occupancy as those which attach to the Indians. They were not settlers within the legal signification of that term, nor did they attract to themselves those territorial or sovereign rights which the law accords to settlers. The interests of civilization, says the law of that civilization, cannot permit a great empire of wild country to remain as such for the use of wild men for a game life; no less could the law of that civilization permit this great foreign monopoly, the Hudson Bay company, to occupy such country for the sole purpose of accumulating and speculating on the spoils of the hunter, and without any effort whatever to either develop or increase the natural productions of the country or locate or promote a single settlement. It was therefore by mere *occupancy*, and not by *settlement*, that England sought originally to strengthen her claim to and acquire rights in the Oregon territory. With the United States and the people of the United States it was entirely different. With the latter occupancy was coupled with that other and higher attribute of development and civilization, namely, scientific exploration and actual settlement.

Astor's project contemplated not merely occupancy of this distant territory for purposes similar to the Hudson Bay company; his purposes were of much higher order. They embraced settlement, the establishment of civil society, the physical development of the country, the leveling of the forest, the construction of houses, the cultivation of the land, the building of homes, the erection of school-houses and churches, the making of towns and cities, the establishing of marts, the creation of commercial arteries, and, in a word, the establishment of such civil institutions as would tend to attach the new territory, with bonds indissoluble, to the states of the American union, and thus weaken and finally and forever sever every adverse claim, and at the same time expand and develop the country and the commercial and political prestige and power of the nation. Irving in his "Astoria" summarizes the plans and expectations of Astor in these words: "He considered his projected establishment at the mouth of the Columbia as the emporium to an immense commerce; as a colony that would form the germ of a wide civilization; that would in fact carry the American population across the Rocky mountains and spread it along the shores of the Pacific as it already animated the shores of the Atlantic."

It was prompted by such impulses and with an aim to such results that the town of Astoria was established by Astor in 1811. The war of 1812 coming on, the English captured Astoria, hauled down the American flag, hoisted the English ensign and changed the name of the fort from Astoria to Fort George; but at the close of the war in 1818 it was restored to the United States by a treaty which stipulated the restoration of "all territory, places and possessions whatsoever taken by either party from the other during the war." In this restoration the English denominated it "the settlement;" and however many may have been the occupants of this country or those employed by the Hudson Bay company prior to that, this was unquestionably the first permanent settlement made by white men in the valley of the Columbia or in the territory of Oregon, and this was by American citizens. The claim, therefore, to prior settlement of Oregon territory, now comprising the whole of the states of Oregon, Washington and Idaho and a part of Montana, can rightfully attach only to the United States.

It is doubtless true that the two Winship brothers, of Boston, are the men who really made the first *attempt* at settlement on Columbia river after Gray's discovery. They sailed from Boston July 7, 1809, in two ships, the *O'Kain*, of which Jonathan was captain, and the *Albatross*, of which Nathan was master. The *O'Kain* went direct to California, while the *Albatross* went to Sandwich islands and thence to Columbia river, arriving there with fifty men on board early in the spring of 1810. The vessel proceeded up the river a distance of forty miles, opposite to the place now known as Oakpoint, where they disembarked, cleared a small tract of land, erected a building and planted vegetables, all of which, however, were demolished and swept away by the June floods of the same year, when Captain Nathan Winship reëmbarked with his men, joined his brother in California and, learning of Astor's expedition, never returned.

That Great Britain, operating through divers influential channels, notably the Hudson Bay company, reënforced as it was in 1821 by consolidation with the Canadian Northwest company of Montreal, exerted a most formidable power against the settlement of Oregon territory by Americans, and the waves of whose influence reached Washington and for a time threatened the loss of the whole territory, is an historic fact well established. That Daniel Webster, as Secretary of State, was by these influences at one time convinced that the whole territory was an unbroken waste of sandy deserts, impassable mountains, and impenetrable jungles there can be no room for doubt. These powerful influences had been operating in divers ways prior to 1842 for more than a third of a century. Their effect on the individual and public mind in the east, and on the official mind as well in Washington, was marked in the highest degree.

That Webster, as Secretary of State, had seriously contemplated including the whole of this territory in the Ashburton treaty, and subsequently in a separate treaty, in exchange to Great Britain for certain cod fisheries in Newfoundland is beyond question. The insidious and powerfully effective influences and the remarkably successful aggressions of the Hudson Bay company are best illustrated by the triumphs it achieved in the face of what seemed insurmountable obstacles. Although its original charter dates back to Charles II of England, in 1670, by which it was granted certain important rights, forty years prior to that a similar charter had been granted to the Canadian Northwest Fur company by Louis XIII of France. Prior to 1821 this company was in numbers, capital, influence and power vastly superior to and a most formidable rival of the Hudson Bay company; yet the latter, notwithstanding all this, through its superior management and great diplomacy, compelled the former in 1821 to yield to and accept its own terms as to union and consolidation, and from that day the Hudson Bay company, thus reënforced in capital, numbers and influence, and in the number and extent of its outposts, directed all its vast energies and immense powers to wrest from the United States and obtain eventually for Great Britain the whole of Oregon territory.

The Error of our Government in treating for Joint Occupancy.

But notwithstanding these superior rights on the part of the United States, in virtue not only of occupancy but also of scientific exploration and settlement, entitling this country to exclusive sovereign rights in the whole of Oregon territory, the fact that the Hudson Bay company had extended its operations into that region and was engaged in trade there with the Indians induced our government to make the fatal mistake of entering into a treaty with Great Britain in 1818 providing for joint occupancy for a period of ten years. This stipulation was extended indefinitely by another treaty with Great Britain in 1827, promulgated May 15, 1828.

These treaties, however, were not intended, nor did they or either of them in any manner attempt, to determine the respective sovereign claims of the United States and Great Britain, or in fact those of any other government, to this territory; they were intended only, as expressly stated in the treaty, "to prevent disputes and differences among the occupants of that territory."

That the government of the United States made a fearful mistake in ever consenting by treaty stipulation that Great Britain should, through its subjects, occupy Oregon territory jointly with our citizens for a period of twenty-eight years, instead of standing in 1817 on our rights as sovereign and insisting that they should be respected, is now generally conceded. The value of the furs of which that country was stripped by the Hudson Bay company in that time was immense, amounting to many millions of dollars. In the four years 1834 to 1837 the Hudson Bay company alone killed in that region (Oregon territory) over 3,500,000 fur-bearing animals, including beaver, marten, otter, fox, muskrat, bear, ermine, fitchew, lynx, mink, wolf, badger and raccoon. The American fur-traders could not compete with the Hudson Bay company, as all the supplies of the latter came in free of duty. But the fact that by the joint occupancy this great monopoly was enabled to strip the country of its wealth was as nothing compared with the powerfully hostile influence it constantly exerted against the settlement of the country by Americans and the foothold it afforded Great Britain, enabling that power to successfully postpone for nearly a century the final settlement of the question as to our rights, and which in the end compelled us to compromise, and deprived us of that vast extent of territory lying between the forty-ninth parallel and 54° 40′, the Rocky mountains and the Pacific ocean. Thomas H. Benton and many other leading men denounced this policy of joint occupation. Said Senator Benton in 1845, referring to the treaty of joint occupation: "I have been clear against joint occupation for twenty-eight years as a treaty of unmixed mischief to the United States." Historians agree that this company stripped Oregon territory of furs of the value of over one million dollars annually, amounting to perhaps thirty millions of dollars in the twenty-eight years of joint occupancy.

The political historian, J. Henry Brown, himself an Oregon pioneer of 1846, in referring to this matter in his "Political History of Oregon," says:

"Our government could have well afforded to have given a bonus of $10,000,000 and settled the question in 1818. Then, to cap the climax, our government was again swindled in the treaty of 1846 by agreeing to pay an unknown bill to that greatest of frauds and swindles, the Puget Sound Agricultural company, to the tune of $450,000, on account of possessory rights and claims of the Hudson Bay company, and on account of possessory rights of the Puget Sound Agricultural company, the sum of $200,000, a total of $650,000—a nice commentary on American sagacity, statesmanship and diplomacy!"

It was the entirely too ready disposition on the part of our government at the outset, in 1824, 1826 and 1829, to compromise our rights in the Oregon territory which resulted eventually in a loss to this country of territory the value of which cannot be estimated. Both Presidents Tyler and Polk were handicapped by the offer of settlement made to Great Britain under former administrations, in which the government had consented from time to time to a compromise on the forty-ninth parallel.

This, then, was the status of the territory of Oregon from the date of our treaty with Great Britain in 1818 until our treaty of 1846, a period of twenty-eight years. It was one of joint occupancy in virtue of treaty stipulation between the two countries, and it was during these twenty-eight years that the great battle as to the ultimate ownership of Oregon was fought and won. It was not wholly, though in part, a warfare of men on the field of carnage; it was a mighty, a prolonged—in one sense a physical and in another sense a diplomatic—contest between the vanguards of two civilizations and of two mighty nations, each contending with the other for the supremacy, and each also with the uncivilized, blood-thirsty savages whose country was being invaded, though for their civilization and ultimate good. Such was the political status, emphasized by treaty stipulation, as to induce the belief on the part of Great Britain that the ultimate right to the whole territory would be determined, not so much by the question as to *priority* of discovery, exploration and settlement, but rather by the *character* and *extent* of settlement in the years that should intervene before the final decision should be made by arbitration or otherwise.

During this period two purposes seemed to inspire the government of Great Britain as a means of ultimately securing to herself the absolute ownership of the whole of the vast Oregon territory. One was to impress on our public men and the government at Washington in every possible manner the alleged worthlessness of the territory; the other was to push forward unremittingly through the instrumentality of the great governmental organ, the Hudson Bay company, actual settlements in the territory. That they succeeded in a very large degree in impressing many of the prominent officials of our government that the whole territory was a worthless waste, not worth having, much less worth contending for, is made clearly apparent from the congressional debates during the twenty-eight years of joint occupancy. Did time permit, it might be interesting, in view of what the state of Oregon is today physically, commercially, socially, and politically, to recite some of the statements made in these debates. I will quote a few extracts:

Senator McDuffie, of South Carolina, in discussing in the United States Senate in 1843 the bill of Senator Linn, of Missouri, extending the laws of the United States over the territory of Oregon and proposing grants of the public lands to American citizens as an inducement to settlers, which bill passed the Senate February 3, 1843, said:

"The whole region beyond the Rocky mountains and a vast tract between that chain and the Mississippi is a desert, without value for agricultural purposes, and which no American citizen should be compelled to inhabit unless as a punishment for crime.

"Why, sir, of what use will this territory be for agricultural purposes? I would not for that purpose give a pinch of snuff for the whole territory. I wish to God we did not own it. I wish it was an impassable barrier to secure us from the intrusion of others. This is the character of the country. Who are we going to send there? Do you think your honest farmers in Pennsylvania, New York, or even in Ohio and Missouri, will abandon their farms to go upon any such enterprise as this? God forbid, if any man is to go to that country under the temptation of this bill?"

Mr McDuffie concluded by saying: "If I had a son who was a fit subject for Botany bay, I would urge him to go there."

The historians of the time were laboring under this fearful delusion as to the character and value of Oregon. Greenhow, writing in 1844 in his "History of Oregon and California," after stating his knowledge and views as to the region included in Oregon territory, says:

"Thus, on reviewing the agricultural, commercial and other economical advantages of Oregon, there appears to be no reason, founded on such considerations, which should render either of the powers claiming the possession of that country anxious to occupy it immediately or unwilling to concede its own pretensions to the other for a very moderate compensation."

Even Senator Benton, of Missouri, who subsequently became one of the great defenders of our rights in Oregon (though unfortunately never to the full extent of our rightful claim to territory in the north, but only to the forty-ninth parallel), as late as 1825 regarded Oregon as not worth holding. In that year he, in his place in the Senate, said:

"The ridge of the Rocky mountains may be named as a convenient, natural and everlasting boundary. Along this ridge the western limits of the Republic should be drawn and the statue of the fabled god Terminus should be erected on its highest peak, never to be thrown down."

Thanks to Dr Whitman and other pioneer heroes whose names and memories are rightfully forever embalmed in the affections of every true American, the western limits of the Republic were not drawn on the ridge of the Rocky mountains. The fabled god "Terminus" was never stationed there. Providence had willed it otherwise, and a brave and courageous people executed that will. Though those mountains are high and rocky and seemingly insurmountable, they were neither high enough nor rocky enough to impress discouragement on the minds or hearts of such dauntless men and women as Whitman and his wife and their followers, or to stem the irresistible tide of the pioneer emigration of these resolute and determined men and women who, by their incomparable courage and untold sufferings, settled the Oregon question forever.

The great historic fact is that prior to Whitman's visit to Washington (to which I shall presently allude) the sentiment among public men was almost universal that Oregon was a worthless waste, not worth contending for. Some in fact never did learn or comprehend its great value. As late as 1846 Senator Winthrop, of Massachusetts, quoted what Benton had said in 1825, and then remarked: "This country will not be straitened for elbow-room in the west for a thousand years, and neither the west nor the country at large has any real interest in retaining Oregon."

The Influence of the Hudson Bay Company.

The Hudson Bay company, through whose active influence this false sentiment was mainly created, was in every essential sense the direct, active and all powerful agent of the British government. It held its charter and its licenses from that government; its officers were superintended by a governor and deputy governor and a committee of directors resident in London, while a resident governor superintended and directed its vast operations in America.

The officers and members of the Hudson Bay company were, as a rule, under the domination of the home government. One grand exception, however, stands out in history: Dr John Mc-

Laughlin was the true friend of the American pioneer. Brave, generous, noble, his house, his larder, his horses, his cattle were all at the service of the poor travel-worn, weary and discouraged emigrant. But for this disposition and these noble qualities he was ostracised by the company and the British government, driven into exile at Oregon City, there to end his days, yet respected, venerated, honored by the pioneers of Oregon and all who knew him and his history.

Doctor Marcus Whitman.

It was at this critical period in our history that the great martyr to the cause of the vindication of American rights and the advancement of national development and Christian civilization came to the front, and in the grandeur of American manhood in its sublimest sense rose equal to the great emergency, and by his memorable trip across the continent, from Oregon to Washington, in the dead of winter in 1842–'43, prevented the contemplated barter of that great empire for a cod fishery bank on the shores of Newfoundland. Dr Marcus Whitman, whose name must be forever associated with the early history of Oregon, had in 1835, under the auspices of the American board of foreign missions in Boston, accompanied by his faithful wife, gone to what was then a distant wilderness, and in 1836 established there a mission. Though 48 years have passed since he and his wife and nine of their household, on November 27, 1847, fell victims to savage outlawry on the plains of Walla Walla, and gave up their lives* as a part of the cost of preserving as our rightful heritage that great territory, his name still lives and will continue to live in the history of his country, imperishable as the stars, honored, respected, admired.

Dr Whitman, being deeply impressed that the government at Washington, through false information received from British sources—among others, from the British minister at Washington and the reports of the governor of the Hudson Bay company—to the effect that the whole of Oregon territory was comparatively worthless, was about to barter the whole thing away for a cod fishery interest on the coast of Newfoundland, determined to proceed to Washington at once at all hazards, for the purpose

* Five of the Indians concerned in the Whitman massacre were tried, convicted, sentenced and hung at Oregon City in May, 1850.

of presenting the true state of the case to the President, the Secretary of State, and other members of the government. That he was justified in his fears is more than fully demonstrated by the historical occurrences of the times.

It is conceded by all historians who have written on the subject that Dr Whitman's mission to Washington, accompanied as he was across the continent by that other brave pioneer, General A. L. Lovejoy, in the winter of 1842–'43, saved Oregon to the union, and all that is implied in, and which attaches to, that salvation. His mission was of a quadruple nature. It was in the interest, *first*, of the preservation of the sovereign rights of the United States to a vast and immensely valuable territory about to be bartered away through misinformation on the part of the government; *second*, of the preservation of the lives and property of American citizens, men, women and children, pioneer emigrants, then settled in Oregon territory, and the protection of Christian missions in the Indian territory of the Far West; *third*, of the material welfare of the United States; and *fourth*, of the great cause of American civilization.

Although the board of missions, under whose auspices Dr Whitman had gone to Oregon seven years before, for the reason, doubtless, that they did not understand the real situation, did not take kindly to his return without leave on his noble and perilous mission, and he was, according to the historian Gray, "Instead of being received and treated as his labors justly entitled him to be, met by the cold calculating rebuke for unreasonable expenses, and for dangers incurred without orders or instructions or permission, from the mission to come to the states." Although this may be, and doubtless was, true, as stated in this paragraph by Gray, the time has at last come when all shadows have been dispelled, all doubts removed, and when in the clear light of accurate, impartial history the motives, the courage, the patriotism, the Christian fidelity of Dr Whitman are seen and recognized in their true character, not only by the representatives of the Congregational church, its early and present missions, not only by the people of the Pacific northwest, nor yet alone by the whole American people, but likewise by those of the whole civilized world.

The interest attaching to this memorable trip of Dr Whitman across the continent in the winter of 1842–'43 was widespread. Its fame extended throughout the nation, and the subject of Oregon and the rights of the United States in respect to the same were matters of discussion in all political circles. Public sentiment was wrought up to the highest pitch, so much so that the democratic national convention which met at Baltimore in 1844 had, as one of its planks, "Fifty-four forty or fight," and on this platform the Polk administration came into power. The embarrassments with which it was surrounded, however, growing out of the Oregon question and this particular plank in the platform, were great.

The President found that preceding negotiations during the administrations of his predecessors, Monroe, Adams, and Tyler, had not proceeded on the part of the United States on the theory of our right to fifty-four forty; that the negotiations proceeded rather on the idea that they should treat the respective claims of the two countries in the Oregon territory with a view to establishing a permanent boundary between them west of the Rocky mountains to the Pacific ocean, and in this compromising spirit these administrations had proposed to fix the boundary on the forty-ninth parallel. To add to the embarrassment, many leading democratic senators, including Benton, of Missouri, scouted at the idea that our rights extended to fifty-four forty, and insisted that we had no rights extending farther northward than the forty-ninth parallel. To add still further to the embarrassment of the situation, Great Britain, through her minister, on June 6, 1846, before the administration of Mr Polk was clearly launched, submitted a proposition, the same that was finally agreed on, of the forty-ninth parallel, and coupled with it the suggestion that it must be accepted at once, and without delay, if at all. In this great political dilemma President Polk resorted to a course which, though adopted a few times in the earlier years of our government, had not been resorted to for nearly half a century—that is, of seeking the advice of the Senate of the United States in advance of action on the part of the executive.

Consequently on June 10, 1846, the President transmitted to the Senate the proposal in the form of the convention presented to the Secretary of State on the sixth of that month by the British envoy, for its advice. Mr Polk's message transmitting this convention concluded as follows:

"Should the Senate by the constitutional majority required for the ratification of treaties advise the acceptance of this proposition or advise it with such modifications as they may upon full deliberation deem proper, I shall conform my action to their advice. Should the Senate, however, decline by such constitutional majority to give such advice or to express an opinion upon the subject, I will consider it my duty to reject the offer."

In other words, President Polk, encompassed on the one hand by the plank in the platform on which he was elected, of "Fifty-four forty or fight," and on the other hand by the action of preceding administrations in conflict with that proposition, his party leaders divided on the question, and the issue brought directly to the front by Great Britain, concluded to and did throw the whole responsibility on the Senate of the United States. Two days subsequently, June 12, 1846, the Senate adopted a resolution advising the President to accept the proposal of the British government, and as a result the convention was finally agreed to June 15, 1846.

So, although this memorable controversy had remained unsettled for nearly half a century, it is a remarkable historical fact that but nine days elapsed between the submission of the final proposition to compromise by Great Britain and the signing of the treaty.

Notwithstanding the fact that one hundred and three years have elapsed since the discovery of Columbia river by Captain Gray, ninety-two years since the cession of Louisiana, and seventy-six years since our cession from Spain, the settlement of our title to a certain portion of the territory of Oregon was held in abeyance until October 21, 1872, less than twenty-three years ago. That was the island of San Juan. The treaty of June 15, 1846, between the United States and Great Britain, which was intended to settle *all* questions relating to our northern boundary, inadvertently left the question as to the title to this island an open one. The treaty in defining the northern boundary of the United States from a point in the Rocky mountains on the forty-ninth parallel, from which point eastward the boundary line had been fixed by the second article of the treaty of Washington, in 1842, reads as follows:

"Shall be continued westward along said forty-ninth parallel of north latitude to the middle of the channel which separates the continent from Vancouver's island, and then southerly through the middle of said channel and of Fuca's straits to the Pacific ocean."

This island is located in the "channel" mentioned in this treaty, and the question at once arose, and for a period of twenty-five years was a source of aggravating controversy between this country and Great Britain, at one time very nearly involving the two nations in war, as to which was the "channel" referred to in the treaty. Great Britain, true to a national tendency, insisted while the United States insisted that Haro channel, on the northern side of the island, was the main channel within the meaning of the treaty.

This minor boundary controversy was finally adjusted by a provision in our treaty with Great Britain of May 6, 1871, submitting the question to the arbitration of the German Emperor, who, on October 21, 1872, made his award sustaining the contention of the United States; and thus, after a period of nearly eighty years, dating from the discovery of the Columbia by Captain Gray, the whole question as to the ownership of the Oregon territory was finally determined, not, however, without a sacrifice of important rights as to our northern boundary in the interest of compromise.

That Dr Whitman was misunderstood at the time by many, and by none more than by the board of American missions, and therefore suffered unjust criticism from that board, there can be no question. Barrows, in his "History of Oregon," in referring to this fact, says: "He, as Coleridge says of Milton, strode so far before his contemporaries as to dwarf himself by the distance." But the day of atonement has come, and although in this as in many other cases justice has been delayed, yet as a poet has said, "Ever the right comes uppermost, and ever justice is done." No longer ago than Sunday, the tenth of the present month (March, 1895), in the city of Chicago, the day was widely observed in the Congregational churches of that city in honor of Marcus Whitman, and incidentally in aid of Whitman college at Walla Walla. The Chicago *Inter-Ocean*, in its issue of March 11, says: "Dr Whitman is the hero of the Congregational church of this century. In fact, in the largeness of the results he accomplished, no man of the century leads him."

At the city of Walla Walla, in the state of Washington, within six miles of Waiilatpu, the spot where he and his missionary wife and nine other companions were, on November 27, 1847, mercilessly slaughtered by the very savages whose best interests had been subserved by them and whose heads had been blessed by their benedictions, there is to be erected a college bearing his name, with an endowment of $200,000, $50,000 of which has been pledged by Dr D. K. Pearson on condition that the balance is raised. That college, when erected, as it doubtless will be, will be a fitting and lasting monument to his name.

Whitman succeeded in disabusing the minds of Daniel Webster, President Tyler, Thomas H. Benton, and other public men as to the character and value of Oregon territory. They had come to believe, through the continuous misrepresentations to which I have referred, not only that Oregon territory was of little value but that it was a physical impossibility to go from Fort Hall to Oregon with wagons. Whitman had taken his wife in a wagon over these mountains eight years before (in 1835) and he assured them there was no insurmountable difficulty; and he proved his assertion by leading back to Oregon an emigration the same year, the summer of 1843, with 200 wagons and over 1,000 men, women and children, not losing, as I remember the history, a single wagon or a single life in the journey west of Fort Hall.

Dr Whitman was a born leader of men. He had the courage to face every danger, however perilous, in defense of the right. His efforts while in Washington, coupled with the magnificent successes of his expedition the same year, turned the scale in which that vast territory was being weighed and balanced between the two countries in favor of the United States.

Had Dr Whitman been possessed of the egotistic assurance of Horace of old, and could he have gazed down the long avenues of coming ages, he might, with him, have truly said:

I have achieved a tower of fame
  More durable than gold,
And loftier than the royal frame
  Of pyramids of old;
Which none inclemencies of clime,
  Nor fiercest winds that blow,
Nor endless change, nor lapse of time,
  Shall ever overthrow.
I cannot perish utterly;
  The broader part of me must live, and live and never die,
But baffle Death's decree!
  For I shall always grow, and spread
My new-blown honors still,
  Long as the priest and vestal tread
The Capitolian hill.
  I shall be sung when thy rough waves,
My native river, foam,
  And when old Daunus scantly laves

And rules his rustic home—
  As chief and first I shall be sung,
Though lowly, great in might,
  To tune my country's heart and tongue,
And tune them both aright.

The Contention of Great Britain.

In our contention with Great Britain respecting Oregon territory it was very earnestly and with some degree of facetiousness asserted by the British minister, Packenham, that the different titles under which we claimed were conflicting and therefore destroyed each other, namely, discovery by Spain, cession from France, and discovery and settlement by American citizens; but Mr Calhoun, as Secretary of State, in his letter to Mr Packenham, disposed of that assertion with this remark:

"It has been objected that we claim under various and conflicting titles which mutually destroy each other. Such might indeed be the fact while they were held by different parties, but since we have rightfully acquired both those of Spain and France and concentrated the whole in our own hands, they mutually blend with each other and form one strong and connecting chain of title against the opposing claims of all others, including Great Britain."

Mr Buchanan, in referring to this phase of the case, said:

"This is a most ingenious method of making two distinct and independent titles held by the same nation worse than one—of arraying them against each other and thus destroying the validity of both. From the moment Spain transferred all her rights to the United States all possible conflict between the two titles ended, both being united in the same party. Two titles which might have conflicted, therefore, were thus blended together. The title now vested in the United States is just as strong as though every act of discovery, exploration and settlement on the part of both powers had been performed by Spain alone before she had transferred all her rights to the United States. The two powers are one in this respect; the two titles are one, and they serve to confirm and strengthen each other."

Great Britain, again through her plenipotentiaries, sought to discredit the effect of the discovery of Columbia river by Captain Robert Gray, for the reason, as suggested, that his ship, the *Columbia*, was a *trading* and not a *national* vessel. This contention was speedily disposed of by Mr Buchanan with this remark:

"The British plenipotentiary attempts to depreciate the value to the United States of Gray's discovery because his ship, the *Columbia*, was a trading and not a national vessel. As he furnishes no reason for this distinction, the undersigned will confine himself to the remark that a merchant vessel bears the flag of her country at the masthead, and continues under its jurisdiction and protection in the same manner as though she had been commissioned for the express purpose of making discoveries."

In this great and prolonged diplomatic contest, one of the most interesting questions discussed was as to what extent continuity of boundary furnishes a just claim in connection with those of discovery and occupation. This question grew out of the claim on the part of the United States that the Louisiana territory extended to the Pacific ocean. This claim was denied on the part of Great Britain. It was insisted, however, with great ability by Secretary of State Calhoun, and subsequently by Secretary Buchanan: *First*, that the claim was valid under public law, and, *secondly*, that Great Britain, having asserted the validity of the doctrine in reference to her possessions in this country as against France, even to the extent of going to war with that power in 1763, was estopped from denying the validity of the doctrine as against the United States, especially inasmuch as our people had contributed so much to a result in that contest favorable to Great Britain; and it was further contended by our diplomatists that Great Britain, whatever may have been her rights in Oregon territory, relinquished all to France by the seventh article of the treaty between Great Britain and France at the close of that war, in 1783.

The controversy in reference to the correct northern boundary of the Oregon territory, whether the forty-ninth parallel, as now agreed upon, except along the straits of Fuca, or 54° 40′ north, is one familiar to all. Spain unquestionably always asserted claim as far north as the sixty-first parallel, but in her treaty with Russia 54° 40′ was recognized. It was claimed, however, that by the treaty of Utrecht in 1713, which provided for determining "the limits to be fixed between the bay of Hudson and the places appertaining to the French," the boundary between Louisiana and the British territories north of it was actually fixed by commissioners on latitude 49°. Whether this is true or not is a matter of very serious disputation. A careful examination of all history bearing upon the point leads me to the conclusion that such was not the fact.

In reply to the claim of the United States to go to 54° 40′, it was asserted that whatever might have been the right of Spain, the latter in ceding to France in 1800 stipulated to convey only as far north as the forty-ninth parallel. To this contention the United States replied and with much force, and the contention should never have been abandoned: If this be so and if it be true the right of Spain is good to 54° 40′, then the strip between the forty-ninth parallel and 54° 40′, which it was alleged was not included in the cession of Spain to France in 1800, was included in the cession of Spain to the United States in the treaty of Florida of 1819, by which Spain conveyed every right she had on the continent north of the forty-second parallel. Mr Secretary Buchanan, in his reply to Packenham, said:

> "It is an historical and striking fact, which must have an important bearing against the claim of Great Britain, that this Nootka convention, which was dictated by her to Spain, contains no provision impairing the ultimate sovereignty which that power had asserted for nearly three centuries over the whole western side of North America as far north as the sixty-first degree of latitude and which had never been seriously questioned by any European nation."

Subsequently to 1818 and down to the final settlement of the boundary question in 1846 the only material difference in the views of American statesmen and diplomatists was as to whether the rightful claim of the United States extended to 54° 40′ or only to the forty-ninth parallel. All concurred in the opinion that our claim was beyond question good at least as far north as the latter, while many of our ablest statesmen and diplomatists, strengthened and supported by a powerful sentiment among the people, insisted that our claim extended to 54° 40′. No one thing, however, nor indeed all other influences combined, did as much to strengthen the sentiment and belief in favor of our claim to 54° 40′ as the mission of Dr Whitman in 1842.

The Opening of the Oregon Route.

Frémont has been designated in history as "the Path-finder," and in some respects he is justly entitled to the pseudonym, but he was not the one who opened the great transcontinental trail to Oregon by way of Fort Hall. Fort Hall was the leading eastern outpost of the Hudson Bay company. It was located on Snake river about 100 miles north of Salt Lake City. "Here," says one historian, "many immigrant companies had been intimidated and broken up by Hudson Bay men, and so Fort Hall served as a cover to Oregon, just as a battery at the mouth of a river protects the inland city on its banks." Here it was that the

Hudson Bay people in 1836 made a determined but unsuccessful effort to prevent Whitman from attempting to go through with his wagon to Oregon, insisting it was a physical impossibility. The Tyler administration had promised to send Lieutenant Frémont and his company as an escort to protect Whitman and his 200 wagons and 1,000 men, women and children on his return to Oregon in the summer and fall of 1843, but failed to do so.

Whitman's expedition left Waldport, Missouri, in June, 1843, and although at Fort Hall, 1,323 miles from the starting point, a determined effort was again made by the Hudson Bay men to prevent further progress, insisting that it was impossible to go through with wagons, Whitman and his 200 wagons did go through and arrived at his home on Columbia river September 4, 1843. Frémont did not reach Fort Hall until October 23 of the same year, forty-nine days after Whitman and his expedition had passed that point; nor did Frémont arrive over a new trail but over the identical one, for a distance of some hundred miles, which Whitman, Spaulding and their wives had trodden seven years before. Dr Whitman left his home on the Columbia on this great mission October 3, 1842, and returned there September 4, 1843, after an absence of just eleven months.

The Organization of a Provisional Government in Oregon.

Following this successful expedition led by Dr Whitman in 1843 came the organization of a provisional government by the people then in the territory and the final settlement of the whole question by the treaty of 1846. At the time of the organization of the provisional government there was but one law book in all that region. This was a copy of the Iowa Statutes; and in the fundamental law of the provisional government there was this provision: "The laws of Iowa territory shall be the law in this territory in civil, military and criminal cases when not otherwise provided." Another provision which these brave, courageous, liberty-loving pioneers inscribed in their fundamental law was this: "There shall be neither slavery nor involuntary servitude in said territory, otherwise than for the punishment of crime whereof the party shall have been duly convicted."

Oregon, though added to the United States by the treaty of 1846, and created a territory, including what is now the states of Washington and Idaho, in August, 1848, had no territorial government until 1849. In March of this year its first territorial governor arrived and organized a territory with 8,785 inhabitants. This territory was not dismembered until 1853, when the territory (now state) of Washington was carved out of it. It became one of the states of the union July 14, 1859, and in 1863 the territory (now state) of Idaho was set apart from its area.

Of all the public men of the country during the period of the early settlement of Oregon, no one seemed to grasp the real situation or so fully comprehend the vastness of the prospective interests at stake as Lewis Field Linn, United States Senator from Missouri. To his memory more than to that of any other public man of the time do the pioneer immigrants and the people of Oregon generally owe a tribute of lasting veneration.

The measure for which Senator Linn so vigorously and constantly labored prior to his death, in 1843, for making donations of the public lands in Oregon territory to citizens of the United States to induce immigration and settlement finally materialized in an act of Congress passed September 27, 1850. This act very largely facilitated immigration to and settlement in that country. One unfortunate incident, however, attached to this otherwise beneficent and highly commendable piece of legislation. While it facilitated immigration it tended also to facilitate marriage, not only among the immigrants, but between male immigrants and Indian women. By the fourth section of the act a grant *in præsenti* was made to any man who would reside on and cultivate for four consecutive years a tract of 320 acres of land if a single man and 640 if married. While under this provision settlement of the country was rapidly developed, it is nevertheless a fact, fully borne out by the records of the courts in that country within the next few years thereafter, that the premium paid on marriage resulted in an unusual and abnormal crop of divorces, as many marriages, especially those with Indian women, were based on no other or higher considerations than the mercenary ones offered by the act.

The Name Oregon.

There are various theories as to the origin and derivation of the name "Oregon." Some writers declare that it is derived from the Spanish, signifying "wild thyme," so called on account of the abundance of that herb found by early explorers. Others insist it is an Indian word, in use about the headwaters of the Columbia to designate the waters of that river and meaning the "great river of the west," and obtained from them by Jonathan Carver, a native of Connecticut, in 1766–'68, who spent two years among the Indians on the waters of the upper Mississippi, now the state of Wisconsin. Carver's accounts, however, in reference to many matters, are contradictory and unreliable, though in reference to this he was quite likely right. It is more than probable that an article published fifty-three years ago, in 1842, in "Hunt's Magazine" and reproduced by the historian Brown in his political history of Oregon, presents the correct solution of the question. Speaking of Oregon territory and the discovery of Columbia river by Captain Gray, this article says: "The territory watered by this river and its tributaries has since"—that is, since the discovery of the river—"been called the Oregon territory from a tradition said to have prevailed among the Indians near lake Superior of the existence of a mighty river rising in that vicinity and emptying its waters into the Pacific, and which was supposed to be the Columbia." Bryant in his celebrated "Thanatopsis," written in 1815, refers to the Columbia river as the Oregon: "Where rolls the Oregon, and hears no sound save his own dashings."

Early News-carrying in and to Oregon.

It is a singular historical fact that the pioneers of Oregon territory down as late as the settlement of our northern boundary, in 1846, received most of their news from Washington by way of the Sandwich islands. A semi-yearly vessel also brought letters and papers around cape Horn, the news in which was necessarily somewhat stale. Lieutenant Howison in his report says:

"October 16, 1846, the American bark *Toulon* arrived from the Sandwich islands and brought news of the Oregon treaty, the Mexican war and the occupation of California. The right of ownership of the soil being vested by treaty, I no longer felt any reserve in hoisting our flag on shore, and it has been some time waving over our quarters on the very spot which was first settled by white men on the banks of the Columbia."

On the receipt of the news from the Sandwich islands, James Douglass, the chief factor of the Hudson Bay company and a pronounced Britisher, addressed the following letter to Governor Abernethy, of Oregon:

"FORT VANCOUVER, *November* 3, 1846.

"GEORGE ABERNETHY, Esq.

"DEAR SIR: Very important news for all parties in Oregon has just been received by the bark *Toulon* from the Sandwich islands. It appears that the boundary question is finally and fully settled. * * * The British government has rendered more than strict justice required; but John Bull is generous, and was bound to be something more than just to his promising son Jonathan, who will no doubt make a good use of the gift. * * *

"Yours truly, JAMES DOUGLASS."

It was not until 1850 that the people of Oregon had a semi-monthly mail, through a service established between San Francisco and Portland, Oregon.

The first attempt at sending mail across the continent from Oregon territory was in 1838, fifty-seven years ago, when letters were carried from the Willamette valley, in Oregon, to Medport, Missouri, in sixty days, including two days' detention at Lapwai and two days at Fort Hall, carrying to Reverend Jason Lee, the Oregon missionary then in the east, the sad intelligence of the death of his wife in Oregon.

The first Printing Press west of the Rocky Mountains.

The first printing press in Oregon was received as a donation from the mission of the American Board of Foreign Missions in the Sandwich islands to the mission of the board in Oregon. It reached its destination at Lapwai, now the state of Idaho, then a part of Oregon territory, and was put in operation by Mr E. O. Hall, of the Sandwich Islands mission, and commenced publishing books in the Nez Percé language. This was in 1838, fifty-seven years ago. It was the first printing press west of the Rocky mountains. The first newspaper published within the limits of the present state of Oregon was established at Oregon City seven years later, in 1845. It was called the "Oregon Spectator."

The first white Birth and Burial.

The first white American child born on the Pacific coast was the daughter of Dr Whitman and wife, born near Walla Walla in 1839. On June 26, 1838, Mrs Maria Pitman, wife of the missionary, Reverend Jason Lee, died near Salem, Oregon. She was the first white American woman to close her eyes in death west of the Rocky mountains. Today, on an humble headstone which marks her last resting place in Salem, Oregon, may be read the following inscription:

"Beneath this sod, the first ever broken in Oregon for the reception of a white mother and child, lie buried the remains of Anna Maria Pitman, wife of Reverend Jason Lee, and infant son. She sailed from New York in July, 1836; landed in Oregon June, 1837; was married in July, 1837, and died June 26, 1838, in full enjoyment of that love which constrained her to leave all for Christ and heathen souls. 'Lo we have left all and followed Thee; what shall we have therefore?'"

Geographic Characteristics and Natural Resources of Oregon.

What, briefly, are the prominent geographic characteristics and natural resources and advantages of the state of Oregon? To enumerate, much less describe or discuss them would require a long series of lectures, each of which, to be properly understood and appreciated, should be fully illustrated. I may mention a few only of the most notable.

First, an area—and I speak now of the present state of Oregon—of 96,030 square miles, containing 60,518,400 acres, comprising every conceivable character of surface configuration; an area greater in extent by more than 6,000 square miles than all of England, Scotland and Wales combined, with their aggregate population of over 32,000,000; an area over eight times larger than Belgium, with its population of above 6,000,000, and but 6,000 square miles less than one-half that of France, with its 40,000,000 people.

This area consists of numerous and extended fertile valleys; mountain ranges, rich in minerals, both precious and base, whose sides are clothed with eternal verdure and whose peaks are crowned with eternal snow; forests unsurpassed in extent and in the number, variety and majesty of the trees composing them; immense fertile plateaus of everlasting green, on whose nutritious grasses feed 2,600,000 sheep, of the value of $6,000,000, and which produce annually over 17,000,000 pounds of wool, averaging, according to price, from $2,000,000 to $2,250,000; 250,000 horses, of the value of $7,000,000; 6,500 mules, of the value of $300,000; 125,000 milch cows, of the value of $3,000,000, and 1,000,000 oxen and other cattle, of the value of $12,000,000.

Then we have sandy deserts, gradually being converted into fruitful grain fields in virtue of the processes of irrigation; magnificent rivers, including the Columbia, the great father of western waters, the Snake, the Willamette, the Yamhill, the Tualatin, the Santiam, the Siuslaw, the Rogue, the Umpqua, the

Coquille, the Nestucca, the Nehalem, the Sandy, the John Day, the Link, the Lost, the Deschutes, the Umatilla, the Grande Ronde, the Powder, and others of less magnitude and significance, including innumerable streams, pure as the snow of the mountain sides whence they spring and filled with trout and other edible fishes; grand lakes, which mirror back in sublime beauty their mountain walls of granite, fringed with the waving branches of stately firs; extensive caverns, brilliant in stalactites and cooled by running mountain streams of living waters; and lastly, volcanic regions, bearing on their encrusted surface the very picture of desolation, thus far successfully defying the ingenuity of man and every effort at reclamation. It is gratifying, however, to be able to say that this character of configuration is confined to a very small area in southeastern Oregon, probably in all less than 1,000 square miles, known as the "Lava Beds." Here it was that General Canby and the Reverend Dr Thomas, peace commissioners, lost their lives while treating with the Indians, in 1872, an Indian desperado known as Captain Jack leading the murderous attack. Peace commissioner Colonel A. B. Meacham, an Oregon pioneer, was seriously wounded at the same time.

Oregon is divided north and south by three mountain ranges, separating the state into four tiers of fertile valleys. First, the Coast range, running parallel with the Pacific ocean the length of the entire state, and on an average distant some 40 miles from the coast, separating the Nehalem, Tillamook, Alsea and other coast valleys from the valley of the Willamette; second, the Cascade range, running also north and south parallel with the Coast range, distant from the latter on an average 75 to 100 miles, and separating the Willamette, Umpqua and Rogue river valleys from the great Inland Empire in eastern Oregon, including the valleys of Umatilla, Ochoco and other grazing plains lying to the eastward; and, third, the Blue mountains, running from southeast to northwest, separating these valleys again from the magnificent wheat fields of the Grand Ronde, Powder river, Wallowa, Snake river and other valleys in the counties of Union, Baker, Grant and Harney, in the region in which are located La Grande, Union, Baker City, Ontario, Huntington, Canyon City, and numerous flourishing mining and commercial towns.

Again, the state is divided in the other direction by the Calapooia mountains, crossing the state from east to west, from the

Cascades to the Pacific ocean, about 150 miles from its southern boundary. Other minor ranges also intersect the state east and west, including the great Siskiyou range on the dividing line between Oregon and California.

The state contains more than 25,000,000 acres of arable land. The Willamette valley alone contains 5,000,000 acres. The whole arable area is greater than the one-half of the entire area of the six New England states. Over 10,000,000 acres (or about one-sixth of the whole state) are covered with forests, the greater portion as magnificent and valuable as any in the world of like species, the balance of the state being mountain, grazing, and desert lands, the latter of which can be nearly all made highly productive by irrigation.

The Mountain Peaks of Oregon.

The great mountain ranges of Oregon and their grand scenery are the pride of all her people and the wonder and admiration of every traveler who beholds them. Rising from the Cascade range, in the state of Oregon, in stately beauty and majestic grandeur, with summits penetrating the clouds and wrapped in everlasting snows, stand, like great sentinels on towering battlements, mount Hood, 12,000 feet in height; Jefferson, 10,200 feet; Black butte, 7,000 feet; Snow butte, 6,000 feet; the Three Sisters, 9,000 feet; Diamond peak, 8,807 feet; mount Theilsen, 7,000 feet; mount Scott, 9,125 feet; Onion peak, over 4,000 feet; and last, but not least, mount Pitt, or mount McLaughlin, as it is sometimes called, near the southern boundary of the state, 9,760 feet in height. These are all in the Cascade range and within the state of Oregon, and, commencing with mount Hood, the giant of the line and seemingly the commander of the column, located about 25 miles due south of Columbia river in the center of the Cascade range, they stand in a line running almost due north and south in the order I have named them, mount Pitt being near the California line. Mount Hood was named after Lord Hood by Vancouver's navigator, Lieutenant Broughton, in 1792. The exact height of this mountain, I believe, has never been accurately ascertained, the reported measurements ranging all the way from 11,000 to 18,000 feet. It is known, however, from more recent measurements, to be about 12,000 feet in height, or some 3,400 feet lower than Shasta, in California, and mount Rainier or Tacoma, in Washington. Slightly east of mount Hood and but 70 miles distant, in what was once a part of Oregon territory, but now the state of Washington, stands mount Adams, 9,570 feet in height, named for John Quincy Adams. It is one of the five snowy peaks visible at the same time from nearly every point of northern Oregon. One hundred miles north of mount Hood and northwest of mount Adams, also in Washington, is mount Saint Helens, some 9,750 feet in height, a magnificent cone, which is said to be frequently in a state of eruption, and which is confidently said to have been (as also Rainier) during the past year. Mr J. Quinn Thornton, one of Oregon's earliest pioneers and chief justice of the territory, in his "History of Oregon and California," asserts it was in a state of eruption in 1831. Frémont records the fact that it was "in a state of activity November 13, 1843." The statement is well authenticated that in 1832 mount Saint Helens scattered ashes over the country to a distance of 100 miles, so obscuring the sunlight as to make it necessary to employ artificial light at midday that distance from the mountain. There is a perpetual flow of hot water at a point in its southern slope, indicating that the volcanic forces are not entirely extinguished.

The ascent of mount Hood from the south has been frequently made, and in more recent years by men and women numbered by the hundred. On July 4, 1887, members of the Oregon Alpine club of Portland, Oregon, carried to its summit 100 pounds of illuminating red-fire. The illumination lasted 58 seconds and was seen from Portland on the west, a distance of 60 miles, and Prineville on the east, a distance of 80 miles. The illumination was repeated in 1888, when it is asserted heliographic communications were exchanged with the Signal Service officers at Portland. In July, 1894, a party numbering about 180 men and women ascended to its summit in two separate columns, one from the north, the other from the south. This mountain has emitted smoke at intervals since the earliest settlement of the country.

Crater Lake.

No less interesting are the lakes of Oregon, which sleep in silent beauty in the icy embrace of the mountains, some of them hundreds and even many thousands of feet above the level of the sea. They are numerous and of interest as deep as their placid waters; but the one which above all is romantically interesting and surprisingly wonderful is that known as Crater lake. It is located in the Cascade range, in southeastern Oregon, at an elevation of over 8,000 feet. Its rim or shore is 1,800 feet higher than mount Washington, in New Hampshire; 4,000 feet higher than Vesuvius, in Naples, and on the same elevation above the sea as mount Sinai, in Arabia. It was discovered in 1853 by gold prospectors from southern Oregon, who in their wonder occasioned by its strange location and startling beauty named it "Lake Mystery." Later another party from fort Klamath in visiting it were so awestricken with its peculiar character and its weird surroundings that they gave it a new name, "Lake Majesty." Subsequently, in 1886, scientific exploration developed the fact that the waters of this strange lake occupy the crater of an extinct volcano; that it is a gigantic bowl carved out of the mountain, whose rock-ribbed rim rises more than 8,000 feet above the level of the sea; that it is elliptical or oval in form, its surface covering an area of some 28 square miles, being about 6¼ miles in length by about 4½ in breadth. These discoveries led to a second change of name, and it is now and has been for several years past known as Crater lake. A few years since, mainly through the efforts of Representative Herman, of Oregon, this lake, including some twenty surrounding townships, was withdrawn from the public surveys and reserved as a national park.

It is one of the most remarkable lakes on the face of the globe. It is the deepest fresh-water lake in the United States, if not in the world. By reason of its phenomenal location and awe-inspiring surroundings it is unsurpassed in scenic grandeur and marvelous beauty by any other known to man. The day is not far distant when travelers, sight-seers, seekers after knowledge, students of nature, and lovers of the beautiful and the sublime of every tongue will come from all countries and every clime for the purpose of standing in the presence of its bewildering wonders, gazing on its entrancing mysteries, and feasting on the inspiration of its majestic beauty.

What is the explanation of scientists of this seemingly abnormal creation, which inspires awe and evokes mingled admiration and wonder in the minds of all who behold it? It is this: that there, in the departed centuries, once stood a giant volcanic mountain whose summit towered into the heavens to a height probably far above any other in the United States, if not in North America. This conclusion is based by scientists on well known geometric and geographic principles. It is determined in part by ascertaining the extent and angle of the rim of the crater and taking into consideration the general configuration and composition of all its surroundings. According to the Geological Survey the depth of this crater is 4,000 feet and of the water 2,000 feet over the greater portion—that is, from the rim of the lake it is from 1,500 to 2,000 feet down to the surface of the water, and the water is 2,000 feet deep. To add to the strange conformation and beauty of this phenomenal lake, located in a mountain cup whose rim is indeed *in nubibus*, there is a second crater within the main one, which looms up in a hollow cone 650 feet above the surface of the water. This is called "Wizard island," while still two more similar craters exist which do not reach the surface of the water, the top of the one being 450 feet below the surface and that of the other 825 feet.

One writer, Mrs Frances Fuller Victor, in her interesting and instructive book entitled "Atlantis Arisen," in speaking of this lake says:

> "One cannot, owing to the sunken position of the lake, discover it until close upon its rim, and I say without exaggeration that no pen can reproduce its image, no picture be painted to do it justice, nor can it for obvious reasons be satisfactorily photographed. At the first view a dead silence fell upon our party. A choking sensation arose in our throats, the tears flowed over our cheeks. I do not pretend to analyze the emotion, but if I were to endeavor to compare it with anything I ever read I should say it must be such a feeling which causes the cherubim to veil their faces before God. To me it was a revelation."

Captain (now Major) C. E. Dutton, in his report of the survey of this lake to the Director of the Geological Survey, says:

> "It was touching to see the worthy but untutored people who had ridden a hundred miles in freight wagons to behold it vainly striving to keep back tears as they poured forth exclamations of wonder and joy akin to pain, nor was it less so to see so cultivated and learned a man as my companion hardly able to command himself to speak with his customary calmness."

Did time permit, attention might be attracted to the many other interesting characteristics of this wonderland in Lake and Klamath counties, in southeastern Oregon. I might point to Upper and Lower Klamath lakes, to Link river uniting the two, with its valuable water power, having a fall of sixty-four feet in a mile and a quarter and an average breadth of 310 feet; to Williamson, Sprague and Lost rivers; to the hot and cold mineral and non-mineral springs; to rivers which in great volume rise from and disappear into the earth; to the lava beds, and to the magnificent fertile plains where wheat is grown in abundance at an elevation of over 4,000 feet; but these and many other features must be passed over or barely mentioned.

The Oregon Caves.

Scarcely less wonderful than the mysterious Crater lake are the caverns of the Oregon mountains. The Josephine county caves, about thirty miles from the railroad southwest of Grant pass, will be found when thoroughly explored, it is believed by those who know most about them, to be as extensive and wonderful as is the Mammoth cave of Kentucky. These caves were discovered but a few years ago by a hunter named Elijah Davidson, who followed a bear to its lair in the lower cave. The entrance to each of the caves, one located higher in the mountain than the other, is about eight feet wide and seven feet high. They contain a great number of wonderful avenues, said to be miles in length, besides large numbers of chambers, grottoes, lakes, abysses and cataracts, and also innumerable chambers, large and small. The first chamber is ten feet in height. One, called "The Devil's Banquet Hall," is 150 feet in length by 75 feet in width and 60 feet in height. Its roof and walls are brilliant with hundreds of scintillating stalactites. The only exploration of these wonderful caverns has been by private parties. A thorough, scientific exploration should be made at an early day, and it is my intention to ask an appropriation from the next Congress for such purpose.

The Great Wheat-producing Inland Empire.

The vast fertile grain-producing valleys of Oregon are the Willamette, the Rogue river, the Umpqua, and that portion of what is known as the "great Inland Empire" which lies in eastern Oregon. The Willamette extends from Portland to the Calipooia mountains, 30 miles south of Eugene, a distance of over 150 miles in length by an average of 75 miles in width. This valley is famed as one of the most fertile and productive in the world. There is scarcely an acre of waste land in this vast area of 12,000 square miles. It is a great Miocene basin; fossils of the Miocene age are found there in abundance. The greater portion of it is under improvement, but much of it is held in large tracts of 640 acres, being the donations made to settlers by the act of Congress of September 27, 1850. Nearly the whole of it is well watered by streams, a very small proportion requiring irrigation. It produces wheat, oats, barley, corn, all kinds of vegetables, and fruits in abundance. The Willamette valley is alone capable of sustaining a population of 5,000,000 souls, and even then the population would be but a fraction in excess that of Belgium to the square mile, and less than that of England by 102 to the square mile. The productive capacity of the Inland Empire in eastern Oregon is something wonderful. Thirty years ago not a bushel of wheat was raised in that entire empire, although across the line near Walla Walla some 300 bushels of wheat were raised by Dr Whitman at his mission in 1841; Commodore Wilkes, a portion of whose party visited this mission in that year, so reports. Twenty years ago the coming fall I left the Central Pacific railroad near Salt Lake and journeyed westward through northern Utah and eastern Oregon. The first wheat of any importance was grown in eastern Oregon that year. There was a three-acre lot located near where the town of Weston, Umatilla county, now is and immediately outside the boundaries of the Umatilla Indian reservation. The crop had been taken off before my arrival. The wheat stubble being so abundant, I was amazed and expressed surprise to my host, with whom I remained over night, that there should be such a fertile spot in this vast desert, as the whole country seemed to me to be little less than a desert. He smiled and replied that the tract on which this wheat had grown was the same character as land of the whole surrounding country, including the greater portion of the Umatilla Indian reservation. I obtained a sack and immediately outside of the field, digging down some 6 or 8 inches, filled it with a peck of soil. I brought it with me to Washington; took it to the late Professor Henry, then Secretary of the Smithsonian Institution, and requested that he analyze it and tell me its properties and what good for. He inquired, "Where did you get this soil?" I replied, "West of the Rocky mountains." Professor Henry remarked, "That is rather indefinite." "But Professor," said I, "I shall not tell you whether it came from California, Oregon, the Willamette valley or the top of mount Hood." He made me a very interesting report, in which it was stated that he regarded the soil as the best wheat-producing soil he had ever examined; that it contained properties very similar to the soil of Sicily, where wheat had been raised for 2,000 years without exhausting the soil. The report further stated that the soil was of such character that it would fertilize itself as cultivated; that it would not be necessary to let it rest after a crop or two, as in many portions of the country, or to fertilize it. The predictions made in that report have been amply verified. Two years ago I visited Umatilla county and what was formerly the Umatilla Indian reservation, and was told that there had been raised and harvested that year in that county alone over 4,500,000 bushels of wheat. That this single county will produce 5,000,000 bushels of the best quality of wheat the present year, or an amount considerably more than was produced in 1893 in any one of twenty-one different states in the Union, I have not the slightest doubt.

In addition, it is estimated that there will be shipped the present year from the city of Pendleton, the county seat of Umatilla county, located on the transcontinental railroad, 5,000,000 pounds of wool, while from The Dalles, the county seat of Wasco county, an equal quantity will be shipped. A large portion of the state, notably Umatilla, Union, and Baker counties, with several others in the eastern section, and Coos and Curry counties in the southwestern portion, are admirably adapted to sugar-beet culture. The beets grown here are said to yield a larger percentage of saccharine matter than those produced elsewhere; while 20 tons per acre is a moderate estimate of the annual crop.

The Forests of Oregon.

Another source of immense wealth in the state of Oregon is her forests. No state in the Union has a greater variety of valuable trees or fine woods. These include sugar pine and silver pine, cedar, red, yellow and white fir, redwood, and spruce of different varieties; ash, hemlock, maple, myrtle, white oak, laurel, alder, dogwood, wild cherry, hazel, chittamwood, and Oregon yew; three species of poplar—the quaking asp, cottonwood and balsam tree; live-oak and chestnut oak, nutmeg, tamarack, mountain mahogany, juniper, birch, box elder, and many other varieties. In addition, there are the vine maple, growing from

6 to 12 inches in diameter and from 12 to 30 feet in height; the Oregon crab-apple, which grows in groves, making the forest impenetrable for man or beast; and many other varieties. The Oregon cedar grows to an immense size. It is no uncommon thing in the forests of Tillamook and Coos counties, on the coast, to find vast forests of these trees 10 to 12 and very often 15 feet in diameter and from 200 to 250 feet in height. The Oregon sugar-pine grows to 250 feet in height, bearing cones from 12 to 18 inches in length. The mills of Oregon manufacture over 250,000,000 feet of lumber annually.

Game.

The forests of the state are filled with all kinds of game, including bear, elk, deer, grouse, prairie-chicken, pheasants, Chinese or Denny pheasants (a most delicious game bird, introduced from China by Honorable O. N. Denny, of Oregon, while United States consul-general at Shanghai), quail, and other varieties of game birds. The rivers and lakes are, during the summer, filled with game fowl, including canvas-back, and teal of excellent quality.

The Precious and other Metals.

No state in the Union is more highly favored in natural endowments than Oregon. Her resources, developed and undeveloped, are almost as varied as are the gifts of nature, and their value cannot be estimated. Her mines, though only partially developed, are rich in the precious metals, as also in iron, coal, nickel, copper, cinnabar, asbestos, tin, marble, onyx, limestone, sandstone, granite, and dolomite. A recent writer on the geologic formations of Oregon remarks that "the igneous rocks of southern Oregon are said to contain all the zeolitic minerals, and some geologists believe precious gems of no small worth."

Already more than $25,000,000 in gold have been taken from the placer mines in two counties in the state—Jackson and Josephine, in southern Oregon. Eastern Oregon is rapidly developing into a great gold and silver producing region. Capital only is required to make it one of the most valuable mineral fields on the Pacific coast.

Oregon has an abundance of the very best quality of iron ore. Clackamas county in particular abounds in this mineral. Extensive iron works are in progress at Oswego, in that county, located on the Willamette river 18 miles from its mouth and 7 miles from Portland, and large amounts of pig-iron are produced annually.

Grains and Fruits; Rivers, Harbors, Railroads, etc.

The resources of Oregon are not confined to her mountains or her rivers. Her valleys are fertility itself. Wheat, oats, corn, barley, hops, flax, hay and other grains and grasses; apples, pears, peaches, apricots, plums, prunes, cherries, nectarines, grapes and other varieties of small fruits and berries, are all products of her soil. The natural advantages of the state are all that could be desired. A seacoast of more than 400 miles, indented with numerous capacious bays and storm-protected deep-water harbors; the Columbia, the Tillamook, the Nehalem, the Yaquina, the Alsea, the Siuslaw, the Umpqua, the Coquille, Coos bay and port Orford, capacious enough to protect in safety all the navies of the world; a mighty river on its north draining a basin of 395,000 square miles, including its tributaries, which combine twelve degrees of latitude and thirteen of longitude. The main Columbia is navigable 725 miles from its mouth, with two interruptions—the first at the Cascades, 150 miles from the mouth, where there is a fall of 300 feet in four miles and where a canal and locks, being constructed by the general government, will be completed in the present year; and another at The Dalles of twelve miles, where the general government has taken steps looking to the construction of a boat railway. Willamette river is navigable for 140 miles; the Snake for 150 miles. The falls of the Willamette at Oregon City are estimated at 1,000,000 horse power; the fall is forty feet. Here a great electric plant has been established within the past two years at an expenditure of several millions of dollars, and this vast water power is being utilized in Oregon City and in Portland, twelve miles distant, in manufactories of various kinds and in electric lighting.

The Salmon Fisheries of Columbia River.

The salmon fisheries of Columbia river are the most extensive and profitable in the world, and a source of immense wealth. It is but thirty-three years since the first fishery for catching and barreling salmon was established there, and not until 1867 was the first fish cannery erected, the purpose of the latter being to preserve salmon in cans—fresh, spiced and pickled. There are today some thirty-eight canneries on Columbia river, in which are invested more than $5,000,000 capital. More than 4,000 men are employed during the fishing season. Canned salmon are shipped by rail across the continent and by ships to all parts of the world. A cargo frequently is valued at a quarter of a million dollars, and single cargoes have gone out occasionally of the value of over $300,000. The salmon season commences in May and ends in August. The fish are caught mainly by drift gill-nets ranging in length from 120 feet to 600 feet. Many salmon are also taken by traps and fish-wheels.

In the single year 1880, 538,587 cases of salmon were canned on Columbia river, having an export value of $2,650,000. The average salmon weighs about twenty pounds, and they are packed three to a case, making a catch that year of about 1,600,000 salmon.

Salmon is by no means the only food-fish produced in large numbers in Columbia river. Sturgeon, flounder, smelt, tomcod, and salmon trout exist in abundance, and within the last few years shad weighing from three to four pounds have been plentiful. Other waters in the state of Oregon are full of salmon, Salmon fisheries are carried on extensively in Tillamook bay. Nehalem bay, Nestucca bay, in northwestern Oregon, and in the Rogue, Siuslaw, Coquille and other rivers in central and southwestern Oregon.

Dairy Interests.

Several of the coast counties, especially Clatsop, Tillamook, Columbia, Douglass, Coos and Curry, in addition to their extensive and valuable lumber interests, and in some cases, notably Clatsop, Columbia, Tillamook and Coos, their valuable coal deposits, are especially well adapted to dairying, and immense quantities of butter and cheese are annually produced.

Railroad Facilities.

In addition to the great facilities resulting from grand navigable water-courses and capacious coast harbors, with which Oregon is so bountifully blessed, the state is now no longer isolated by reason of lack of railroad transportation facilities. The city of Portland, the metropolis of the state, with a present population of more than 80,000 people and an annual trade of over $140,000,000, is the western terminus of five transcontinental railroads—the Southern Pacific, the Union Pacific in connection with the Oregon Short Line and the line of the Oregon Railway and Navigation Company, the Northern Pacific, the Great Northern, and the Canadian Pacific; besides these, several state railroads center here. In addition to this, the city of Portland is the head of ship navigation on the waters of the Columbia, located on the Willamette river 12 miles from its mouth, and to which ships of all nations, of whatever draught, steam and sail, come and go without interruption. The great warships of the navy, the *Baltimore*, the *Chicago* and the *Monterey*, have all been in her harbor within the past two years. But not only so, there are regular lines of first-class ocean steamers running weekly between San Francisco, California, and Yaquina bay, Oregon, connecting with the Oregon Pacific railroad, a first-class full-gauge road, now constructed and running regularly from Yaquina bay eastward across the entire Willamette valley, and which, I am credibly advised, will within the present year be extended to a transcontinental connection. Another line of steamers plies weekly between San Francisco and Coos bay, Oregon. A railroad is now under construction connecting Astoria, Oregon, with Portland and the great transcontinental lines of railroad. Other lines of railroad are being projected and built in Oregon, one connecting the valleys of the Willamette, Umpqua and Rogue rivers with the waters of Coos bay on the Pacific ocean. The interior cities and towns of eastern Oregon are rapidly being connected with branch lines. This has already been done as to Weston, Athena, Heppmer and other important points.

Demand for the Nicaragua Canal.

The people of Oregon, although blessed with innumerable blessings and endowed with commercial advantages not common to states and people generally, nevertheless are in want of one thing. We want, our interests demand, and we must and will have at no distant day, a ship canal crossing the isthmus of Nicaragua. The interests not only of Oregon, but of the Pacific coast, of the whole nation, and of all the civilized nations of the globe demand it. With one voice and with no uncertain sound should the people of all the commercial and civilized nations of the earth demand the speedy construction of this great work, so absolutely essential to the commercial necessities of the age and the proper advancement and promotion of the enlightened civilization of the century in which we live. We of the Pacific coast are no longer unimportant factors in the trade and commerce of the world. When Dr Marcus Whitman crossed the continent in 1842–'43 to save Oregon to the union, the trade of the Pacific coast with foreign or domestic ports amounted to nothing. To-day our trade with Great Britain, France, Germany, Belgium, Cuba and Brazil, to say nothing of our trade with China, Japan and the Sandwich islands, amounts in value to more than $45,000,000 annually. Give us the Nicaragua canal and we will then stand erect in every element which constitutes independent commercial supremacy. Capable of meeting every home want of whatever nature, we become at once and forever a formidable competitor for our surplus products, not only in the home market, but in all the markets of the world.

Conclusion.

In conclusion, I cannot better personify the state of Oregon than by employing the language of that gifted writer, the author of "Atlantis Arisen." She said:

> "I know how, if I were a painter, I should personify the young giant Oregon. Lithe, strong, beautiful should he be, with Empire written on his brow and power tempered by mildness beaming from his eyes. Of fair complexion he, with tawny, blonde hair and curly, golden beard. His robe should be of royal purple, embroidered with wheat ears, and his crown of tarnished gold. His throne should be among the rugged mountains, with a lake at his feet, rolling yellow plains on one hand and smiling green valleys on the other. His sceptre, shaped like the tapering pine, should be of silver, set with opals, emeralds and diamonds. On his right should roll the magnificent Columbia, to which ships in the distance should seek entrance, and over his shoulder the white crest of mount Hood stand blushing in a rosy sunset."

The names and memories of the brave pioneer men and women who laid the foundations of empire in the wilds of Oregon deserve to be forever perpetuated, not only in their country's history, but in the reverential hearts and minds of the people of the present and all future generations. There is something strangely dramatic, as also sublimely pathetic, in the strange scene of hundreds of men, with their wives and little ones, bidding farewell to friends, to home, to civilization, and starting on a journey with ox-teams a distance of 3,000 miles across a trackless waste, and over rugged, unexplored mountains, the way obstructed by numberless bridgeless rivers, yawning, desolate canyons and parched repellent deserts, with a view of establishing new homes amid all the perils incident to a wilderness inhabited only by savage men and beasts. Many of these brave men and women never lived to reach their destination, but fell by the wayside, like Hervey's ships, "that sailed for sunny isles, but never came to shore." But, leaving the lonely grave of the loved one in the desert, the body soon to be devoured by the hungry wolf of the plain, the brave column of survivors, sustained by Wordsworth's "amaranthine flower of faith," and, in the language of Milton, "finding new hope springing out of despair," moved on and on, and although, in the words of Southey, "no station is in view nor palm grove islanded amid the waste," they still press on and on, over burning deserts and trackless mountain steeps, until at last they rest in the cooling shades of "the continuous woods where rolls the Oregon."

As a factor in the civilization of America and of the age in which we live, Oregon as a state challenges attention. Civilization over two hundred years ago marshalled its battalions and took up its line of march in the Orient. Gathering strength with the steady advance of its conquering column, the tread of its victorious legions among the mountains and over the plains of the distant west signaled the rapid approach of the builders of empire; and though beauteous in its infancy, grand in the clear light of the Orient in the early morn of its existence, may we not expect that the state of Oregon will realize its grandest achievements amid the glories of accumulated splendor in the distant Occident?

It was truly a grand conception, a sublime thought, inspired by an almost supernatural prescience on the part of Coleridge when, more than half a century ago, he in his "Table Talk" gave utterance to this sentence:

"The possible destiny of the United States of America, as a nation of an hundred million of freemen, stretching from the Atlantic to the Pacific, living under the laws of Alfred and speaking the language of Shakespeare and Milton, is an august conception.

The time is rapidly approaching when more than one hundred millions of freemen, breathing the pure air of liberty, inspired by one common sentiment of patriotism, sharing the blessings of a free country, upholding one flag, respecting and abiding by the same code of laws, honoring and revering the memories of the men who laid the foundations of the Republic, loving the same country and worshiping the same God, shall fill this great land from sea to sea with the glad anthems of a free, courageous, independent and happy people.

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