ELISHA HANSON

Smithsonian Institution
Libraries

Given in memory of
Elisha Hanson
by
Letitia Armistead Hanson

G
1
N27
NH

THE NATIONAL GEOGRAPHIC MAGAZINE

AN ILLUSTRATED MONTHLY

EDITOR: JOHN HYDE

ASSOCIATE EDITORS

A. W. GREELY W J McGEE HENRY GANNETT

C. HART MERRIAM ELIZA RUHAMAH SCIDMORE

VOL. VIII—YEAR 1897

WASHINGTON

THE NATIONAL GEOGRAPHIC SOCIETY

1897

SMITHSONIAN

NOV 5 1981

LIBRARIES

WASHINGTON, D. C.
JUDD & DETWEILER, PRINTERS
1897

CONTENTS

ILLUSTRATIONS

The National Geographic Magazine

AN ILLUSTRATED MONTHLY

Honorary Editor: JOHN HYDE

Honorary Associate Editors

A. W. GREELY W J McGEE HENRY GANNETT
C. HART MERRIAM ELIZA RUHAMAH SCIDMORE

CONTENTS

WASHINGTON
PUBLISHED BY THE NATIONAL GEOGRAPHIC SOCIETY

AGENTS IN THE UNITED STATES AND CANADA
THE AMERICAN NEWS COMPANY, 39 AND 41 CHAMBERS STREET, NEW YORK
PARIS: BRENTANOS, 37 AVENUE DE L'OPERA

Price 25 Cents $2.50 a Year

Entered at the Post-office in Washington, D. C., as Second-class Mail Matter

THE

National Geographic Society

ORGANIZED, JANUARY, 1888

PRESIDENT

GARDINER G. HUBBARD

VICE-PRESIDENTS

MARCUS BAKER
WILLIAM H. DALL
G. K. GILBERT
A. W. GREELY
C. HART MERRIAM
HERBERT G. OGDEN

TREASURER

CHARLES J. BELL

RECORDING SECRETARY

EVERETT HAYDEN

CORRESPONDING SECRETARY

HENRY GANNETT

MANAGERS

H. F. BLOUNT
C. W. DABNEY, JR.
DAVID T. DAY
JOHN HYDE
W J McGEE
F. H. NEWELL
W. B. POWELL
J. B. WIGHT

SECRETARY'S OFFICE, 1517 H STREET N. W., WASHINGTON

The National Geographic Society, the object of which is the increase and diffusion of geographic knowledge, has a paying membership of 1,400. Its membership is not restricted to practical geographers, but is open to any person in good standing who may be sufficiently interested in its work to seek admission. The annual subscription is: for active members, $5.00 per annum; for corresponding members, $2.00 per annum. Active members pay also an entrance fee of $2.00 on election. THE NATIONAL GEOGRAPHIC MAGAZINE is sent regularly to all members, both active and corresponding.

Donations for the founding of Prize Medals and Scholarships are respectfully solicited.

THE

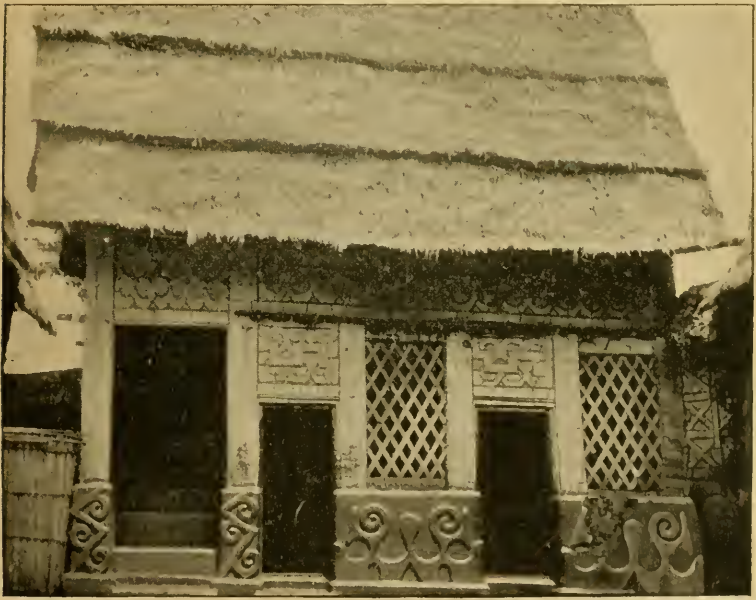
National Geographic Magazine

Vol. VIII JANUARY, 1897 No. 1

THE GOLD COAST, ASHANTI, AND KUMASSI

By George K. French

The Guinea coast lies between the southern boundary of Sierra Leone and the delta of the tortuous Niger, in West Africa. It is a part of Africa that abounds in dark tradition and tragedy, and romance has never dared to trespass on its forbidding shore or penetrate its deadly swamps and jungle. It is a place where



ONE OF THE HUTS OF KING PREMPEH'S PALACE

From a photograph by George K. French

the fiercest and most selfish passions of man, white and black, have vented themselves for four centuries. The white slaver came here for his merchandise, the black slave-owner ashore supplied the trade, and if his barracoons were empty when a cargo was needed, a quantity of trade goods—rum, gin, cloth, and trinkets—accomplished his purpose in a moment. It was in very truth a survival of the stronger, and one native was as eager to sell his brother as he was to collect his pay from the native procureur.

The old Grain coast is comprised within the Republic of Liberia, while the Ivory coast, now French territory, is adjacent on the southeast. The Slave coast extends from the Niger some 200 miles west to the Gold coast, the latter section of the Guinea coast lying between the old Ivory and Slave coasts. A hundred years ago these distinctive names were applied by all geographers, but today only the Gold coast is to be found on our maps. Three hundred and fifty miles of the latter coast belong to Great Britain, while the interior borders of the colony, of which this sea-coast forms one boundary, stretch away toward the north as far as the Ashanti country. Since the recent taking of Kumassi and the downfall of the Ashanti confederation the hinterland of the colony has been extended 100 miles further to the north.

Between the eastern and the western boundaries of the Gold coast the view presented from the sea is varied and picturesque. The shore is often girt with great rocks over which the surf breaks with tremendous force; again, a sandy beach, fringed with tall, spectral palms, which stand like mute sentinels guarding the approach to the forlorn shore, separates the ocean from salt lagoons and swamps of immense area, while in places the mouths of rivers reveal themselves by the presence of dangerous bars, over which the waters boil and seethe, affording fair warning of their existence to anxious mariners. The villages of the natives are discernible at frequent intervals, and a fair appreciation of architectural taste is evinced in the construction of their huts. Rectangular houses of swish, or adobe, sometimes with a second story, take the place of the rude huts of the Grain and Ivory coasts, and among these are interspersed the more pretentious residences of European traders, and forts which have been erected from time to time during the past four centuries.

As early as the middle of the fourteenth century the Gold coast was known to the European world, but not until 1471, when the Portuguese navigators, Juan de Santarem and Pedro Escobar touched at a point on the coast which they called Oro de la Mina, was there any definite knowledge concerning it. In 1481 a large fort was erected at Oro de la Mina, or Elmina, as it is now called, by the Portuguese, and it stands today in an excellent state of preservation. The Dutch captured it in 1637, and held it until 1872, when it was transferred to the British. Other stations on the Gold coast, established between the end of the fifteenth and the middle of the present centuries by the Portuguese, Spanish, Danes, French, Dutch, and Brandenburgers, have finally become British possessions either by conquest or purchase.

Cape Coast Castle is eight miles east of Elmina. While the latter was under Dutch control it was the port of the Ashanti country, but since the expedition against King Kwofi in 1873–74, when a road through the dense forest was constructed to Kumassi

MILITARY ROAD FROM CAPE COAST CASTLE TO KUMASSI

From a photograph by George K. French

from Cape Coast Castle, the trade has followed this route, and thus the latter place has developed into a town of some commercial importance. Palm-oil, palm-kernels, ginger, gold-dust, mahogany, monkey skins, camwood, and rubber are exported in enormous quantities to England and the European continent from this port in exchange for rum, gin, cloth, trinkets, and other articles of European manufacture. The castle from which this last-named town takes its name was built by the Portuguese and taken by the Dutch in the seventeenth century, but since 1666 it has been a British possession. It is a spacious, strongly fortified, stone building, and back of it at a distance of two miles rise a series of heavily timbered hills, which have an altitude of eight or nine hundred feet. Between the fort and these hills lies the town. Akkra. the seat of government of the Gold Coast colony, is about sixty miles east of Cape Coast Castle. There are numerous smaller towns and trading posts along the coast, but their European population is limited to two or three traders and an occasional missionary.

The shore is difficult of access, as is the case along the entire Guinea coast; sand-bars block the mouths of rivers, and harbors are lacking; consequently passengers and cargo are discharged in boats through a heavy surf on a frequently dangerous beach, and many a human life and many a ton of valuable merchandise have been lost in the effort to effect a landing. These surf-boats are English built, of heavy timber, are twenty-eight feet long, six feet beam, and have long, overlapping bow and stern in order that they may surmount and not cut the breakers. A boat's crew is made up of eleven men and a coxswain. The latter steers with an ordinary long-bladed, straight oar or sweep, while the crew sit on the gunwales of the boat and propel it with paddles, the blades of which are fashioned not unlike a trident. The crew are almost naked, a loin cloth being the only attempt at clothing. They sing lustily while paddling, bestowing fulsome praise on the particular individual who has engaged them, and chanting vigorously of the amount of "dash," equivalent to the "bakshish" of the East, which he will probably shower upon them when they have landed him in safety.

The population of the Gold Coast colony, excluding the tribes of the Ashanti confederation, is roughly estimated at 2,000,000, of whom only about 150 are Europeans. There are many different tribes of natives, speaking various languages or dialects, but all belonging to the negro race. The tribes of the Fanti confederation, who line the coast from Elmina to Akkra, deserve special mention as having from time immemorial been brought into close contact with the British. Of the natives who have migrated to the colony within the last fifty years, the most important are the Mohammedan Haussas, from the Niger districts of the interior, who man the ranks of the military police, and the Krumen, from the coast to the west. The latter are a most useful element, but are somewhat unstable, as they invariably return to the Kru coast as soon as they have earned a small competence. Most of the natives are still pagans, but the presence of Christian missionaries among them for the last fifty years has at least resulted in their modifying their fetich worship and savage rites. The Mohammedans on the Gold coast are, with the exception of the Haussas, mainly traders, and they are found in the larger settlements on the coast and along the trade routes of the interior.

The Fantis are an inoffensive, peace-loving, happy-hearted race, who readily succumbed to European aggression, but have been exceedingly loth to accept its civilization and Christianity. In common with the other natives of West Africa, with the exception of the Haussas and the Krumen, the Fanti is shiftless and will work only when it is absolutely necessary. Centuries of life without a want that nature did not lavishly supply have quite spoiled him for the advantages of civilization and its accompanying responsibilities, and it is no easy task to convert him to the ways of European life; yet he is tractable and readily governed, and the colonial official and trader find no great difficulty in utilizing him for many purposes. He has a full appreciation of justice, is honest, hospitable to strangers who approach him for no evil purpose, and has an absolute faith in the superior beauties and advantages of Fantiland, though to the white man it seems the dreariest and most hopeless place in the world, and official statistics prove it to be the most deadly spot on the face of the earth for the foreigner of every nationality. In the year 1895, for instance, the average European population of Cape Coast Castle was thirty-two. Of these, seventeen died during the first two months of the year from the malignant fevers which plague the coast at all seasons. It is true that, as a British colonial report apologetically states, it was a bad season on the coast, but the figures for every other year show an appalling death-rate among Europeans at all stations on the Slave and Gold coasts. So far as can be judged from imperfect statistics, the Grain coast and the British colonies of Sierra Leone and the Gambia, and also the region between the Niger delta and the mouth of the Kongo, are by comparison less deadly, but this is indeed faint praise.

The stranger visiting the Gold coast will at first be sorely puzzled by the similarity of the names of the natives. Every child takes its surname from the week-day of its birth, and strangers theirs from the day of their arrival, with an additional sobriquet descriptive of some personal peculiarity. For instance, a child born on Wednesday receives the name of that day of the week, Kwako. Kwábina (Tuesday) and Kwako are held to be "strong days" of birth; but children that appear on Fridays, Saturdays, and Mondays are considered "weak as water." Nothing will induce the Fanti to sleep with his head toward the sea or to take possession of a new dwelling-house on a Tuesday or Friday, both these days being regarded as unlucky for this purpose. Paternal affection and filial love apparently do not exist. The mother nurses her child for one or two years, and then it must shift for itself. There is no appearance of affection even between husbands and wives, or between parents and children; and Duncan, an English traveler who visited the Gold coast fifty years ago, states that many parents offered to sell him their sons or daughters as slaves.

In common with many other natives of Africa, the Fanti lives in close communion with the vague and mysterious beings of the unseen world. A large proportion of his time is spent in consulting or appeasing the deities that inhabit the earth, the air, the sea, the rivers, and even trees, sticks, stones, and bits of cloth. If he is ill, he believes that his ancestors are summoning him, and he at once proceeds to consult the fetichman. The latter is given a fee and is requested to present the sick man's excuses to the expectant shades. These fetich priests generally exercise great influence over their superstitious fellows. Sometimes the departed is supposed to have returned to earth in the body of a child, and yet remaining in Deadland, thus giving rise to the assertion by some travelers that the doctrine of metempsychosis obtains among the Fantis. They bury their dead in their houses, choosing a room that can afterward be kept fastened up or secluded. This custom the colonial authorities have attempted to abolish on sanitary grounds, but the effort has not wholly succeeded. So much homage did the Egyptians pay to their dead, that it was said that they lived in Hades, rather than on the

THE KING OF ELMINA AND HIS COURT

From a photograph by Skues, Cape Coast Castle

banks of the Nile. So is it with the Fantis; constant sacrifices must be made to appease the departed and to remind them that they are not forgotten; and it is part of the Fanti belief that unless the custom is religiously observed the shade will wander on the banks of the Sacred Prah for the space of a hundred years before it has performed sufficient penace for its friends' neglect. Abonsam and Sasabonsam are the two great deities conjured up by the Fantis. The former controls the wicked in the land of shades, while the latter has his domicile on earth. Death is a matter of much moment, and extravagant "customs" are held and heavy expenses incurred by the deceased's relatives in order to satisfy the demands of the shade, these orgies frequently being repeated at intervals in order to "lay the ghost" in case it becomes restive. The rumbling of thunder is supposed to be the voice of the dead demanding propitiation and sacrifice, and lightning as the direct infliction of the evil spirit on the person or object struck. Mourning is evidenced by shaving the head for a certain period, and this is accomplished by bits of jagged stone or broken bottles.

There was a time when the Fantis were the most powerful tribe of the Gold coast, but during the last century they have suffered so many crushing defeats from the Ashantis that they have lost their national spirit, and are regarded both by the British and by their hereditary enemies as arrant cowards. Land is held by individuals and families in severalty under well recognized rules, but boundary disputes are frequent, and are generally determined by the memory of the oldest inhabitants. The Fantis are good artisans and make musical instruments (instruments of torture they seem to the white man's ear), and iron implements for agricultural purposes, and they weave handsome cloths in narrow strips, which are sewn together so as to make them of any size required. Children go naked up to their ninth or tenth year. Men of the upper and middle classes wear robes of Manchester cotton, in exactly the same manner as the Romans wore the toga. Married women expose the upper half of the body and wear capacious cloths, which are deftly fastened about the waist and hang below the knees. Maidens cover the breast, and are much given to personal adornment.

As the shore is difficult of access from the sea, so Kumassi and the interior are difficult of access from the coast. The country lies in the forest belt of the continent, and the white man travels with difficulty. The native can wend his way along the narrow path, sleeping wherever nightfall may find him, and eating from his own supply of kenke, fûful, or plantain. But the white man must provide himself with hammockmen, if he would spare himself, and carriers to transport his food supplies and paraphernalia; in fact, the necessary preparations for a trip of a few hundred miles through the average African hinterland are quite as extensive as for a trip around the world by the regular routes of travel. For a week after landing at Cape Coast Castle in January of last year, I devoted my entire time to engaging carriers, hammockmen, and attendants. In this I was assisted by a Fanti youth of sixteen years, Amoah by name, who spoke fair English and a dozen native dialects in addition to his own tongue. His grandfather, a great war chief, enjoyed a pension of seven pounds a month from the British government for services rendered the colony in the Ashanti war of 1873–74, and this distinction gave Amoah superlative standing both in his own estimation and that of his friends.

The distance from Cape Coast Castle to Kumassi is 142 miles, and I pursued the identical route taken by the expedition of 1874 under Sir Garnet Wolseley. Prahsu, a town of not less than 10,000 inhabitants, is situated on the Prah river, 72 miles from the coast, and this I reached at the end of ten days. The road from the coast to this point has been through the Assin country, a veritable wilderness of swamp and virgin forest, the monotony of which was broken only by great bamboo groves and by stagnant pools of fetid water. Villages of from 50 to 500 huts were passed at intervals of a few miles, and in all of them the inhabitants proved hospitable and honest. The Prah, which forms the southern boundary of the Ashanti country, is an insignificant stream whose course is frequently interrupted by rapids and shoals. In the dry season it is navigable only a short distance from its mouth, near Chama, 30 miles west of Cape Coast Castle. As water is a precious commodity on the Gold coast, particularly during the dry season, the natives have imposed the term "sacred" upon it, although it may have been in deference to the particular god which makes its habitat therein.

The path from Prahsu to Kumassi threads its way through the Adansai country. For days at a time the light of the sun never pierces the gloomy forest, and, although the traveler is thus protected from the fierce tropical heat, the damp atmosphere is most depressing. Forty miles south of Kumassi is the Monse or Adansai hill. Stanley, in 1873, roughly estimated its altitude at 1,600 feet, but recent observations determine it to be but 700. It is an abrupt elevation, and a hundred Ashantis with modern guns could easily repulse ten thousand adversaries from its rugged slopes and passes. On our fourteenth day out from the coast a small Ashanti village, within four miles of Kumassi, was reached. My carriers insisted upon stopping here for an hour in order to prepare for an imposing entry into the capital of the Ashanti kingdom. When we resumed our journey we found the physical features of the country changing rapidly. The forest had disappeared, and we passed along a narrow road, lined on either side with tall plantains and bananas, until we emerged into an open plain covered with stubble. Over this plain our path led for some two hundred yards, until the edge of the swamp which surrounds Kumassi was touched. A corduroy road made this easy of passage, and we soon found ourselves marching up a slight incline that broadened into a wide street or avenue which, as we afterward learned, was the main street of Kumassi. The first glimpse was disappointing. Travelers, from Bowditch to Winwood Reade, have described Kumassi as a city of pretentious houses, possessing a stone palace wherein the king lived in

ASHANTI WOMEN

From a photograph by Skues, Cape Coast Castle

great splendor, and containing a population variously estimated at from 40,000 to 100,000. But the first view convinced me that, whatever Kumassi may have been in the past, it was now but a poorly built town of a few thousand huts. Later and more careful observations confirmed me in this estimate.

Some writers assert that the Fantis and Ashantis originally occupied the country south of the Kong mountains, near the great bend of the upper Niger. The Mohammedan tribes drove them south as far as the coast, where they were forced to stop. As the two peoples undoubtedly sprang from the same stock, the natural boundaries of rivers and hills, among other causes unknown to African history, were probably the first dividing lines in their development as separate nations. The languages of both are derived from the Tshi tongue and differ in only a few words and idioms. Their customs, folk-lore and legends, supernatural deities and fetich worship, dress, and physical characteristics are almost the same, but the Fanti, through the civilizing influence of his contact with Europeans, extending over four centuries, has abandoned many of the savage practices which still obtain among the Ashantis.

For three centuries Ashanti has maintained its existence as a confederation of powerful tribes, acknowledging as its only rival the neighboring kingdom of Dahomey. From the beginning of the seventeenth century down to the present time its history is replete with bloody wars and mercenary incursions on weaker tribes, and among the latter the Fantis have felt its merciless heel only too often. Great Britain has during the present century sent five expeditions against Ashanti, and, with the exception of the last one, with but little success. In 1824 Sir Charles McCarthy, governor-general of the British possessions on the Gold coast, led a large force of loyal natives as far north as Mansu, where the Ashantis gave battle. Sir Charles and his officers were captured and put to death, their bones being distributed among the Ashanti chiefs and sub-chiefs as talismans. Between 1824 and 1873 two other expeditions were dispatched against the Ashantis by Great Britain, but both of them were driven back to the coast. In 1874, however, Sir Garnet Wolseley marched straight into Kumassi at the head of only 1,400 troops, among whom were the 42d Highlanders, the famous "Black Watch" of the Indian mutiny; but, although Kumassi was sacked and burned, the expedition accomplished little beyond inspiring the natives with a high opinion of British valor.

ASHANTI CHILDREN

From a photograph by George K. French

A ROYAL PROGRESS IN WEST AFRICA — THE KING OF DADIASSI

From a photograph by George K. French

Toward the end of 1895 the once powerful Ashanti confederation had become greatly weakened by the open secession or wavering loyalty of its constituent tribes. These were ten in number, namely, Beckwai. Daniassi, Kokofu, Nkoranza, Dadiassi, Juabin, Mampon, Nquanta, Nsuta, and Kumassi. Only three of these, the most remote from the coast to the north of Kumassi, were openly loyal to the King of Kumassi, who held the throne or golden stool and was called the King of Ashanti. The other kings were quite ready to secede from the confederation, the unity of which was now about to be attacked and destroyed by British arms, and they were anxiously awaiting overtures from the coast. Such was the pitiable and humiliating condition of the " Ruler of Heaven and Earth " at this time. Proud and arrogant to the last, although abandoned by most of his followers, King Prempeh calmly awaited the approach of the little band of British soldiers, led by Sir Francis Scott, from Cape Coast Castle. He was, however, only a weak and misguided tool of the savage Queen Mother and a dupe of dishonest advisers, and he offered no resistance to his seizure, with some forty of his courtiers, and his removal to the coast, where he is now imprisoned in Elmina castle. Thus Kumassi fell without the shedding of a drop of blood, though the deadly fever claimed its usual victims, among them being Prince Henry of Battenberg.

Kumassi is about three miles in circumference, oval in shape, and is surrounded by a noisome swamp. The main street runs north and south and is about a mile in length. It is less than thirty yards in width, and on either side are built the swish and thatch huts of the general aspect of those given in the accompanying illustration. Back of these two rows of huts are perhaps

DOMESTIC ARCHITECTURE OF KUMASSI

From a photograph by George K. French

three thousand other huts. Allowing six or seven inhabitants to each hut, the population may number, but can hardly exceed, 20,000. There seemed no regularity of direction or plan in the streets or passage-ways between the huts, and without a guide it would be difficult to find a given place. In the extreme southeastern part of Kumassi, adjacent to the swamp, is the king's palace. It consists of a hundred huts grouped within a stockade thirty feet high. This stockade gives way in places to the walls of two- and even three-storied huts, evidently erected under the direction of European captives. The decorations on the walls of the palace, both interior and exterior, are crudely worked in clay in faint bas-relief, and consist of grotesque figures of men and women, hybrids, with bodies of sheep, goats, elephants, snakes, deer, and leopards combined with heads and tails of monkeys, lizards, and alligators. On one hut I noticed the figure of a man holding in one hand a human head, evidently his own, as that member was missing from its proper place.

West of the main street and near its southern extremity is the Sacred Grove, so graphically described by Stanley and others, as it existed prior to 1874. Several hundred lofty cottonwood trees, scattered over a rectangular space four acres in area, thousands of bodies in all stages of decomposition and grinning skulls gleaming white from their resting-place, scores of vultures hovering above or perched on the limbs of the trees waiting for the next human sacrifice — such was the Sacred Grove at the beginning of 1896. Dynamite, however, had materially altered its appearance before I left Kumassi. The Great Executioner, an officer of high rank closely attached to the king's household, presided here in his gruesome work. While in recent years the practice of making human sacrifices in Kumassi has been greatly checked by European influences, the present executioner is chargeable with the taking of many thousands of human lives—a number variously estimated at from twenty to fifty thousand—during the thirty years of his tenure of office. Some time after the main body of the British expedition under Sir Francis Scott had returned to the coast the executioner was captured and held as a prisoner in Kumassi, the British authorities believing that he knew where the golden stool, the emblem of the king's office, was hidden. While he was thus detained I photographed him on several occasions, and the picture reproduced in this article is from the best of these.

On the return journey to the coast I diverged from the main route in order to visit the King of Beckwai. I found him living in pomp and splendor at the town of Beckwai, the population of which is about half that of Kumassi. It has no characteristics dissimilar to those of the latter place. Lake Busumakwe, carefully explored in February, 1896, by Major Donovan, of the British army, I spent two days in exploring, but found nothing that Major Donovan had not noticed.

It is unnecessary to trace the real reasons that impelled the British government to subjugate Ashanti and annex it to the Gold Coast colony. A careful study of the history of the colony and its relations with its savage neighbors will throw much light on the subject; but it is proper to assert that England's enlightened policy in other parts of Africa will undoubtedly be applied here and will result in the ultimate spread of civilization throughout this darkest part of the dark continent. In this connection it seems proper to call attention to a map of the "British Possessions in West Africa," published in November, 1895, by Stanford, of London, whereon, before the expedition had left England, Ashanti was presented as a part of the Gold Coast colony. The same map gives the Half Cape Mount river as the boundary line between the English colony of Sierra Leone and Liberia, whereas it should have been the Manoah river, 50 miles further north.

THE KING OF BECKWAI AND HIS COURT

From a photograph by George K. French

ALL AROUND THE BAY OF PASSAMAQUODDY

By Albert S. Gatschet,

Bureau of American Ethnology

Travelers coming from the south will find in the deeply indented coast lands of the state of Maine a type of landscape differing considerably from others previously noticed. Through the fiord-like character of Maine's tidewater section the water element everywhere blends in with *terra firma*, which alternately projects and recedes, and by the well-marked color contrast between the blue ocean and the green or somber-hued earth strikes our sight agreeably. The level shore lands of the southern Atlantic states are here replaced by hills, headlands, and capes of bolder outlines, partly clothed in the fainter green of northern vegetation, while other elevations exhibit the rocky, ocean-beaten foundation upon which they are built. The dark-hued pine and fir trees, which in other countries live in the mountains only, here descend to the sea-coast, enlivening the tops and sides of the numerous islands which lie scattered along the coast. The further we proceed northeastward along the coast, the more the scenery assumes a northern character. This is well evidenced by the spare vegetation and the thinness of the humus which we notice everywhere in and around Passamaquoddy bay, an extensive basin, the waters of which are fed by the majestic St Croix river from the north and by the St George or Megigadevic river from the east. The mainland encompasses this bay on all sides, fringing it with rock-bound promontories and some flat sand spits; only on the southeast side does it open toward the Atlantic ocean, and there a row of islands forms its limit and affords numerous passages suitable for navigation.

The elevations encircling the bay of Passamaquoddy, though bolder than those we see further south, are mostly flat-topped and of tame outlines. They are nearing an incline of 20 to 30 degrees, and therefore the local erosion through the impact of rain is not very considerable. None of the hills or islands in the bay rise above sea level more than about 300 feet. A feature that may be pertinently called the *headland shore* is prominent here.

Whenever a portion of the mainland or of one of the larger islands in this region advances toward the salt water it first sinks down, forming a depression, and then rises as a knoll or rounded hillock or hill before it plunges its rocky face abruptly into the ocean. These formations, appropriately termed *heads* or *headlands*, are frequent all around Passamaquoddy bay, Campobello island, Cobscook bay, and in many other sections of the Maine and New Brunswick coasts. Beaches filled with coarse gravel, the detritus of the rocky shores, form the transitory stage between the headlands and the more level promontories or *points*. Not infrequently one headland succeeds another in a line before reaching the water, and even after reaching the shore they reappear, jutting out from the briny element, two or three in succession, and lying in one continuous file. This I have observed, *e. g.*, on the north shore of Cobscook bay, west of Eastport, Maine. Campobello island, New Brunswick, is replete with "heads" on its far-extending shores, the island being eleven miles long from north to south; thus we have Bald head, Wilson head, East Quoddy head, Friar's head, Head harbor—whereas the term "point," less frequent there, appears in more numerous instances on the west side of the bay and up the St Croix river.

Two large *whirlpools*, perceptible in the channel of the St Croix river, are objects of great curiosity to the strangers visiting these parts. One of them occurs between Moose island and the southern end of Deer island, New Brunswick; the other, of minor proportions, lies two miles above, the river being over one mile wide at each place. They are carefully avoided by people passing, either in a white man's boat or in the Indians' canoe, for, like Charybdis of old, they are liable to capsize any small craft that ventures to come too near. They owe their existence not exclusively to the shock produced by the impact of the currents from the bay meeting those of the river, but also to the incoming tides and to a difference of temperature between the two bodies of water.

The air temperature is generally low on the bay and around it. Winter begins in October, and even at midsummer persons who are not provided with warm clothing will often feel a chill pervading their system when a sudden breeze breaks in from the north or a thick fog stays till noontime over the ever-moving waters. The weather is generally serene throughout the year, but nevertheless morning fogs are of frequent occurrence.

The Canadian Pacific is the only railroad company that brings visitors to the hospitable shores of Passamaquoddy bay, but there are numerous steamboats plying between St Andrews, St Stephen, Calais, and Eastport and the neighboring cities of St Johns, Bar Harbor, and Portland. Whether the tourist visits these parts for sightseeing or for restoring impaired health by the aid of their bracing sea-breezes, he is sure to take a peculiar interest in the native Indians, whom he sees peddling their neat baskets and toys along the streets, on steamboats, and on hotel verandas. But little attention is needed to scan the Indian among a crowd of people by his dusky complexion and a sort of nonchalance in his deportment. His appearance and habits show him to be a living and moving survival from prehistoric times.

The Passamaquoddy Indians of Maine constitute a portion of the northeastern or Abnáki group of the widespread Algonkinian stock, of which the ancient domain extended over a large area of the United States and Canada. The Abnáki Indians now surviving are divided into five sections, among which (1) the *Penobscots* in Oldtown are the nearest affinity in language and race to the (2) *St Francis Indians* of Canada; (3) the *Passamaquoddies*, whose nearest kinsmen are (4) the *Milicites*, or Etchemins (this is their Micmac name), scattered along the St Johns river, New Brunswick; (5) the *Micmacs*, settled in Nova Scotia and on the east coast of New Brunswick.

The present Passamaquoddies are about five hundred in number, and a large intermixture with white blood has taken place, which according to a safe estimate may amount to one-third of the tribe. In about the same proportion they have also preserved their Indian vernacular, which among its European loan words counts more of English than of French origin. Many of these natives exhibit unmistakably the full physical marks of Indian descent—the long, straight, and dark hair, the strong nasal bone, and a rather dark complexion. The cheek-bones are not very prominent. The majority of the tribe are slim-built and of a medium stature. They are not increasing, and their Indian congeners on the Penobscot river are positively on the decrease.

No central chief rules over these Indians now, but each of their three settlements in Maine has a sagum or elective governor. These settlements all lie on watercourses or on the seashore. The one nearest to Eastport is at Pleasant point, near the town of Perry; another is in a suburb of Calais, and a third one formerly lived upon Lewis island, but transferred its seats to the neighboring Peter Dana's point, near Princeton, on the Kennebassis river, about 42 miles north of Eastport. Fishing is one of their chief industries, but in this they now follow entirely the example set by the white man; they care nothing for agriculture, and their village at Pleasant point is built upon the rockiest and most unproductive ground that could have been selected. The same may be said of some other Indian settlements, for many Indians do not require any better soil to rest their houses upon.

The industries now forming their main support are the manufacture of toy boats from birch bark, of fishing canoes from the same material, of fans from ash-wood, and, chiefly, of ornamental and fancy baskets from the wood of the yellow ash. The baskets are made by the women, and during the summer season the men sell them in the markets, especially at the watering-places and in the commercial centers of the eastern states. The women display a high degree of taste in selecting their models for these tiny, elegant, and delicate art-products. The ash-wood is split into splints or blades of extreme thinness by machinery, seldom wider than an inch, then dyed in all possible, but always bright, colors. After this the splints are interlaced so as to form baskets of the most varied shapes. During the work of interlacing, blades of sweet-scented grass are inserted in the baskets, and thus "finished" they are sent to the stores with a fragrant odor, which clings to them for months and increases their salability.

The present area of the Passamaquoddy dialect is confined within a small district in Washington county, in southeastern Maine, and limited to the three settlements already mentioned. We may, however, add to it the area of the Milicite or "Broken language" dialect, which is heard in five or six Indian villages on the St Johns or Ulastuk river, in New Brunswick, and differs but little from Passamaquoddy. In former centuries these two dialectic areas were much more extensive, the proof of this resting in the spread of geographic names worded in Passamaquoddy over the whole of Washington and Hancock counties, a part of Aroostook county, Maine, and over the western part of the New Brunswick territory. Just as large as this historic area was that of the Penobscot dialect, for, as the local names still demonstrate, it embraced the whole Penobscot river basin, with the valleys of its numerous tributaries.

Inquiry into the signification of historic and actual geographic names of Indian origin has of late become popular among the educated classes of Americans. It is just twelve years since Charles Godfrey Leland encouraged those who might be able to accomplish the task to solve the riddles contained in the names of that country, most of which have a sound so musical and harmonious.* Long acquainted with the great historic value of

*The Century Magazine, New York, 1884, vol. 28, pp. 668–677, in Leland's article: "Legends of the Passamaquoddies."

topographic names, Leland's suggestion induced me, while studying the dialect, to listen to the opinions of capable Indians when I requested them to interpret a series of these names. Many interpretations thus obtained were so crude and ungrammatic that they could not be sustained for a moment; but the majority of those resting on a correct linguistic basis disclosed the fact that they are mostly compound nouns and combinations either of two substantives or of an adjective and a substantive, with the substantive standing last. In the first case, the noun standing first is sometimes connected with the noun standing second by the case-suffix *i*, as in Edu'ki m'ni'ku, *Deer island*, from ĕdúk, *deer*. The local names around the bay mostly refer to the watery element, for the terms *beach*, *sand-bar*, *cliff*, *rocky shore*, *island*, *headland*, *point*, *bay* and *cove*, *current* and *confluence* make up almost the whole terminology of the region. The frequent ending *-k* (-ăk, -ĭk, -ŏk, -ûk) sometimes marks the plural of a noun considered as animate, but more frequently it is the *locative case-ending* observed in all Algonkinian dialects under various forms. This case-suffix corresponds minutely to our prepositions *at*, *in*, *on*, *upon*, *at the place or spot of*. It also obtains in the Penobscot and Milicite dialects; but in the southwest corner of Maine occur a number of geographic names in *-et*, *-it*, *-ot*, which approximates the dialect in which they originate to that of Massachusetts and of Eliot's Bible. So we meet there with names like Abadasset, Harriseekit, Manset, Millinoket, Ogunquit, Pejepscot (Sheepscot), Webhannet, and Wiscasset. The name Penobscot cannot be adduced here, for its original form in that dialect is Panawámpskek, "where the conical rocks are."

The *Indian names* of elevations, rivers, and localities are in this article spelt in a scientific alphabet in which the vowels possess the value of and are pronounced as they are in the languages of the European continent.* To readers it will soon appear how inconsistently the Indian names were rendered by the American and British natives in their pronunciation and how often parts of them were dropped entirely. These Indian names are generally easy to pronounce for Americans; still, Algonkinian dialects have a tendency to drop vowels when standing between consonants at the beginning of words. This causes a peculiar difficulty of utterance, and makes some of them unpronounceable to a majority of English-speaking people.

**g* is always hard and ĕ has the sound of *e* in *bucket*.

A LIST OF INDIAN GEOGRAPHIC NAMES OCCURRING AROUND PASSAMAQUODDY BAY, MAINE, WITH THEIR DERIVATIONS

Bar Harbor, Mount Desert, and Mount Desert island are all called in Indian Péssank or Pĕssan, "at the clam-digging place or placès;" from ess, "shell," referring here to the clam only; p- prefix, -an verbal ending.

Bay of Fundy, a storm-beaten corner of the Atlantic ocean between Nova Scotia and New Brunswick, is to the Indians Wekwabegituk, "waves at the head of the bay," -tuk referring to waters driven in waves or moved by the tide. Nowhere else in the world are the tides so high as in this bay. (See Oak bay.)

Bishop's point, a locality on north head of Grand Manan island, New Brunswick. Its Indian name, Budebé-uhigen, means death-trap of whales, from budebé-u, "whale"; -higen, a suffix which stands for "tool" or "instrument."

Campobello island, New Brunswick, is called Ebagwídek, from its position between Maine and the mainland of New Brunswick, "floating between;" éba, between; gwiden, floating. Another Indian name for this island is Edlitik, which seems to refer to the sudden deepening of the waters on the west side.

Cherry island, a rocky formation just south of Indian island, New Brunswick, is known to the native Indian as Mísik nĕgúsis, "at the little island of trees." Mísi is "tree" or "trees;" misik, "where trees stand;" nĕgú, abbreviation of m'níku, "island;" -sis, diminutive ending.

Cobscook bay, a body of salt water lying west and southwest of Moose island. It is the Indian term kápskuk, "at the waterfalls." The tide, rising here daily to about twenty feet, enters into the sinuosities of the shorelands, and the waters returning to the ocean form rapids, riffles, or cascades (kápsku).

Deer island, New Brunswick, a large isle at the southern extremity of Passamaquoddy bay, is Edúki m'niku, "of the deer the island."

D'Orville's head, eminence where St Croix river empties into Passamaquoddy bay; Kwagustchus'k, "at the dirty mountain;" from kwagwéyu, "dirty;" tçhús, "mountain;" -k, locative particle, "at." The name was long ago corrupted into the more popular "Devil's head."

Eastport, city and harbor, has the same Indian name as *Moose island*, upon which it is built, Muselénk. This is a corruption from the hybrid compound Mús-ĕländ'k, its second half being a corruption of *island*, with the locative -k appended. The locality where the las moose was killed, about a century ago, lies on its northern part. The genuine Indian name for Moose island is Mús m'níku. The Moose islanders (and the Eastport people especially) are called Musĕléniek.

Eel brook, a small rivulet at the northern end of Grand Manan island, is in Indian Katekádik, which stands for Kat-akádik, and signifies "where (-k-) eels (kát) are plentiful (akádi)."

Gardner's lake, in Machias township, is called Némdamsw' águm, the term némdam designating a species of fresh-water fish rushing up brooks and channels (ném, *upward*); águm, "lake."

Grand Manan, New Brunswick, a large island with high shores, south of Passamaquoddy bay, is the Menanúk of the Indians. The name probably signifies "at the island" in the Micmac dialect.

Herring cove, a large sea-beach on the east side of Campobello island, facing Fundy bay and Grand Manan island, is called Pitchamkíak, "at the long beach;" pitchéyu, *it is long;* ámk, *gravel;* -kie, *beach;* locative case, -kíak. This cove has lately been made accessible by a good road leading to it from the Tyn-y-coed hotel, and with its picturesque views and its multicolored pebbles forms quite an attraction to visitors.

Indian island, New Brunswick, forms a narrow strip of one and a half miles' length at the southwestern entrance to Passamaquoddy bay, and was inhabited by these Indians before they crossed over to Lincoln's point and Pleasant point, Maine. They call it Misik-nĕgús, "at the tree island." The name of Cherry island (q. v.) is a diminutive of this.

Kendall's head, a bold headland in northern part of Moose island and facing Deer island, New Brunswick, upon the "western passage" of St Croix river, is called by the Indians Wabígenĕk, or "at the white bone," or Wabígĕn, "white bone," from the white color of a rock ledge on its top; wábi, *white;* -gen or -ken, *bone;* -k, *at.*

Kunaskwámkuk, abbreviated frequently into Kunaskwámk, is a comprehensive name given to the town of St Andrews, New Brunswick, to the heights above and north of it, where the Algonquin hotel is erected, and to the coast between St Andrews and Joe's point. The name signifies "at the gravel beach of the pointed top;" kuná, "point," referring to a sandbar projecting into the bay; kunaskwá, "pointed top or extremity;" ámk, "gravel," and here "gravelly beach;" -uk, locative ending, *at, on, upon.*

Lubec, a village south of Eastport, at the narrows between Campobello island and the mainland of Maine, is called Kebamkíak, "at the beach forming the narrows." Kebé-ik means "at the narrows," and is the same word as the Cree and Montagnais: Kébek, *Quebec,* in Canada; -kíak is the locative case of kie, "at the beach or beaches."

Machias and **East Machias**, two towns on the southern trend of the Maine coast, in Washington county, which were settled from Scarborough, in Maine, represent the term metchiéss, *partridge.*

Meddybemps village and **Meddybemps lake**, drained by Dennys river, Dennysville township, are called after a fresh-water fish, mĕdebéss'm, or the *hanpout.*

Moose island. (See Eastport.)

Moosehead lake, in the interior of Maine, Piscataquis county, is called in Passamaquoddy Ktchi-ságuk, "at the wide outlet." A literal translation of the English name would be Musátp ágĕmuk; mús, "moose deer;" -atp suffix referring to "head;" ágĕmuk, "at the lake." Chesuncook is in *Penobscot* dialect the name of a lake to the northeast of Moosehead lake, and signifies "at the big outlet," Ktchi-sánkuk.

Mount Katahdin, on Penobscot river, though its name is worded in the Penobscot dialect, may be mentioned here as signifying "large mountain;" the syllable kt- is equivalent to ktchí, "large, great, big;" ad'ne, ad'na, is "mountain." The Penobscot Indians pronounce it Ktă'd'n (*a* short); the Passamaquoddies, Ktād'n (*a* long).

Norumbega is the alleged name of a river and some ancient villages or Indian "cities" in Maine, spelled in many different ways, but never located with any degree of certainty. The name does not stand for any Indian settlement, but is a term of the Abnáki languages, which in Penobscot sounds nalambígi, in Passamaquoddy nalabégik—both referring to the "still, quiet" (nala-) stretch of a river between two rifles, rapids, or cascades; -bégik, for nipégik, means "at the water." On the larger rivers and watercourses of Maine ten to twenty of these "still water stretches" may occur on each; hence the impossibility of determining the sites meant by the old authors speaking of these localities. *Naranlsuak*, now Norridgewok, on middle Penobscot river, has the same meaning.

Oak bay, a large inlet of St Croix river, east of the city of Calais, is named Wekwáyik—"at the head of the bay."

Passamaquoddy bay, according to its orthography now current, means the bay where pollock is numerous or plentiful. The English spelling of the name is not quite correct, for the Indians pronounce it Peskĕdémakádi pekudebégek. Peskĕdem is the pollock-fish or "skipper," "jumper;" called so from its habit of skipping above the surface of the water and falling into it again; -kadi, -akadi is a suffix, marking plenty or abundance of the object in question. (Cf. the name Acadia, derived from this ending.) There are several places on the shores of this bay especially favorable for the catch of this food-fish, like East Quoddy head, etc, as mentioned previously in this article. Quoddy, the abbreviated name now given to a hotel in Eastport, should be spelt: Kadi or Akádi, for there is no *u*-sound in this Indian term, and it would be better to write the name of the bay, if scientific accuracy is desired, "Peskedemakadi bay."

Pembroke lake, a long water sheet, stretching from northwest to southeast, is in Indian Ímnakwan águm, or "the lake where sweet tree-sap is obtained." Mákwan, or "sweet," stands for the liquid sugar running from the sugar maple in season. Agum means "lake."

Pleasant point, Indian village on the western shore of St Croix river, is called Sibá-ik, Sibáyik: "at the water-passage, on the thoroughfare for ships *or* canoes," which refers to the sites just south of the "point."

Princeton, a village on the Kennebasis river, south shore (an affluent of the St Croix river from the west), is called Mdakmíguk, "on the rising soil;" from mdá, "high, rising," and kmígu, an abbreviation of ktakmígu, "land, soil, territory."

Red Beach, on west shore of lower St Croix river, Calais township, above Robbinston, is named Mekwamkés'k, "at the small red beach;" from mékw(a), "red;" ámk, "beach;" -es, diminutive ending, "small, little," and 'k, -ûk, locative case suffix, "at, on."

Schoodic or **Skúdik**, "at the clearings," is a topographic term given to the Schoodic or Grand lake, on headwaters of St Croix river; also to the St Croix river itself, and to the town of Calais, built on its lower course. That these clearings were effected by burning down the timber appears from the term itself; for skwút, skút means *fire*, and the name really means "at the fire." Another *Skúdik lake* lies in the southeastern corner of Piscataquis county, Maine.

St Croix river, in Indian Skúdik síp, "the river of clearings;" from the clearings on its shores or on the *Skúdik lake*, where the river takes its origin. For a long distance it forms the frontier between Maine (Washington county) and New Brunswick. The French name, "Holy Cross," came from a cross erected by early French explorers.

St Francis river, in Canada, Ontario province, upon which Indians cognate to the Penobscots of Maine are living, is called by them Lesigantuk, a contraction of Ulastigán-tuk. The same name is given to their village and to the natives themselves.

St George and **St George river**, emptying into the northeast end of Passamaquoddy bay, are just as well known by their Indian name, Megigadéwik, "many eels having;" from mégi, *many;* gat or kat, *eel;* -wi, adjectival ending; -k, locative case suffix.

St John river, running near the western border of New Brunswick and its large tributary, the Aroostook, are both called in Penobscot and in Passamaquoddy, Ulastúk, "good river," meaning river of easy navigation, without cascades, falls, or rapids; from úla, wúli, *good;* -tuk, tidal river and waters driven in waves.

RETURN OF THE HOURST NIGER EXPEDITION

The great geographical event in France just now is the return of the Hourst Niger expedition. The object of the mission was to survey the Niger, especially that part of the river which flows through French territory. As will be remembered, the Anglo-French agreement of 1890 made the boundary between the French and English "spheres of influence" a line starting from Say and running eastward to lake Chad. The upper Niger being unknown, the French government decided to send an expedition, and the occupation of Timbuktu by the French made it imperative. Accordingly the expedition was organized and placed under the command of Lieut. Hourst of the navy, his companions being Father Hacquard, a man of imposing appearance and well versed in Arabic and especially Tuareg dialects; Beaudry, senior midshipman; Bluzet, a lieutenant of marines, and Dr Taburet; in all five young men whose combined ages would hardly make 140 years.

The party started in August, 1895, and has just returned. The expedition was a complete success. The river has been duly studied and surveyed by competent men; about 45 meters of maps were brought back;

hostile tribes of wild Tuaregs were visited and friendly intercourse established (this was due mainly to Father Hacquard); not a man, white or black, has been killed; in fact, not a shot was fired (this is characteristic of French explorations anyhow), and the five men returned safe and sound. The maps which they bring will soon be published. The party, in three boats, descended the Niger from Timbuktu to its mouth, in spite of the rapids of Bussa, always declared impassable by the English Royal Niger Company. One of the boats was of aluminum and the other two were dug-outs.

An interesting and amusing incident of the trip is told as follows: When the celebrated Barth visited that part of the Sudan he was accompanied by a Tuareg interpreter called Backhay, who saved Barth's life. When the great traveler left, Backhay prophesied that a son of Barth would some day visit the Sudan. Accordingly when Hourst appeared he was asked whether he was not Barth's son, and the lieutenant, not knowing just what that meant, said that he was Barth's nephew. When the history of the western Sudan is written up the Hourst expedition will certainly receive more than a passing notice.

Ernest de Sasseville.

GEOGRAPHIC SERIALS

The Geographical Journal for November contains a valuable paper by Major Leonard Darwin on Railways in Africa, in which the author suggests the railway system necessary to supplement the facilities afforded by the rivers for commerce. It contains also the narrative of a Journey around Siam, by J. S. Black, of a Journey in the Valley of the Upper Euphrates, by Vincent W. Yorke, and from Teheran towards the Caspian, by Lieut. Col. Henry L. Wells. There is also a review of De Morgan's Mission Scientifique to Persia, by Major General Sir Frederick J. Goldsmid. The December number is a notable one. It begins with the presidential address of Sir Clements Markham. Arthur Montefiore Brice contributes a long and extremely interesting article summarizing the work done by the Jackson-Harmsworth Polar Expedition during the last year. It is accompanied by a map summarizing the discoveries made by this expedition. Prince Henri d'Orleans gives the narrative of his journey from Tonkin to Assam. Commander H. E. Purey-Cust describes the Eruption of Ambrym Island in the New Hebrides in 1894. This article is accompanied by maps and illustrations. Other articles are "An Attempt to Reconstruct the Maps Used by Herodotus" and "The Surface of the Sea and the Weather."

The Scottish Geographical Magazine for November contains notes on the Yukon country, and particularly that part of it which adjoins the boundary between Canada and Alaska, including the Forty Mile district, and the region about Juneau, by Alexander Begg. The subject of geographical education is continued by Prof. A. J. Herbertson. Much prominence has been given to this subject by the Scottish Magazine in its recent issues. The December number contains an article by W. Eagle Clarke on Bird Migration in the British Isles. The most important article is one summarizing the work of M. V. L. Seroshevski on the Country of the Yakuts—*i. e.*, northern Siberia. It is an admirably condensed description of a little-known region.

The quarterly *Bulletin of the American Geographical Society* for October opens with an article by Prof. I. C. Russell, of the University of Michigan, entitled "Mountaineering in Alaska," which is in substance an account of the author's last trip to the St Elias region. The bulletin also contains an article by Franz Boas on the Indians of British Columbia and on a Graphic History of the United States by Henry Gannett.

Appalachia, the journal of the Appalachian Mountain Club, devotes a large part of its November number to Philip S. Abbot, one of its members, whose lamented death in the Canadian Rockies was noticed in The National Geographic Magazine for the same month. Other articles are entitled "Ascents near Saas, Switzerland," "Grand Cañon of the Tuolumne," "Exploration of the Air," and "Notes on a recent Visit to Katahdin." H. G.

GEOGRAPHIC NOTES

NORTH AMERICA

Canada. Of the 21,341 immigrants who arrived in Canada last year, 14,197 declared their intention to settle in the Dominion.

Mexico. The coffee crop of 1895 amounted to 24,100 tons, of which Oaxaca furnished 9,610, Veracruz 8,817, Chiapas 1,962, and Puebla 1,256 tons. These four states have doubled their production since 1892, and they contribute 90 per cent of the entire crop. The best Mexican coffee is a variety of mocha, and the second best, known as myrtle, is similar to java. Trees in full bearing yield on an average about 24 ounces of coffee per annum, but some run as high as 60 to 80 ounces. The methods of curing and the quality of the product are steadily improving.

SOUTH AMERICA

The ascent of Aconcagua, the highest summit of the Andes, is being attempted by a scientific expedition under the direction of Mr E. A. Fitzgerald, who recently returned from his explorations in the New Zealand alps. The exploring party are well equipped, the sum of £5,000 having been made available for the expedition.

Argentina. A recent report of the Argentine Census Bureau shows the de facto population of the republic on May 10, 1895, to have been 4,042,990, to which number an addition of 50,000 is made for persons temporarily absent from the country. This shows an average annual increase of 4.6 per cent since 1869. The city of Buenos Ayres contains 663,854 inhabitants, of whom 345,393 are foreigners.

EUROPE

England. Dr Nansen's lectures are attracting large audiences, notwithstanding the very high prices charged for admission.

Although the traffic receipts of the Manchester ship canal for 1896 show a large increase over those for 1895, the diversion of trade has made no appreciable impression upon the revenues of the port of Liverpool.

France. The Paris Academy of Sciences has awarded one of the two Arago medals to M. D. Abadie, the Abyssinian explorer, and a prize to Prince Henry of Orleans for his explorations.

Germany. 7,531 steamships and 9,023 sailing vessels passed through the North Sea and Baltic canal during its first year. The receipts from tolls fell far short of the official estimates.

ASIA

Japan. The German consul at Yokohama reports that a general rise in the cost of living as well as in the scale of wages is already decreasing the danger of Japanese industrial competition with European nations.

India. The production of coal has increased 55 per cent in a single year and has almost quadrupled in ten years. The imports are also increasing rapidly, and as coal is not used for domestic purposes, its increasing consumption points to that expansion of manufacturing industries of which there are so many other indications. An illustration of the maxim that the trade follows the flag is found in the fact that 86 per cent of the tonnage that entered the ports of India last year was British.

AFRICA

Transvaal. It is believed that of the public revenue for the current year, estimated at £4,462,193, the Uitlanders will pay £3,500,000.

West Africa. Telegraphic dispatches announce that ex-King Prempeh and his relatives and attendants have been removed to Sierra Leone. — A British officer has just returned from an important mission, occupying five months, to the north and northwest of Kumassi, having traversed the entire distance of 900 miles on foot. He reports the country as exceedingly rich in mineral and vegetable products, gold, rubber, kola-nuts, and mahogany being abundant.

MISCELLANEA

In a paper read last month before the Royal Geographical Society, Col. J. K. Trotter, R. A., who was the principal British officer of the Anglo-French Delimitation Commission appointed in 1895, stated that the commission were disappointed at finding the sources of the Niger at so low an elevation, the highest recorded being 3,379 feet. The adjacent country was mountainous, but none of the summits exceeded 5,000 feet.

The Proceedings and Transactions of the Queensland Branch of the Royal Geographical Society of Australasia contain, among other articles, a Résumé of Capt. Cook's First Voyage Around the World, by Gen. Sir Henry W. Norman; a summary history of Arctic exploration, by Major A. J. Boyd, and the narrative of Capt. G. A. Tennefather; also Exploration of the Coen, Archer, and Batavia Rivers and of the islands of the western coast of Karpantaria, by the same author.

The Weather Bureau has recently issued Part 3 of the *Report of the International Meteorological Congress* held at Chicago in 1893, in connection with the World's Columbian Exposition. It contains brief papers upon the climates of various parts of the world, commencing with that of the United States, by Prof. H. A. Hazen. Under the title of "Instruments and Methods of Investigation" are described many of the latest adaptations of instruments for special work, including "Observations of Solar Radiation" and "The Study of the Upper Atmosphere by Means of Balloons, from Mountain Stations, and from Cloud Observations."

PROCEEDINGS OF THE NATIONAL GEOGRAPHIC SOCIETY, SESSION 1896-'97

Special Meeting, December 4, 1896.—President Hubbard in the chair. Admiral R. W. Meade, U. S. N., delivered an address, with lantern-slide illustrations, descriptive of a Winter Voyage through the Straits of Magellan, with Visits to Rio Janeiro and Valparaiso.

Regular Meeting, December 11, 1896.—President Hubbard in the chair. President David Starr Jordan, Ph. D., of the Leland Stanford Junior University, read a narrative entitled "Matka: a Story of the Mist Islands." This story, the life history of a fur-seal family (the members half personified), was followed by a series of lantern-slide illustrations of scenes in the Pribilof islands.

Special Meeting, December 18, 1896.—Secretary Hayden in the chair. Geo. M. Sternberg, M. D., LL. D., Surgeon-General of the Army, read a paper on the Etiology and Geographic Distribution of Infectious Diseases, afterwards exhibiting a series of lantern-slides illustrative of the subject.

Elections.—New members have been elected as follows:

November 25.—G. W. Bacon, F.R.G.S., Gen. Samuel Breck, U.S.A., Col. Chas. Chaillé-Long, A. W. Cowles, Prof. Thomas Davidson, Walter R. Davies, J. P. Earnest, Col. M. J. Foote, Henry S. Graves, Lieut. T. D. Griffen, U.S.N., Mrs Bella Kilbourn-Bourgeat, Miss Elizabeth A. Riley, F. P. Schumann, C. E., Mrs Emma Triepel, Miss Alice Twight, M. Gregory de Vollant (Russian Legation), Geo. H. Warner, John H. White.

December 11.—Dr Aaron Baldwin, John S. Blair, Prof. Frank M. Comstock, Dr Ira W. Dennison, Rev. Geo. A. Dougherty, Dr L. W. Eugster, Fred. L. Fishback, Señor Don Domingo Gana (Chilean Minister), Prof. Wm. H. Goodyear, Lee R. Grabill, C. E., Miss Edith S. Hancock, Hon. M. A. Hanna, Henry L. Haven, John J. Heron, Hon. S. G. Hilborn,

M. C., R. H. Hood, David Hutcheson, Henry Clay Johnson, William D. Kelly, Miss Mary A. Law, Capt. S. C. Lemly, U. S. N., J. E. Luckett, Col. Geo. G. Martin, Wm. W. Neifert, Lieut. H. C. Poundstone, U. S. N., L. M. Prindle, Hon. Redfield Proctor, U. S. S., Mr von Reichenau (German Embassy), Bushrod Robinson, Señor Don J. D. Rodriguez (Minister, Greater Republic of Central America), Geo. Otis Smith, Prof. A. W. Spanhoofd, T. W. Stanton, John J. Stephens, Capt. C. A. Stevens, Dr Chas. Swisher, Lt. Comdr. E. D. Taussig, U. S. N., Hon. E. O. Wolcott, U. S. S.

December 30.—Geo. H. Baker, Jas. A. Barwick, Marcus W. Bates, John D. Blagden, W. L. Blunt, H. B. Boyer, A. von Breuning, Prof. J. P. Byrne, Henry Calver, Prof. R. A. Dobie, Dr Geo. A. Dorsey, Prof. J. Fairbanks, Count A. Goetzen (German Embassy), Prof. R. R. N. Gould, Arpad Grossmann, Hon. F. M. Hatch (Hawaiian Minister), Edwin B. Hay, Med. Director A. A. Hoehling, U. S. N., Corliss W. Lay, Prof. E. H. Mark, Frank E. Pyne, Prof. A. W. Riggs, James A. Scott, Dr Z. X. Snyder, Joseph Stewart.

THE NATIONAL GEOGRAPHIC SOCIETY

SYNOPSIS OF A COURSE OF LECTURES ON THE EFFECTS OF GEOGRAPHIC ENVIRONMENT IN DEVELOPING THE CIVILIZATION OF THE WORLD

The National Geographic Society has for several seasons given three courses of lectures, a technical course and two popular courses; the former by officers of the Army and Navy and distinguished scientists in different departments of the Government, the latter by leading exponents of original investigation of subjects pertaining to geographic research.

It is the intention that each speaker in the popular course shall be a recognized authority on the subject treated by him, and that each lecture shall be illustrated by stereopticon views, which have been found to add not only to the interest but also to the value of the lectures.

The average attendance at the popular lectures has increased steadily from 500 in 1893–94 to 800 in 1894–95, and to 1,000 in 1895–96. The audience is composed of members of the Society and their friends, comprising many of the most cultured residents of Washington, senators and representatives, scientists and students. The second course of lectures has been held on Monday afternoons. Two years ago the subject was a trip over the Northern Pacific Railroad to the Pacific ocean, returning via San Francisco, the cañons of the Colorado, and the Rocky mountains. Last year it was a trip through Canada and the inland passage to Alaska.

For the popular course of 1896–97 the subject selected is the effects of geographic environment in developing the civilization of the world. The course opens with prehistoric man and the beginnings of history, and passes on to the period of our earliest definite knowledge in those countries where the history of our race begins. At this epoch geographic environment exercised a controlling influence on life, character, institutions, and religion; it was the primary if not the sole cause of development in the transition of man from savagery through barbarism to civilization. The same cause continued to influence the successive stages of civilization, though as man advanced in knowledge and intelligence he became more and more independent of his surroundings. Even now they influence him in various ways.

The first lecture will be of a general character, showing prehistoric man, the beginnings of industries (such as agriculture and the domestication of animals), of institutions and religion, and of the acquisition of real and personal property, and will be delivered by the President of the Society.

We look for the earliest civilization where the environment was most favorable, as in Babylonia and Egypt, and possibly in China. The transition of man from barbarism to partial civilization in these countries probably originated at about the same time, and therefore the second lecture will be on Babylonia, where the environment is in some respects more marked than in Egypt or China. In the rich valleys of the Tigris and Euphrates men were first gathered into great cities under the rule of a despot who was above all humanity, the representative only of himself and of God. Here the family seems to have become obsolete, all rights undefined, personal and civil liberty unknown, for there were only two classes, the master and slave. Yet here we find the first great library, hanging gardens, and magnificent architecture.

This lecture will tell us of the development of the city, library, and architecture, and of the rule of the despot, and will be delivered by Mr Talcott Williams, of the Philadelphia *Press*, a gentleman born in Mesopotamia and well acquainted with the country and its inhabitants.

The third lecture will be on Syria. In Syria we have an entirely different geographic environment, developing different institutions and religious beliefs, with a nationality and history of a different type. The Semites, probably Bedouins, came from the desert of Arabia, a country as unlike the valley of the Euphrates as the people of the two countries are unlike each other. In these deserts originated the ideas of humanity and charity, and a religion tending to monotheism. The chiefs or rulers of the nomad clans were patriarchs, like Abraham and Jacob, wandering over the desert. Although their civilization was in some respects and for a long time inferior to that of the Babylonians, yet they had a love of freedom and manly character unknown in the despotisms of the Euphrates and Nile. While they estimated the value of the life of the individual higher than did the Assyrian, yet even here personal liberty, as we understand it, did not exist, as every man belonged to a family group and was subject to its head, and every family to its clan.

This lecture will trace the development of the family, monotheism, and the Jewish nation, and will be delivered by Prof. Thomas J. Shahan, LL. D., of the Catholic University of America.

The fourth lecture will be on Tyre and Sidon, cities which derived their civilization from Assyria. Here we find a third condition of environment—mountains behind, the sea in front—evolving a higher civilization.

Life on the eastern shores of the Mediterranean led the inhabitants to find in commerce prosperity, wealth, and civilization. Their ships followed along the coast, then gradually sailed out into the Mediterranean, on through the Pillars of Hercules into the Atlantic, and north to England; the ships of Tarshish sailed south, through the Red sea, into the Indian ocean, south of Africa, and they may even have circumnavigated that continent.

This lecture will show the development of commerce and shipping; the origin and growth of colonies, exemplified by Carthage, Sicily, and Spain, and will be delivered by Prof. Thomas Davidson, M. A., of Aberdeen University, Scotland.

Fifth lecture—Greece. Tyre and Sidon gave to Greece all their knowledge. There it was developed by different geographic conditions. The two great races of the world—the Semitic and the Aryan—differed in their environment as in their institutions and habits. In Syria was monotheism, in Greece unlimited polytheism. The language and country of the Grecian Aryan were more favorable than those of the Semite in Syria. Their mountains, inclosing numerous small valleys, the islands and seas of Greece, its beautiful climate and luxuriant soil, developed a people different in their institutions, their government, arts, and sciences from any that ever existed, either before or since, and gave the world the first idea of personal liberty of the individual man. As no other nation ever showed such rapid development, such early maturity, so no other people ever had such a rapid decline without renaissance.

The lecture will show the causes for this wonderful development and early decay, and will be delivered by Prof. Benjamin Ide Wheeler, LL. D., of Cornell University, Ithaca, New York, professor in the American School of Archeology at Athens, 1895-96.

Sixth lecture—Rome. The Seven Hills, one densely wooded, the river Tiber, and the rich valley and plain around made the environment of Rome, and secured Romulus and his band of freebooters from attack, while they easily invaded the country of their neighbor. In Rome the civilizations of the old world met, and from this union a broader culture was developed, upon which modern civilization was founded. By the conquest of Italy, Greece, Egypt, Syria, and Assyria, Rome obtained from each what was best adapted to its needs—arts and letters from Greece, agriculture from Egypt, commerce and colonization from Tyre; from Syria and Arabia, monotheism and science; from Assyria, imperial government. The lecture will show the conditions and causes that led to this expansion of Rome, slowly and steadily extending its dominion until it embraced in its empire the whole of the known world. From Rome came law, authority, and power, with a dominion so wide and powerful that in any part of the world a man could say with the Apostle Paul, "I am a Roman citizen," and thus secure protection. Freeman truly says: "None but those who have grasped the place of Rome in history can ever fully understand the age in which we live." By Rev. Alex. Mackay-Smith, D. D., of Washington, D. C.

Seventh lecture—Constantinople. The culture and civilization of Rome were carried to Constantinople by Constantine. The geographic position of this city is more commanding than that of any other city. Seated on two continents, the connecting link between the Orient and Europe, mistress of the seas, glorious in situation, the desired of many nations, we behold environments which caused its rise and continued existence. We are not surprised that this city has been the seat of a government longer than any other that ever existed, and has enjoyed a continuity and concentration of imperial rule in an imperial city without parallel in the history of mankind. By Prof. Edwin A. Grosvenor, of Amherst College, Amherst, Massachusetts, formerly of Roberts College, Constantinople.

Eighth lecture—Venice and Genoa. When the rule of Constantinople passed from the Christians to the Mohammedans, on the ruins of the old world rose these two cities, fitted by their geographic environment to take up the civilization of the old world and to develop that of modern Europe—two cities unlike any other cities of Europe, each supreme within its small territory, owing no fealty to any sovereign outside its own district, each deriving power and wealth from the control of the sea. In their conditions of environment on the Mediterranean, with colonies in the Crimea and in Asia Minor, with easy access to the interior of Europe, we find the causes which led to the increase of their population and wealth, to the expansion of their commerce and their territorial possessions. When these are known we understand the part they bore in the awakening of the world from the torpor of the Dark Ages, opening the way to the new world, and to the renaissance of commerce, literature, arts, and science. By Prof. William H. Goodyear, of the Brooklyn Institute of Arts and Sciences.

Ninth lecture—America. From the Old World we pass to the New, America, where the Puritans of Plymouth and Massachusetts bay, the Knickerbockers of New Amsterdam, the Quakers of Pennsylvania, the Catholics of Baltimore, and the Royalists of Virginia all unconsciously laid the foundation of a unique empire. Their descendants have spread over the whole land and mingled with the best class of emigrants from every country of Europe, and are the progenitors of a new race. All geographic environments have become subservient to the will of the people, from ocean to ocean, from the waters of the Hudson to the waters of the gulf of Mexico, one people and one language, an American race, an empire vaster than that of Rome, home of all the nations of the world, welded into one great and free people.

The lectures will be neither historical nor scholastic treatises, but general accounts of the several nations and cities in popular language, so arranged as to show how largely their development depended on natural causes, including their geographic environment, until we come to the New World, where the environments become subservient to man and not man to his environments.

With this exception, it suffices to indicate only the general scope of the lectures, leaving to each lecturer perfect freedom to treat his subject in his own manner, ever bearing in mind the effect of geographic environment on the continuous development of civilization from one nation to another through the centuries.

Gardiner G. Hubbard.

AN IMPROVED METHOD OF KEEPING THE SCORE IN

DUPLICATE WHIST, COMPASS WHIST, STRAIGHT WHIST AND EUCHRE.

Since Duplicate and Compass Whist have come into fashion there has been an unprecedented revival of interest in the game, due to the fact that mere *luck* is to a large extent eliminated by a comparison of the scores made in the play of the same hands by different players.

The one thing needed to perfect the new method has been a convenient device by means of which the score made on the first round can be concealed until after the replay of the hands, as a knowledge of the first score often enables a good player to make a decisive gain, and matches are lost and won on just such little chances.

A Washington player has at length invented and put upon the market at a very low price a little device which admirably answers the purpose, and at the same time serves as a pretty and useful table ornament, marker, and pencil rest. It is called the "COSMOS COUNTER," and consists of a little polished wood tablet with a metal keyboard that can be clamped down on the score in such a way as to bring 24 little metal plates over the 24 spaces in the "score" column of the card, for use in concealing each first score as soon as recorded and until the hand is replayed (in duplicate whist) or the entire series finished (in compass whist).

Whist players will at once see the advantage of this new method of keeping the score, as it effectually prevents their opponents at the same or another table from taking advantage, either by accident or design, of a knowledge of what the hand is capable. The trouble with duplicate whist, especially, is that the replay is liable to be influenced by memory of the cards and score, and anything that helps to confuse such recollection is a great gain to fair play.

The "Cosmos Score Card," prepared for use with the counter, shows several new features, such as a heading for both Duplicate and Compass Whist and (on the reverse) for Straight Whist, Euchre, &c., thus enabling the same counter and score to be used for any game of cards.

Cosmos Counters, with tablet of quartered oak, maple, or birch, and metal in either gold or silver finish, 50 cts. apiece; 6 for $2.75; 12 for $5; by mail, 4 cts. apiece extra. Cosmos Score Cards, 25 cts. per package of 50; 12 packages for $2.50; by mail free of postage.

Ask to see samples at any stationer's, or order direct from the General Agents.

Cosmos Duplicate Whist Score

N .... E ....

S .... W ....

HAND		COMPASS WHIST: SCORE	TOTALS	TRUMP	OPPONENTS		HAND
		DUPLICATE WHIST: SCORE	GAIN	TRUMP	GAIN	SCORE	
1							1
2							2
3							3
4							4
5							5
6							6
7							7
8							8
9							9
10							10
11							11
12							12
13							13
14							14
15							15
16							16
17							17
18							18
19							19
20							20
21							21
22							22
23							23
24							24

Copyright 1895, by Everett Hayden, Washington, D. C. For use with the Cosmos Duplicate Whist Counter, patented July 7, 1896.

TOTALS .... TOTALS

........................, 189 ....

E. MORRISON PAPER CO., 1009 Penna. Avenue, Washington, D. C.

C&O ROUTE

CHESAPEAKE

AND

OHIO ROUTE.

"The Rhine, the Alps and the Battlefield Line."

THE

FAMOUS F.F.V. LIMITED

FAST FLYING VIRGINIAN

IS THE ONLY SOLID VESTIBULED TRAIN, ELECTRIC-LIGHTED, STEAM-HEATED, WITH THROUGH DINING CAR,

BETWEEN

NEW YORK, PHILADELPHIA, BALTIMORE, WASHINGTON

AND

CINCINNATI, LOUISVILLE, ST. LOUIS, CHICAGO, AND THE WEST.

OBSERVATION CAR ATTACHED.

H. W. FULLER, General Passenger Agent, WASHINGTON, D. C.

The Mutual Life Insurance Company

OF NEW YORK,

RICHARD A. McCURDY, President,

IS

The Largest and Best Life Insurance Company in the World.

Assets over $220,000,000.

The Mutual Life has Paid since Organization . . . . Over $388,440,897 to Policy-holders.

The New Instalment Policy issued by this Company is admirably adapted to the wants of the Insuring Public.

EVERY DESIRABLE FORM OF POLICY IS ISSUED BY

THE MUTUAL LIFE INSURANCE COMPANY OF NEW YORK.

SOUTHERN RAILWAY

GREATEST

SOUTHERN SYSTEM.

Penetrates with its main line or branches eight States South of the Ohio and Mississippi Rivers, and in conjunction with its friendly allied connections reaches all the commercial centers of the South and Southwest . . .

DOUBLE DAILY VESTIBULED LIMITED TRAINS

. . . BETWEEN . . .

Washington and Chattanooga via Salisbury, Asheville and Knoxville.
Washington and Tampa via Columbia, Savannah and Jacksonville.
Washington and Memphis via Atlanta, Birmingham and K. C. M. & B.
Washington and Galveston via Atlanta, Montgomery and New Orleans.
Washington and Birmingham via Lynchburg, Charlotte and Atlanta.
Norfolk and Chattanooga via Salisbury, Asheville and Knoxville.

Pullman Sleepers—Dining Cars—Day Coaches.
Additional Trains for local travelers . . . .

The direct line to the Winter Resorts of { FLORIDA, GULF COAST and TEXAS, ... MEXICO and CALIFORNIA,

—AND THE BEST—

Through Car Line to and from Asheville and Hot Springs—"The Land of the Sky."

Write for Map Folders.

R. D. CARPENTER, General Agent, 271 Broadway, New York City.
L. S. BROWN, General Agent Passenger Department, Washington, D. C.
WM. HENRY TAYLOE, District Passenger Agent, Norfolk, Va.

S. H. HARDWICK, Assistant General Passenger Agent, Atlanta, Ga.
C. A. BENSCOTER, Assistant General Passenger Agent, Chattanooga, Tenn.
J. M. CULP, Traffic Manager. **W. A. TURK**, General Passenger Agent.

FLORIDA

THE SHORTEST, QUICKEST, MOST ATTRACTIVE ROUTE

IS BY THE LINES OPERATED OVER THE

Florida Central & Peninsular R. R.

THE FLORIDA CENTRAL AND PENINSULAR RAILROAD begins on the north at Columbia, runs through Savannah, Jacksonville, Ocala, Tampa, Fernandina, Gainesville, Orlando, and Tallahassee.

It is the direct route to take for St. Augustine, Lake Worth, and all East Coast points; for Miami, Key West, and Nassau; also for points on the Gulf of Mexico and Havana and for all the principal interior points in Florida. Three trains daily from New York during the tourist season, passing through Philadelphia, Baltimore, and Washington.

One of the finest trains in the country is the **NEW YORK AND FLORIDA LIMITED**, with Compartment Cars, Pullman Sleepers, Observation Cars, Dining Cars, and Passenger Coaches. This train leaves New York at **12.10** noon and arrives at Jacksonville at **3.30** p. m. next day, St. Augustine at **4.30** p. m.

The **CINCINNATI AND FLORIDA LIMITED**, another very elegant vestibuled train, makes the run in about **24** hours between Cincinnati and Jacksonville, via Chattanooga, Atlanta, Macon, and Everett.

The **ASHEVILLE ROUTE** is the scenic route (over the Carolina mountains) between Cincinnati and Jacksonville, via Knoxville, the Mountain Resorts, Columbia, and Savannah.

The **KANSAS CITY** through car route is by this road, via Fort Scott, Memphis, Holly Springs, Birmingham, Atlanta and Everett.

The **NEW ORLEANS** through sleeper route runs from New Orleans by Pensacola on this route and via the beautiful Middle Florida Country.

Remember that the **FLORIDA CENTRAL AND PENINSULAR** does not only go to Jacksonville, but distributes passengers by close connections all over the State.

Get **THE BEST INDEXED MAP OF FLORIDA** from any of our agents or from the General Passenger Agent.

J. L. ADAMS, Genl. Eastern Agt., 353 Broadway, New York.
W. B. PENNINGTON, Genl. Western Agt., 417 Walnut Street, Cincinnati, O.
WALTER G. COLEMAN, Genl. Trav. Agt., 353 Broadway, New York.
N. S. PENNINGTON, Traffic Manager, **A. O. MacDONELL**, Genl. Pass. Agt., Jacksonville, Fla.

"FROM FROST TO FLOWERS."

"The Chariot . . .

. . . of the Sun"

SUNSET LIMITED is the Southern Pacific's great train, running through solid from New Orleans to the Pacific Coast.

SUNSET LIMITED leaves New Orleans every Monday and Thursday, at 10 o'clock in the morning.

SUNSET LIMITED covers the 2006 miles to Los Angeles in 58 hours, and the 2489 to San Francisco in 75 hours.

SUNSET LIMITED is vestibuled throughout, steam heated and gas lighted.

SUNSET LIMITED has a ladies' parlor the full width and a third the length of a car, equipped with fine library, escritoire and writing materials, large easy chairs, etc.

SUNSET LIMITED has an equally commodious smoking and reading room for gentlemen, supplied in a similar manner.

SUNSET LIMITED has bath room, barber shop and buffet—luxuries the tourist will appreciate.

SUNSET LIMITED has a car containing seven drawing rooms, which can be used separately or *en suite*, each having private lavatory and toilet facilities.

SUNSET LIMITED has a sumptuous diner, which goes through with it and in which meals are served *à la carte*.

SUNSET LIMITED is accompanied by a maid whose services are at the disposition of lady passengers.

SUNSET LIMITED traverses a road where snow never falls and blockades and blizzards are unknown, and through a region of marvelous interest.

SUNSET LIMITED is at your service, and any Southern Pacific Agent will be glad to tell you all about it, or if you want to know more, send 10 cents in stamps to the General Passenger Agent, and a beautiful book of 205 pages, that will tell you all about the route, will be sent you.

S. F. B. MORSE,

General Passenger and Ticket Agent,

NEW ORLEANS.

National Geographic Monographs

On the PHYSICAL FEATURES OF THE EARTH'S SURFACE, designed especially to supply to teachers and students of geography fresh and interesting material with which to supplement the regular text-book.

LIST OF MONOGRAPHS COMPRISING VOLUME I:

GENERAL PHYSIOGRAPHIC PROCESSES	J. W. Powell
GENERAL PHYSIOGRAPHIC FEATURES	J. W. Powell
PHYSIOGRAPHIC REGIONS OF THE UNITED STATES	J. W. Powell
BEACHES AND TIDAL MARSHES OF THE ATLANTIC COAST	Prof. N. S. Shaler
PRESENT AND EXTINCT LAKES OF NEVADA	Prof. I. C. Russell
APPALACHIAN MOUNTAINS—NORTHERN SECTION	Bailey Willis
APPALACHIAN MOUNTAINS—SOUTHERN SECTION	C. Willard Hayes
MT. SHASTA—A TYPICAL EXTINCT VOLCANO	J. S. Diller
THE NEW ENGLAND PLATEAU	Prof. W. M. Davis
NIAGARA FALLS AND ITS HISTORY	G. K. Gilbert

Price for one set of ten monographs, **$1.50**. Five sets to one address, **$6.00**. Single monographs, **20c**.

Remit with order to AMERICAN BOOK COMPANY,

New York - Cincinnati - Chicago

The RATES FOR ADVERTISING in THE NATIONAL GEOGRAPHIC MAGAZINE will be furnished on Application to the MANAGER, No. 1458 EUCLID PLACE, WASHINGTON.

Ripans Tabules assist digestion.

WHENEVER YOU VISIT WASHINGTON . .

YOU ARE INVITED TO INSPECT THE

MAMMOTH DRY GOODS ESTABLISHMENT

OF

WOODWARD & LOTHROP

Where the **LATEST PARIS NOVELTIES** are always on Exhibition. The attention of those who anticipate purchasing . . . .

BRIDAL TROUSSEAUX

Is invited especially to extreme PARIS NOVELTIES in matched sets of French Hand-made Lingerie, including Gowns, Skirts, Chemises, Drawers, Corset Covers, &c. These can be furnished in any number of pieces desired. . . . .

HAND-MADE BRIDAL TROUSSEAUX, personally selected in Paris and exclusive in style and design: Three or more pieces . . . . **$10 to $250.**

CORRESPONDENCE SOLICITED. MAIL ORDERS RECEIVE PROMPT AND CAREFUL ATTENTION.

TENTH, ELEVENTH, AND F STREETS N. W. . . . . . WASHINGTON, D. C.

Burlington Route

TO

ST. PAUL
MINNEAPOLIS

BEST LINE
CHICAGO OR ST. LOUIS

Ripans Tabules cure headache.

The Fastest and Finest Train in the West . . . .

IS

UNION PACIFIC
THE OVERLAND ROUTE
WORLD'S PICTORIAL LINE

The Overland Limited

......TO......

UTAH and CALIFORNIA.

FROM 16 TO 20 HOURS
SAVED BY USING

"THE OVERLAND ROUTE."

Double Drawing-Room Pullman Sleepers.
Free Reclining Chair Cars.
Pullman Dining Cars.
Buffet Smoking and Library Cars.

Send for Descriptive Pamphlet "49-96,"
Folders and other Advertising Matter.
(Mention this publication.)

E. L. LOMAX,
General Passenger and Ticket Agent,
OMAHA, NEB.

THE CHICAGO, MILWAUKEE AND ST. PAUL RAILWAY

. . RUNS . .

Electric Lighted and Steam Heated Vestibuled Trains between **Chicago, Milwaukee, St. Paul and Minneapolis** daily.

Through Parlor Cars on day trains between **Chicago, St. Paul and Minneapolis.**

Electric Lighted and Steam Heated Vestibuled Trains between **Chicago and Omaha and Sioux City** daily.

Through Sleeping Cars, Free Reclining Chair Cars and Coaches between **Chicago and Kansas City, Mo.**

Only two hours from Chicago to Milwaukee. Seven fast trains each way, daily, with Parlor Car Service.

Solid trains between **Chicago** and principal points in **Northern Wisconsin** and the **Peninsula of Michigan.**

Through Trains with Palace Sleeping Cars, Free Reclining Chair Cars and Coaches between **Chicago** and points in **Iowa, Minnesota, Southern and Central Dakota.**

The **finest Dining Cars** in the World.

The **best Sleeping Cars. Electric Reading Lamps in Berths.**

The best and latest type of **private Compartment Cars, Free Reclining Chair Cars, and buffet Library Smoking Cars.**

Everything First-class. First-class People patronize First-class Lines.

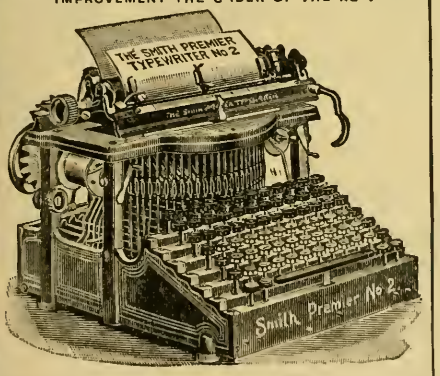
Ticket Agents everywhere sell tickets over the Chicago, Milwaukee and St. Paul Ry.

GEO. H. HEAFFORD,

General Passenger Agent, Chicago, Ill.

A VITAL POINT

"IMPROVEMENT THE ORDER OF THE AGE."



A TYPEWRITER'S PRINTING MECHANISM

MUST BE SCIENTIFICALLY CONSTRUCTED. THIS POINT IS OF UTMOST IMPORT FOR

EASY OPERATION AND PERFECT EXECUTION.

The Smith.. Premier Typewriters

Superior on This Point as Well as on All Others.

ONLY CORRECT PRINCIPLES EMPLOYED.

The Smith Premier Typewriter Co.,

SYRACUSE, N. Y., U. S. A.

FLORIDA

The Great Hotels
OF THE

East Coast

AT

ST. AUGUSTINE,
ORMOND,
PALM BEACH
AND
MIAMI.

Railway.

KEY WEST AND MIAMI
. . . STEAMSHIP CO.

THE BEAUTIFUL ROUTE TO

KEY WEST.

Ten Hours from Miami along the Florida Keys in daylight.

See local time card for sailing dates.

MIAMI AND NASSAU
STEAMSHIP SERVICE
BETWEEN
Miami and Nassau, N. P.
(Bahama Islands),

Will be inaugurated about JANUARY 15th for the WINTER TOURIST SEASON OF 1897.

See advertisements for sailing dates.

For map of Florida and book Florida East Coast, address—

J. R. PARROTT, *Vice-President.*
J. P. BECKWITH, *Traffic Manager.*
J. D. RAHNER, *Ass't General Pass'r Agent. St. Augustine, Fla.*

SPEND THE WINTER

— IN —

CALIFORNIA

. . . AS USUAL . . .

RAPIDS NEAR UPPER FALL.

But vary the monotony of travel by returning via the

SHASTA ROUTE

—AND—

NORTHERN PACIFIC R. R.

By so doing you can see the

ORIGINAL OF THIS SCENE.

It is in the YELLOWSTONE PARK, and can be reached on your return from CALIFORNIA if you will see that your ticket reads as above. In addition you will see

MT. SHASTA, MT. HOOD, and MT. TACOMA,

the Giant Peaks of the Pacific Coast, and pass through Portland, Tacoma, Seattle, Spokane, Helena or Butte, Missoula, Bismarck, Fargo, Minneapolis, and St. Paul.

Send me 6 cents for

SKETCHES OF WONDERLAND.

CHAS. S. FEE, Gen. Pass. Agent.

Northern Pacific Railroad. St. Paul, Minnesota.

Among the Contents of Forthcoming Numbers of

THE NATIONAL GEOGRAPHIC MAGAZINE

WILL BE THE FOLLOWING:

A Winter Voyage through the Straits of Magellan,

BY ADMIRAL R. W. MEADE, U. S. N.;

The Physical Features of Lake Superior,

BY DR MARK W. HARRINGTON,

PRESIDENT OF THE UNIVERSITY OF THE STATE OF WASHINGTON;

Crater Lake, Oregon,

BY MR J. S. DILLER;

The Utilization of the Vacant Public Lands,

BY JUDGE EMORY F. BEST,

ASSISTANT COMMISSIONER OF THE GENERAL LAND OFFICE;

—— AND ——

Down the Volga, from Nijni Novgorod to Kazan,

BY PROF. FREDERIC W. TAYLOR.

JUDD & DETWEILER, PRINTERS, WASHINGTON, D. C.

The National Geographic Magazine

AN ILLUSTRATED MONTHLY

Honorary Editor: JOHN HYDE

Honorary Associate Editors

A. W. GREELY W J McGEE HENRY GANNETT
C. HART MERRIAM ELIZA RUHAMAH SCIDMORE

CONTENTS

WASHINGTON
PUBLISHED BY THE NATIONAL GEOGRAPHIC SOCIETY

Agents in the United States and Canada
The American News Company, 39 and 41 Chambers Street, New York
Paris: Brentanos, 37 Avenue de l'Opera

Price 25 Cents $2.50 a Year

Entered at the Post-office in Washington, D. C., as Second-Class Mail Matter

THE

National Geographic Society

ORGANIZED, JANUARY, 1888

PRESIDENT

GARDINER G. HUBBARD

VICE-PRESIDENTS

MARCUS BAKER
WILLIAM H. DALL
G. K. GILBERT
A. W. GREELY
C. HART MERRIAM
HERBERT G. OGDEN

TREASURER

CHARLES J. BELL

RECORDING SECRETARY

EVERETT HAYDEN

CORRESPONDING SECRETARY

HENRY GANNETT

MANAGERS

H. F. BLOUNT
C. W. DABNEY, JR.
DAVID T. DAY
JOHN HYDE
W J McGEE
F. H. NEWELL
W. B. POWELL
J. B. WIGHT

SECRETARY'S OFFICE, 1517 H STREET N. W., WASHINGTON

The National Geographic Society, the object of which is the increase and diffusion of geographic knowledge, has a paying membership of 1,400. Its membership is not restricted to practical geographers, but is open to any person in good standing who may be sufficiently interested in its work to seek admission. The annual subscription is: for active members, $5.00 per annum; for corresponding members, $2.00 per annum. Active members pay also an entrance fee of $2.00 on election. THE NATIONAL GEOGRAPHIC MAGAZINE is sent regularly to all members, both active and corresponding.

Donations for the founding of Prize Medals and Scholarships are respectfully solicited.

MT. SHASTA,	14,350 feet high,	
MT. HOOD,	11,225 "	"
MT. ST. HELENS,	9,750 "	"
MT. RAINIER,	14,532 "	"
MT. ADAMS,	12,250 "	"

CAN ALL BE SEEN

BY TAKING THE

NORTHERN PACIFIC

AND

SHASTA ROUTE.

Returning from CALIFORNIA,

See that your return tickets read *via* this route, and visit

Yellow-Stone Park

SIX CENTS sent to me will bring you TOURIST MATTER that will detail the scenic features of this route. For rates, etc., write to

CHAS. S. FEE,
Gen. Pass. Agt.,
St. Paul, Minnesota

SOUTHERN RAILWAY

GREATEST

SOUTHERN SYSTEM.

Penetrates with its main line or branches eight States South of the Ohio and Mississippi Rivers, and in conjunction with its friendly allied connections reaches all the commercial centers of the South and Southwest . . .

DOUBLE DAILY VESTIBULED LIMITED TRAINS

. . . BETWEEN . . .

Washington and Chattanooga via Salisbury, Asheville and Knoxville.
Washington and Tampa via Columbia, Savannah and Jacksonville.
Washington and Memphis via Atlanta, Birmingham and K. C. M. & B.
Washington and Galveston via Atlanta, Montgomery and New Orleans.
Washington and Birmingham via Lynchburg, Charlotte and Atlanta.
Norfolk and Chattanooga via Salisbury, Asheville and Knoxville.

Pullman Sleepers—Dining Cars—Day Coaches.
Additional Trains for local travelers . . . .

The direct line to the Winter Resorts of { FLORIDA, GULF COAST and TEXAS, ... MEXICO and CALIFORNIA,

—AND THE BEST—

Through Car Line to and from Asheville and Hot Springs—"The Land of the Sky."

Write for Map Folders.

R. D. CARPENTER, General Agent, 271 Broadway, New York City.
L. S. BROWN, General Agent Passenger Department, Washington, D. C.
WM. HENRY TAYLOE, District Passenger Agent, Norfolk, Va.
S. H. HARDWICK, Assistant General Passenger Agent, Atlanta, Ga.
C. A. BENSCOTER, Assistant General Passenger Agent, Chattanooga, Tenn.
J. M. CULP, Traffic Manager. W. A. TURK, General Passenger Agent.

FLORIDA

THE SHORTEST, QUICKEST, MOST ATTRACTIVE ROUTE

IS BY THE LINES OPERATED OVER THE

Florida Central & Peninsular R. R.

THE FLORIDA CENTRAL AND PENINSULAR RAILROAD begins on the north at Columbia, runs through Savannah, Jacksonville, Ocala, Tampa, Fernandina, Gainesville, Orlando, and Tallahassee.

It is the direct route to take for St. Augustine, Lake Worth, and all East Coast points; for Miami, Key West, and Nassau; also for points on the Gulf of Mexico and Havana and for all the principal interior points in Florida. Three trains daily from New York during the tourist season, passing through Philadelphia, Baltimore, and Washington.

One of the finest trains in the country is the **NEW YORK AND FLORIDA LIMITED**, with Compartment Cars, Pullman Sleepers, Observation Cars, Dining Cars, and Passenger Coaches. This train leaves New York at **12.10** noon and arrives at Jacksonville at **3.30** p. m. next day, St. Augustine at **4.30** p. m.

The **CINCINNATI AND FLORIDA LIMITED**, another very elegant vestibuled train, makes the run in about **24** hours between Cincinnati and Jacksonville, via Chattanooga, Atlanta, Macon, and Everett.

The **ASHEVILLE ROUTE** is the scenic route (over the Carolina mountains) between Cincinnati and Jacksonville, via Knoxville, the Mountain Resorts, Columbia, and Savannah.

The **KANSAS CITY** through car route is by this road, via Fort Scott, Memphis, Holly Springs, Birmingham, Atlanta and Everett.

The **NEW ORLEANS** through sleeper route runs from New Orleans by Pensacola on this route and via the beautiful Middle Florida Country.

Remember that the **FLORIDA CENTRAL AND PENINSULAR** does not only go to Jacksonville, but distributes passengers by close connections all over the State.

Get **THE BEST INDEXED MAP OF FLORIDA** from any of our agents or from the General Passenger Agent.

J. L. ADAMS, Genl. Eastern Agt., 353 Broadway, New York.
W. B. PENNINGTON, Genl. Western Agt., 417 Walnut Street, Cincinnati, O.
WALTER G. COLEMAN, Genl. Trav. Agt., 353 Broadway, New York.
N. S. PENNINGTON, Traffic Manager, **A. O. MacDONELL**, Genl. Pass. Agt., Jacksonville, Fla.

FLORIDA

The Great Hotels OF THE

East Coast

AT

ST. AUGUSTINE, ORMOND, PALM BEACH AND MIAMI.

Railway.

KEY WEST AND MIAMI . . . STEAMSHIP CO.

THE BEAUTIFUL ROUTE TO

KEY WEST.

Ten Hours from Miami along the Florida Keys in daylight.

See local time card for sailing dates.

MIAMI AND NASSAU

STEAMSHIP SERVICE

BETWEEN

Miami and Nassau, N. P.

(Bahama Islands),

Will be inaugurated about **JANUARY 15th** for the WINTER TOURIST SEASON OF 1897.

See advertisements for sailing dates.

For map of Florida and book Florida East Coast, address—

J. R. PARROTT, *Vice-President.*
J. P. BECKWITH, *Traffic Manager.*
J. D. KAHNER, *Ass't General Pass'r Agent, St. Augustine, Fla.*

C&O ROUTE

F.F.V. LIMITED

CHESAPEAKE & OHIO RY.

THE F. F. V. LIMITED is one of the finest trains hauled over any railway track in America. It runs solid between Cincinnati and New York, the route from Washington being over the Pennsylvania system. It has every modern convenience and appliance, and the dining-car service has no superior if it has an equal. The road-bed is literally hewed out of the eternal rocks; it is ballasted with stone from one end to the other; the greater portion is laid with one-hundred-pound steel rails, and although curves are numerous in the mountain section, the ride is as smooth as over a Western prairie.

One of the most delightful rides in all the route is that through the New River valley. The mountains are just low enough to be clad with verdure to the very top, and in the early spring every variety of green known to the mixer of colors can be seen, while the tones in autumn take on all the range from brown to scarlet.

These facts should be borne in mind by the traveler between the East and the West.

H. W. FULLER, *Genl. Pass. Agent, Washington, D. C.*

The Mutual Life Insurance Company

OF NEW YORK,

RICHARD A. McCURDY, President,

—IS—

The Largest and Best Life Insurance Company in the World.

Assets over $220,000,000.

The Mutual Life has Paid since Organization . . . . Over $388,440,897 to Policy-holders.

The New Instalment Policy issued by this Company is admirably adapted to the wants of the Insuring Public.

EVERY DESIRABLE FORM OF POLICY IS ISSUED BY

THE MUTUAL LIFE INSURANCE COMPANY OF NEW YORK.

Burlington Route

TO

ST. PAUL

BEST LINE
CHICAGO OR ST. LOUIS

MINNEAPOLIS

Ripans Tabules cure headache.

The Fastest and Finest Train in the West . . . .

IS

UNION PACIFIC
THE OVERLAND ROUTE
WORLD'S PICTORIAL LINE

The Overland Limited

......TO......

UTAH and CALIFORNIA.

FROM 16 TO 20 HOURS
SAVED BY USING

"THE OVERLAND ROUTE."

Double Drawing-Room Pullman Sleepers.
Free Reclining Chair Cars.
Pullman Dining Cars.
Buffet Smoking and Library Cars.

Send for Descriptive Pamphlet "49-96,"
Folders and other Advertising Matter.
(Mention this publication.)

E. L. LOMAX,
General Passenger and Ticket Agent,
OMAHA, NEB.

National Geographic Monographs

On the PHYSICAL FEATURES OF THE EARTH'S SURFACE, designed especially to supply to teachers and students of geography fresh and interesting material with which to supplement the regular text-book.

LIST OF MONOGRAPHS COMPRISING VOLUME I:

GENERAL PHYSIOGRAPHIC PROCESSES	J. W. Powell
GENERAL PHYSIOGRAPHIC FEATURES	J. W. Powell
PHYSIOGRAPHIC REGIONS OF THE UNITED STATES	J. W. Powell
BEACHES AND TIDAL MARSHES OF THE ATLANTIC COAST	Prof. N. S. Shaler
PRESENT AND EXTINCT LAKES OF NEVADA	Prof. I. C. Russell
APPALACHIAN MOUNTAINS—NORTHERN SECTION	Bailey Willis
APPALACHIAN MOUNTAINS—SOUTHERN SECTION	C. Willard Hayes
MT. SHASTA—A TYPICAL EXTINCT VOLCANO	J. S. Diller
THE NEW ENGLAND PLATEAU	Prof. W. M. Davis
NIAGARA FALLS AND ITS HISTORY	G. K. Gilbert

Price for one set of ten monographs, **$1.50**. Five sets to one address, **$6.00**. Single monographs, **20c**.

Remit with order to AMERICAN BOOK COMPANY,

New York - Cincinnati - Chicago

Ripans Tabules assist digestion.

WHENEVER YOU VISIT WASHINGTON . . .

YOU ARE INVITED TO INSPECT THE

MAMMOTH DRY GOODS ESTABLISHMENT

OF

WOODWARD & LOTHROP

Where the **LATEST PARIS NOVELTIES** are always on Exhibition. The attention of those who anticipate purchasing . . . .

BRIDAL TROUSSEAUX

Is invited especially to extreme PARIS NOVELTIES in matched sets of French Hand-made Lingerie, including Gowns, Skirts, Chemises, Drawers, Corset Covers, &c. These can be furnished in any number of pieces desired. . . . .

HAND-MADE BRIDAL TROUSSEAUX, personally selected in Paris and exclusive in style and design: Three or more pieces . . . . **$10 to $250.**

CORRESPONDENCE SOLICITED. MAIL ORDERS RECEIVE PROMPT AND CAREFUL ATTENTION.

TENTH, ELEVENTH, AND F STREETS N. W. . . . . WASHINGTON, D. C.

THE CHICAGO, MILWAUKEE AND ST. PAUL RAILWAY

. . RUNS . .

Electric Lighted and Steam Heated Vestibuled Trains between **Chicago, Milwaukee, St. Paul and Minneapolis** daily.

Through Parlor Cars on day trains between **Chicago, St. Paul and Minneapolis.**

Electric Lighted and Steam Heated Vestibuled Trains between **Chicago and Omaha and Sioux City** daily.

Through Sleeping Cars, Free Reclining Chair Cars and Coaches between **Chicago and Kansas City, Mo.**

Only two hours from Chicago to Milwaukee. Seven fast trains each way, daily, with Parlor Car Service.

Solid trains between **Chicago** and principal points in **Northern Wisconsin** and the **Peninsula of Michigan.**

Through Trains with Palace Sleeping Cars, Free Reclining Chair Cars and Coaches between **Chicago** and points in **Iowa, Minnesota, Southern and Central Dakota.**

The **finest Dining Cars** in the World.

The **best Sleeping Cars. Electric Reading Lamps in Berths.**

The best and latest type of **private Compartment Cars, Free Reclining Chair Cars, and buffet Library Smoking Cars.**

Everything First-class. First-class People patronize First-class Lines.

Ticket Agents everywhere sell tickets over the Chicago, Milwaukee and St. Paul Ry.

GEO. H. HEAFFORD,
General Passenger Agent, Chicago, Ill.

A VITAL POINT

"IMPROVEMENT THE ORDER OF THE AGE."

A TYPEWRITER'S PRINTING MECHANISM

MUST BE SCIENTIFICALLY CONSTRUCTED. THIS POINT IS OF UTMOST IMPORT FOR

EASY OPERATION AND PERFECT EXECUTION.

The Smith.. Premier Typewriters

Superior on This Point as Well as on All Others.

ONLY CORRECT PRINCIPLES EMPLOYED.

The Smith Premier Typewriter Co.,
SYRACUSE, N. Y., U. S. A.

Catalogues and Information at Washington Office, No. 1416 F Street.

AN IMPROVED METHOD OF KEEPING THE SCORE IN

DUPLICATE WHIST, COMPASS WHIST, STRAIGHT WHIST AND EUCHRE.

Since Duplicate and Compass Whist have come into fashion there has been an unprecedented revival of interest in the game, due to the fact that mere *luck* is to a large extent eliminated by a comparison of the scores made in the play of the same hands by different players.

The one thing needed to perfect the new method has been a convenient device by means of which the score made on the first round can be concealed until after the replay of the hands, as a knowledge of the first score often enables a good player to make a decisive gain, and matches are lost and won on just such little chances.

A Washington player has at length invented and put upon the market at a very low price a little device which admirably answers the purpose, and at the same time serves as a pretty and useful table ornament, marker, and pencil rest. It is called the "COSMOS COUNTER," and consists of a little polished wood tablet with a metal key-board that can be clamped down on the score in such a way as to bring 24 little metal plates over the 24 spaces in the "score" column of the card, for use in concealing each first score as soon as recorded and until the hand is replayed (in duplicate whist) or the entire series finished (in compass whist).

Whist players will at once see the advantage of this new method of keeping the score, as it effectually prevents their opponents at the same or another table from taking advantage, either by accident or design, of a knowledge of what the hand is capable. The trouble with duplicate whist, especially, is that the replay is liable to be influenced by memory of the cards and score, and anything that helps to confuse such recollection is a great gain to fair play.

The "Cosmos Score Card," prepared for use with the counter, shows several new features, such as a heading for both Duplicate and Compass Whist and (on the reverse) for Straight Whist, Euchre, &c., thus enabling the same counter and score to be used for any game of cards.

Cosmos Counters, with tablet of quartered oak, maple, or birch, and metal in either gold or silver finish, 50 cts. apiece; 6 for $2.75; 12 for $5; by mail, 4 cts. apiece extra. Cosmos Score Cards, 25 cts. per package of 50; 12 packages for $2.50; by mail free of postage.

Ask to see samples at any stationer's, or order direct from the General Agents.

Cosmos Duplicate Whist Score

N	E ....
S	W ....

HAND	COMPASS WHIST: SCORE	TOTALS	TRUMP	OPPONENTS		HAND
	DUPLICATE WHIST: SCORE	**GAIN**	**TRUMP**	**GAIN**	**SCORE**	
1						1
2						2
3						3
4						4
5						5
6						6
7						7
8						8
9						9
10						10
11						11
12						12
13						13
14						14
15						15
16						16
17						17
18						18
19						19
20						20
21						21
22						22
23						23
24						24
TOTALS						TOTALS

Copyright, 1895, by Everett Hayden, Washington, D. C. For use with the Cosmos Duplicate Whist Counter, patented July 7, 1896.

...., 189....

E. MORRISON PAPER CO., 1009 Penna. Avenue, Washington, D. C.

CRATER LAKE, OREGON

WIZARD ISLAND; DEVILS BACKBONE AND LLAO ROCK IN THE DISTANCE

From a photograph by M. M. Hazeltine

THE

National Geographic Magazine

Vol. VIII FEBRUARY, 1897 No. 2

CRATER LAKE, OREGON*

By J. S. Diller,

United States Geological Survey

Of lakes in the United States there are many and in great variety, but of crater lakes there is but one. Crater lakes are lakes which occupy the craters of volcanoes or pits of volcanic origin. They are most abundant in Italy and Central America, regions in which volcanoes are still active; and they occur also in France, Germany, India, Hawaii, and other parts of the world where volcanism has played an important rôle in its geological history.

The one in the United States belongs to the great volcanic field of the northwest, but it occurs in so secluded a spot among high mountains that it is almost unknown to tourists and men of science, who are especially interested in such natural wonders. Crater lake of southern Oregon lies in the very heart of the Cascade range, and, while it is especially attractive to the geologist on account of its remarkable geological history, it is equally inviting to the tourist and others in search of health and pleasure by communion with the beautiful and sublime in nature.

According to W. G. Steel,† the lake was first seen by white men in 1853. It had long previously been known to the Indians, whose legends, as related by Steel,‡ have contributed a name, Llao rock, to one of the prominences of its rim. They regarded the lake with awe as an abode of the Great Spirit. The first travelers of note who visited the lake were Lord Maxwell

*Published by permission of the Director of the U. S. Geological Survey.

† The Mountains of Oregon, by W. G. Steel, 1890, p. 13. ‡ Ibid

and Mr Bentley, who, in 1872, with Captain O. C. Applegate, of Modoc war fame, and three others, made a boat trip along its borders and named several of the prominences on the rim after members of the party.* Mrs F. F. Victor saw the lake in 1873 and briefly describes it in "Atlantis Arisen."†

The first Geological Survey party visited the lake in 1883, when Everett Hayden and the writer, after spending several days in examining the rim, tumbled logs over the cliffs to the water's edge, lashed them together with ropes to make a raft, and paddled over to the island. In 1886, under the direction of Captain (now Major) C. E. Dutton, many soundings of the lake were made by W. G. Steel, and a topographic map of the vicinity was prepared by Mark B. Kerr and Eugene Ricksecker. Dutton was the first to discover the more novel and salient features in the geological history of the lake, of which he has given, for his entertaining pen, an all too brief account.‡

Under the inspiration of the "Mazamas," a society of mountain climbers at Portland, Oregon, of whose work an account is given in this magazine (page 58), a more extended study of the lake has just been made by government parties from the Department of Agriculture, the Fish Commission, and the Geological Survey.

Crater lake is deeply set in the summit of the Cascade range, about 65 miles north of the California line. As yet it may be reached only by private conveyance over about 80 miles of mountain roads from Ashland, Medford, or Gold Hill, on the Southern Pacific railroad, in the Rogue River valley of southern Oregon. This valley marks the line between the Klamath mountains of the Coast range on the west and the Cascade range on the east. The journey from the railroad to Crater lake affords a good opportunity to observe some of the most important features of this great pile of lavas. The Cascade range in southern Oregon is a broad irregular platform, terminating rather abruptly in places upon its borders, especially to the westward, where the underlying Cretaceous and Tertiary sediments come to the surface. It is surmounted by volcanic cones and coulees, which are generally smooth, but sometimes rough and rugged.

* The names Watchman, Glacier, Llao, and Vidae, which appear on the map of the lake, have recently been adopted by the United States Board on Geographic Names.

† "Atlantis Arisen," by Mrs Frances Fuller Victor, p. 179.

‡ *Science*, vol. 7, 1886, pp. 179–182, and Eighth Annual Report of the U. S. Geological Survey, pp. 156–159.

Contour Interval 500 feet.

MAP SHOWING ROUTES TO CRATER LAKE FROM ASHLAND AND MEDFORD ON THE OREGON AND CALIFORNIA LINE OF THE SOUTHERN PACIFIC RAILROAD

Reduced from U. S. Geological Survey Ashland Sheet, Oregon

The cones vary greatly in size and are distributed without regularity. Each has been an active volcano. The fragments blown out by violent eruption have fallen about the volcanic orifice from which they issued and built up cinder cones. From their bases have spread streams of lava (coulees), raising the general level of the country between the cones. From some vents by many eruptions, both explosive and effusive, large cones, like Pitt, Shasta, and Hood, have been built up. Were we to examine their internal structure, exposed in the walls of the canyons carved in their slopes, we should find them composed of overlapping layers of lava and volcanic conglomerate, a structure which is well illustrated in the rim of Crater lake.

The journey from Ashland by the Dead Indian road crosses the range where the average altitude is less than 5,000 feet. The road passes within a few miles of Mount Pitt and skirts Pelican bay of Klamath lake, famous for its fishing. After following northward for some twenty miles along the eastern foot of the range, it ascends the eastern slope, along the castled canyon of Anna creek to the rim of Crater lake.

From Medford or Gold Hill, the trip is a trifle shorter by the Rogue River road. It affords some fine views of the canyons

RIM OF CRATER LAKE IN THE DISTANCE, AS SEEN FROM THE SOUTH, ACROSS THE CANYON OF ANNA CREEK

From a photograph by J. S. Diller

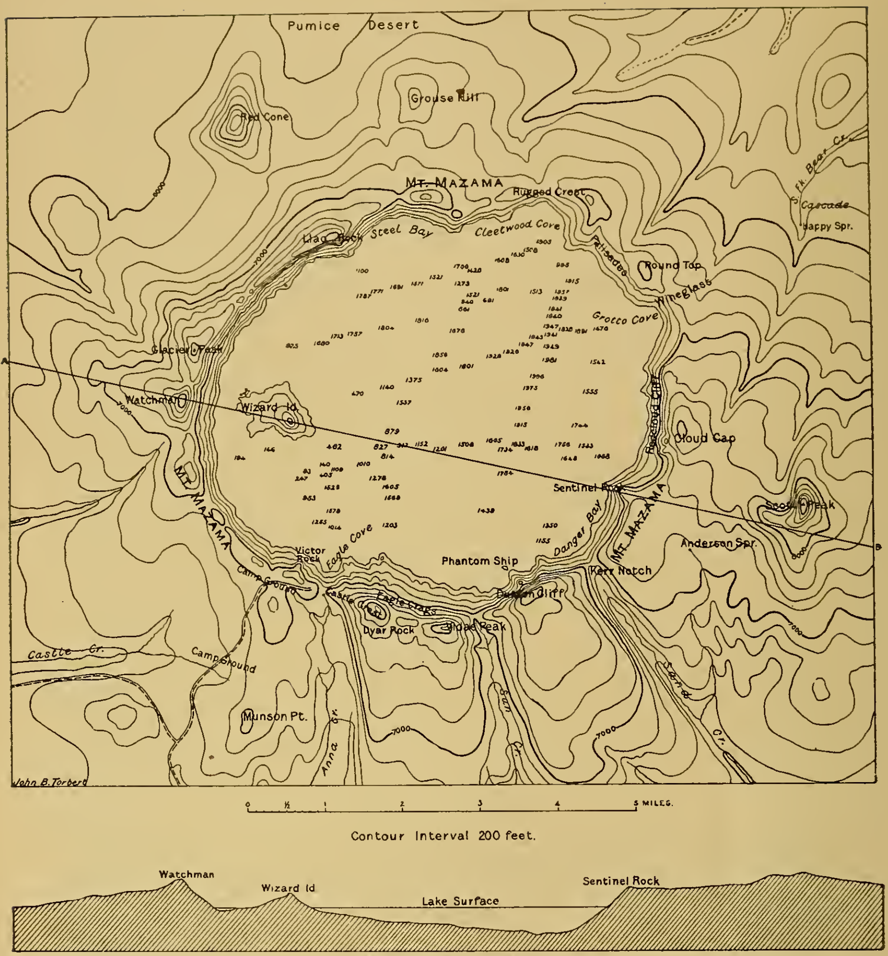
and rapids of that turbulent stream and of the high falls, where it receives its affluents. Striking features along both roads, within 20 miles of the lake, are the plains developed upon a great mass of detritus filling the valleys. Across these plains Anna creek and Rogue river have carved deep, narrow canyons with finely sculptured walls, which the roads follow for some distance.

Approaching the lake from any side, the observer sees a broad cluster of gentle peaks rising about a thousand feet above the general crest of the range on which they stand, but not until after he has left the main road, three miles from the lake, does he begin to feel the steepness of the ascent. The way winds over a large moraine littered with lava boulders and well studded with firs. Arriving at the crest, the lake in all its majestic beauty comes suddenly upon the scene, and is profoundly impressive. Descending the wooded slope a short distance within the rim to Victor rock, an excellent general view of the lake is obtained. The eye beholds 20 miles of unbroken cliffs ranging from over 500 to nearly 2,000 feet in height, encircling a deep blue sheet of placid water, in which the mirrored walls vie with the originals in brilliancy and greatly enhance the depth of the prospect.

The first point to fix our fascinated gaze is Wizard island, lying nearly two miles away, near the western margin of the lake. Its rugged western edge and the steep but symmetrical truncated cone in the eastern portion are very suggestive of volcanic origin. We cannot, however, indulge our first impulse to go to the island, for the various features of the rim are of greater importance in unraveling the earlier stages of its geological history.

The outer and inner slopes of the rim are in strong contrast; while the one is gentle, ranging in general from 10° to 15°, the other is abrupt and full of cliffs. The outer slope at all points is away from the lake, and as the rim rises at least 1,000 feet above the general summit of the range, it is evidently the basal portion of a great hollow cone in which the lake is contained.

The map of Crater lake, prepared from the U. S. Geological Survey special sheet, fully illustrates this feature, and also in part another feature, namely, the occurrence of a number of small cones upon the outer slope of the great cone. These adnate cones are of peculiar significance when we come to consider the volcanic rocks of which the region is composed. The rim is ribbed by ridges and spurs radiating from the lake, and the head of each spur is marked by a prominence on the crest of the rim. The variation in the altitute of the rim crest is 1,469 feet (from 6,759 to 8,228)



MAP OF CRATER LAKE, OREGON

Reduced from U. S. Geological Survey Special Sheet

with seven points rising above 8,000 feet. The crest generally is passable, so that a pedestrian may follow it continuously around the lake, with the exception of short intervals about the notches in the southern side. At many points the best going is on the inner side of the crest, where the open slope, generally well marked with deer trails over beds of pumice, affords an unobstructed view of the lake.

Reference has already been made to the glacial phenomena of the outer slope of the rim. There are boulders not only upon the surface, but also in piles of glacial gravel and sand spread far and wide over the southern and western portion of the rim, extending down the watercourses in some cases for miles to broad plains through which the present streams have carved the deep and picturesque canyons already observed on the ascent. At many points the lavas are well rounded, smooth, and striated by glacial action. This is true of the ridges as well as of the valleys, and the distribution of these marks is coextensive with that of the detritus.

A feature that is particularly impressive to the geologist making a trip around the lake on the rim crest is the general occurrence of polished and striated rocks, in place, on the very brow of the cliff overlooking the lake. The best displays are along the crest for three miles northwest of Victor rock, but they occur

GLACIATED CREST OF RIM OF CRATER LAKE

From a photograph by M. M. Hazeltine

also on the slopes of Llao rock, Round Top, Kerr Notch, and Eagle crags, thus completing the circuit of the lake. On the adjacent slope toward the lake the same rocks present rough fractured surfaces, showing no striæ. The glaciation of the rim is a feature of its outer slope only, but it reaches up to its very crown. The glaciers armed with stones in their lower parts, that striated the crown of the rim, must have come down from above, and it is evident that the topographic conditions of today afford no such source of supply. The formation of glaciers requires an elevation extending above the snow line to afford a gathering ground for the snow that it may accumulate, and under the influence of gravity descend to develop glaciers lower down on the mountain slopes. It is evident that during the glacial period Crater lake did not exist, but that its site must then have been occupied by a mountain to furnish the conditions necessary for the extensive glaciation of the rim, and the magnitude of the glacial phenomena indicates that the peak was a large one, rivaling, apparently, the highest peaks of the range.

The Mazamas held a meeting last summer at Crater lake in connection with the Crater Lake clubs of Medford, Ashland, and Klamath Falls, of the same state. Recognizing that the high mountain which once occupied the place of the lake was nameless, they christened it, with appropriate ceremonies, Mount Mazama. The rim of the lake is a remnant of Mount Mazama, but when the name is used in this paper reference is intended more especially to that part which has disappeared.

The inner slope of the rim, so well in view from Victor rock, although precipitous, is not a continuous cliff. It is made up of many cliffs whose horizontal extent is generally much greater than the vertical. The cliffs are in ledges, and sometimes the whole slope from crest to shore is one great cliff, not absolutely vertical, it is true, but yet at so high an angle as to make it far beyond the possibility of climbing. Dutton cliff, on the southern, and Llao rock, on the northern, borders of the lake are the greatest cliffs of the rim. Besides cliffs, the other elements of the inner slope are forests and talus, and these make it possible at a few points to approach the lake, not with great ease, but yet, care being taken, with little danger. Southwest of the lake the inner slope, clearly seen from Victor rock, is pretty well wooded, and from near the end of the road, just east of Victor rock, a steep trail descends to the water. Where talus slopes prevail, there are no trees, and the loose material maintains the steepest slope possible without sliding. Such slopes are well displayed along the western shore opposite the island and near the northeast corner of the lake under the palisades. At the latter point the rim is only 520 feet high, and a long slide, called from its shape the *Wineglass*, reaches from crest to shore.

The best views of the rim are obtained from a boat on the lake, which affords an opportunity to examine in detail the position and structure of the cliffs. They are composed wholly of volcanic conglomerate and streams of lava arranged in layers that dip into the rim and away from the lake on all sides. Both forms of volcanic material are well exposed on the trail descending the inner slope, and although most of the cliffs are of lava many are of conglomerate.

On arriving at the water's edge, the observer is struck with the fact that there is no beach. The steep slopes above the surface of the lake continue beneath its waters to great depths. Here and there upon the shore, where a rill descends from a melting snowbank near the crest, a small delta deposit makes a little shallow, turning the deep-blue water to pale green.

As the boat skirts the western shore and passes toward Llao rock, the layered structure of the rim is evident. On the whole the lava streams predominate, although there is much conglomerate. Of all the flows exposed upon the inner slope, that of Llao rock is most prominent and interesting. In the middle it is over 1,200 feet thick, and fills an ancient valley down the outer slope of the rim. Upon either side it tapers to a thin edge against the upper slope of the valley, as shown in Plate 1, and to the lake it presents a sheer cliff—that is, it is abruptly cut off—and one wonders how much farther it may have extended in that direction. Beneath the rock the outline of the valley in cross-section is evident, and it rests upon many layers of older lavas forming the rim down to the water's edge. The direction of flow in this great lava stream forces us to believe that it was erupted from a large volcano which once stood upon the site of the lake. Every layer of lava in the rim is a coulee, dipping away from the lake. This is especially well shown in the canyon of Sun creek, cut in its outer slope. The sections of these radiating flows exposed upon the inner slope of the rim all tell the same story as to their source. By projecting the lavas in their course toward a common center we can reconstruct in fancy the great volcanic mountain that once occupied the place of the latter—that is, Mount Mazama—and, like Shasta or Rainier, formed a great landmark of the region. Proceeding eastward from Llao rock, the rim loses somewhat in height, and at the head of Cleetwood cove one sees the remarkable spectacle of a lava stream descending the inner slope of the rim. It is the only one that has behaved in this way, and its action throws much light upon the disappearance of Mount Mazama.

The Palisades are less than 600 feet in elevation above the lake, and are composed almost wholly of one great flow. The streams of lava extending northeast from this portion of the rim are broad and much younger in appearance than those forming the great cliffs south of the lake, where the flows are thinner and more numerous.

Round Top is a dome-shaped hill over the eastern end of the Palisades, and is made up chiefly of the lava stream that formed the Palisades, overlain by two sheets of pumice separated by a layer of rhyolite. The upper surface of the Palisade flow, where best exposed upon the lakeward slope of Round Top, bears glacial striæ that extend beneath the layers of pumice and rhyolite of later eruption from Mount Mazama. It is evident from this relation that Mount Mazama was an active volcano during the glacial period. The occurrence of eruptions from a snow-capped volcano must necessarily produce great floods, and these conditions may account in some measure at least for the detritus-filled valleys of the streams rising on the rim of Crater lake.

Returning from this glacial digression to the boat trip on the lake, it is observed upon the eastern side of the lake that Red Cloud cliff is rendered beautiful by the pinnacles of reddish tuff near the summit, where it is capped by a great, dark flow of rhyolite filling a valley in the older rim and extending far to the northeast. Here the springs begin to gush from the inner slope and cascade their foaming rills to the lake. They recur at Sentinel rock, Dutton cliff, and especially under Eagle crag, as well as further westward. Their sources in many cases can be seen in the banks of snow above, but in others they gush forth as real springs whose water must find its way in from the snow upon the outer slope.

The boldest portion of the rim, excepting perhaps Llao rock, is Dutton cliff, which is made more impressive by the deep U-shape notches on either side and the Phantom Ship at its foot. The notches mark points where the canyons of Sun and Sand creeks pass through the rim to the cliff overlooking the lake. These canyons, due to erosion on lines of drainage, belong

SOUTHERN SHORE OF CRATER LAKE, AS SEEN FROM KERR NOTCH. DUTTON CLIFF ON THE LEFT: EAGLE CRAGS AND CASTLE CREST BEYOND THE PHANTOM SHIP

From a photograph by J. S. Diller

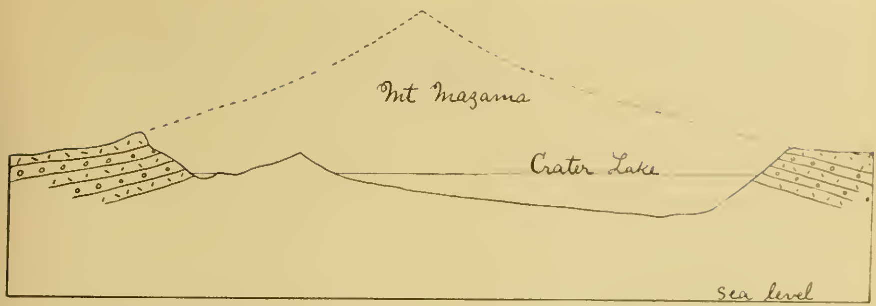
to the period when the topographic conditions in that region were quite unlike those of today. They were carved out by streams of ice and water descending from a point over the lake, and their presence, ending as they do in the air thousands of feet above the present water level, affords strong evidence in favor of the former reality of Mount Mazama.

The Phantom Ship is a craggy little islet near the border of the lake under Dutton cliff. Its rugged hull, with rocks towering like the masts of a ship, suggests the name, and, phantomlike, it disappears when viewed in certain lights from the western rim. Standing in line with an arête that descends from an angle of the cliff, it possibly marks a continuation of the sharp spur beneath the water, or perhaps, but much less likely, it is a block slid down from the cliff. Whatever its history, it attracts everyone by its beauty and winsomeness.

At times of volcanic eruption the lava rises within the volcano until it either overflows the crater at the top or, by the great pressure of the column, bursts open the sides of the volcano and escapes through the fissure to the surface. In the latter case, as the molten material cools, the fissure becomes filled with solid lava and forms a dike. The best example of this sort about Crater lake appears along the inner slope directly north of Wizard island, and is locally known as the Devil's Backbone. This dike rock standing on edge varies from 5 to 25 feet in thickness and cuts the rim from water to crest. Dikes are most numerous in the older portion of the rim under Llao rock. They do not cut up through Llao rock and are clearly older than the lava of which that rock is formed. Dikes occur at intervals all around the lake, and radiate from it, suggesting that the central volcanic vent from which they issued must have been Mount Mazama.

There is another important feature concerning the kinds of volcanic rocks and their order of eruption and distribution about the rim of Crater lake that is of much interest to the geologist. All the older lavas comprising the inner slope of the rim, especially toward the water's edge, are andesites. The newer ones forming the top of the rim in Llao rock, Round Top, and the Rugged Crest about the head of Cleetwood cove, as well as at Cloud Cap, are rhyolites. Other later flows, all of which escaped from the smaller adnate cones upon the outer slope of the rim, are basalts. The eruptions began with lavas of medium acidity (andesites), and after long-continued activity lavas both rich (rhyolites) and poor (basalts) in silica follow, giving a completeness to the products of this great volcanic center that make it an interesting field of study. Furthermore, the remarkable opportunity afforded by the dissected volcano for the examination of its structure and succession of lavas is unsurpassed. It should be stated, before dismissing the kinds of lava, that there are some rhyolites in the Sun Creek canyon south of the lake that appear to be older than those upon the north side, and that the final lava of the region on Wizard island is andesitic.

The glaciation and structure of the rim clearly establish the former existence of Mount Mazama, but there may well be doubt as to its exact form and size. Judging from the fact that Mount Shasta and the rim of Crater lake have the same diameter at an altitude of 8,000 feet, and that their lavas are similar, it may with some reason be inferred that Mount Mazama and Mount Shasta were nearly of equal height. The slopes of Mount Shasta may be somewhat steeper than those of the rim of Crater lake at an equal altitude, but the glaciation of the rim is such as to require a large peak for its source.



SECTION OF CRATER LAKE AND ITS RIM, WITH THE PROBABLE OUTLINE OF MOUNT MAZAMA

Vertical and Horizontal Scales the same

In the accompanying figure is given a section of Crater lake and its rim, with the probable outline of Mount Mazama. Wonderful as the lake, encircled by cliffs, may be, it serves but to conceal in part the greatest wonder—that is, the enormous pit which is half filled by the lake. The pit or caldera, as it is called by some geologists, is 4,000 feet deep. It extends from the top of the rim half-way down to the sea-level, and nearly a square mile of its bottom is below the level of Upper Klamath lake at the eastern foot of the range. The volume of the pit is nearly a dozen cubic miles, and if we add the volume of the lost Mount Mazama, that amount would be increased by at least one-half. How was it possible to remove so large a mass and in the process develop so great a pit?

The pit is completely inclosed, so that it cannot be regarded as an effect of erosion. The volcanic origin of everything about the lake would suggest in a general way that this great revolution must have been wrought by volcanism, either blown out by a great volcanic explosion or swallowed up by an equally great engulfment. It is well known that pits have been produced by volcanic explosions, and some of them are occupied by lakes of the kind usually called crater lakes. Pits produced in this way, however, are, with rare exceptions, surrounded by rims composed of the fragmental material blown from the pit.

At first sight the rim about Crater lake suggests that the pit was produced by an explosion, and the occurrence of much pumice in that region lends support to this preliminary view; but on careful examination we find, as already stated, that the rim is not made up of fragments blown from the pit, but of layers of solid lava interbedded with those of volcanic conglomerate erupted from Mount Mazama before the pit originated. The moraines deposited by glaciers descending from the mountain formed the surface around a large part of the rim, and as there is no fragmental deposit on these moraines it is evident that there is nothing whatever to indicate any explosive action in connection with the development of the pit.

We may be aided in understanding the possible origin of the pit by picturing the conditions that must have obtained during an effusive eruption of Mount Mazama. At such a time the column of molten material rose in the interior of the mountain until it overflowed at the summit or burst open the sides of the mountain and escaped through fissures. Fissures formed in this way usually occur high on the slopes of the mountain. If instead, however, an opening were effected on the mountain side at a much lower level—say some thousands of feet below the summit—and the molten material escaped, the mountain would be left hollow, and the summit, having so much of its support removed, might cave in and disappear in the molten reservoir.

Something of this sort is described by Professor Dana as occurring at Kilauea, in Hawaii. The lake in that case is not water, but molten lava, for Kilauea is yet an active volcano. In 1840 there was an eruption from the slopes of Kilauea, 27 miles distant from the lake and over 4,000 feet below its level. The column of lava represented by the lake of molten material in Kilauea sank away in connection with this eruption to a depth of 385 feet, and the floor of the region immediately surrounding the lake, left without support, tumbled into the depression. In the intervals between eruptions the molten column rises again toward the surface, only to be lowered by subsequent eruptions, and the subsidence is not always accompanied by an outflow of lava upon the surface. Sometimes, however, it gushes forth as a great fountain a hundred feet or more in height.

The elevated position of the great pit occupied by Crater lake makes its origin by subsidence seem the more probable. The level of the lowest bed of the lake reaches the surface within 15 miles to the westward. That Mount Mazama was engulfed is plainly suggested by the behavior of its final lava stream. The greater portion of this last flow descended and spread over the outer slope of the rim, but from the thickest part of the flow where it fills an old valley at the head of Cleetwood cove some of the same lava, as already noted, poured down the inner slope. The only plausible explanation of this phenomena seems to be that soon after the final eruption of Mount Mazama, and before the thickest part of the lava effused at that time had solidified, the mountain collapsed and sank away and the yet viscous portion of the stream followed toward the pit.

It has been suggested, but perhaps not in serious thought, that the cone on Wizard island may represent the summit of the sunken Mount Mazama, projecting above the water. To determine the truth of the matter we must cross over to the island. Wizard island has two portions—an extremely rough lava field and a cinder cone. The lava is dark and has a much more

SNOWDRIFT IN THE CRATER OF THE CINDER CONE ON WIZARD ISLAND

From a photograph by H. B. Patton

basaltic look than any seen in the main body of the rim. It has evidently been erupted from the base of the cinder cone in its present position. The cinder cone, too, is a perfect little volcano with steep symmetrical slopes, 845 feet in height, and surmounted by a crater 80 feet deep. It is so new and fresh that it is scarcely forested, and shows no trace of weathering. Instead of being a part of the sunken Mount Mazama, it is an entirely new volcano built up since the subsidence by volcanic action upon the bottom of the pit. Were it not for the lake the whole bottom of the pit could be examined, and it is possible that other small volcanic cones might be found. This suggestion is borne out by the soundings of the lake, which appear to reveal two other cases, but they do not rise to within 400 feet of the surface of the water. It is evident that the volcanic eruptions upon the bottom of the pit have partially filled it up. Originally it may have been much more than 4,000 feet deep.

Given the pit with water-tight walls, there is no difficulty in forming Crater lake, for in that region precipitation is greater than evaporation. The lake does not fill up and overflow. The surplus water must have a subterranean outlet, probably toward the southeast, where the region is traversed by extensive breaks in the rocks, and abounds in excellent springs.

The color of the lake is deep blue excepting along the borders, where it merges into various shades and tints of green. It is so transparent that even on a hazy day a white dinner plate 10 inches in diameter may be seen at a depth of nearly 100 feet. It contains no fish, but a small crustacean flourishes in its waters, and salamanders occur in abundance locally along the shore.

The level of the lake oscillates with the seasons. During the rainy winter it rises, and in the summer it falls. In August last observations were made for twenty-two days, and the lake sank at the rate of one inch for every five or six days, depending somewhat on the conditions of the weather. The Mazamas have established a water gauge, and it is hoped that an extended series of observations may be obtained in the future.

Mr B. W. Evermann, of the U. S. Fish Commission, who visited the lake last summer, made some interesting observations of its temperature. At 1 p. m., August 22—

The temperature of the surface water was.	60°
At a depth of 555 feet the temperature was	39°
At a depth of 1,043 feet the temperature was	41°
At a depth of 1,623 feet (on the bottom) the temperature was.	46°

The increase of temperature with the depth suggests that the bottom may yet be warm from volcanic heat, but more observations are needed to fully establish such an abnormal relation of temperatures in a body of water.

Aside from its attractive scenic features, Crater lake affords one of the most interesting and instructive fields for the study of volcanic geology to be found anywhere in the world. Considered in all its aspects, it ranks with the Grand Canyon of the Colorado, the Yosemite valley, and the Falls of Niagara, and should be set aside as a National Park for the pleasure and instruction of the people.

THE UTILIZATION OF THE VACANT PUBLIC LANDS

By Emory F. Best,

Assistant Commissioner of the General Land Office

No question of public policy has demanded more earnest consideration than the disposal of the public domain. It involved not only the creation of a fund for the redemption of the public debt, but the fundamental principles of government upon which the republic was founded. It has been asserted by some that mismanagement and an inefficient policy have characterized the disposal of the public land from the foundation of the government. On the other hand, it is claimed that a wise and beneficent system has peopled the country with thrifty and energetic settlers, and this is pointed to as one of our greatest achievements.

When the Treaty of Peace was concluded between Great Britain and the United States the unsettled territory west of the Appalachians belonged to certain of the colonies. This fact was one of many obstacles to the ratification of the Articles of Confederation. . It was removed by the cession of these lands to the United States. By such cession the United States became the proprietor of a territory greater in extent than France or Spain. This formed the nucleus of the public domain, and the laws enacted for the disposal of the public lands in that region have been extended over all the territory thereafter acquired by the national government except Alaska.

The first step in the disposal of the public lands was the passage by Congress of the ordinance of 1787 for the organization and government of the territory northwest of the Ohio. It provided for the organization of the territories into states, with all the rights of the original states, but declared that the new states should never interfere with the disposal of the soil by the United States, nor with any regulations Congress might find necessary for securing the title in such soil to the purchaser. Upon the admission of new states into the Union, the absolute proprietary power and primary right of disposition of the soil has been uniformly reserved by solemn compact in conformity therewith.

The cessions of territory made to the United States by the several states were upon the condition that the land should be held in trust, to be disposed of for the common benefit of all the states, and this condition applied as well to all land thereafter acquired by the United States. At first the controlling purpose in the disposal of the lands was to create a fund for the redemption of the public debt. Settlement upon the public domain was not only discouraged, but was actually forbidden. In pursuance of the policy to convert the public domain into cash as rapidly as possible for the extinguishment of the public debt, large tracts of land in the Northwest Territory were sold to individuals and companies under authority granted by special act of Congress prior to the adoption of the Constitution.

In 1790 Mr Hamilton, then Secretary of the Treasury, submitted to Congress a plan for the disposal of the public domain, which has formed the basis of the public-land system. All legislation upon this subject, until the Homestead Act of 1862, embodied the fundamental principle of Mr Hamilton's plan, which contemplated the raising of revenue from the sale of the land. His plan presented two leading features: one, the facility of advantageous sales, which, as a financial operation, claimed primary attention; the other, the accommodation of individuals then inhabiting the Northwest Territory, or who might afterward settle therein, who were permitted to purchase small tracts for homes. Upon this plan our public land system was laid. It provided for the disposal of the public domain at public offering, by private cash sales, and by the allowance of the preference right of purchase to actual settlers under the several preëmption laws. The preëmption laws were at first temporary, being limited in their operation, until the general law of 1841, which continued in force until its repeal by the act of March 3, 1891.

While the preëmption right was generally considered as a special favor or benefit conferred upon those who inhabit, cultivate, and improve a tract of public land, with the intention of making a permanent home, it was practically only the extension of a credit for twelve months to the settler, but with no actual security that he would finally get the land. Up to 1843 there was no land subject to preëmption that could not at any time be bought upon application at the local office, at private cash entry, at the same price the preëmptor was required to pay, and it was not until 1860 that preëmption rights could be initiated by settlement upon unsurveyed lands. Even in the bestowal of the munificent grants of alternate sections to aid in the construction of railroads and other works of public improvement, the controlling feature in the disposition of the public lands was not abandoned, because the sections of land remaining to the government within the limits of the grant were doubled in price for the purpose of reimbursing the government for the land granted. It was not until the agitation of the question of free homes for the people, which resulted in the act of May 2, 1862, that the general policy of sales for revenue was changed.

The homestead law provided that any citizen who is the head of a family, or who has arrived at the age of 21 years, may acquire title to 160 acres of land by residing upon, cultivating, and improving the tract for five years immediately preceding his final proof, free from all cost except the land office fees. Since the year 1862, when this law went into effect, up to the close of the last fiscal year, 508,936 homestead entries have been allowed, embracing an area of 67,618,451 acres.

How far this beneficent act has demonstrated the wisdom of the measure and fulfilled the expectations of its advocates must be judged by the growth and prosperity of the country since the period of its enactment. It is true that it went into operation at practically the same period that witnessed the extensive grants in aid of the construction of the Pacific railroads and other important works of internal improvement; but this important factor, with the aid of the railroads, was mainly instrumental in converting the boundless domain of wild, unsettled Indian country into thriving communities and states, adding immensely to the material wealth and prosperity of the nation. Thus the government has indirectly derived larger revenues from its bounties than it could have acquired from the cash sales of its lands.

It is unnecessary to give a detailed statement of the extent to which the public lands have been entered under the several laws by which such disposition has been governed. Suffice it to say that about 247,000,000 acres of land have been sold for cash, including commuted homestead entries, for which the government has received about $280,000,000, and that this item, with the grants to aid in the construction of railroads and the donations to states for educational purposes and internal improvements, constitute the largest portion of the public domain that has been disposed of by the government.

It is estimated that there now remain, exclusive of Alaska, over which the general land laws have not been extended, about 600,000,000 acres of vacant public land, of which about 500,000,000 are within a region where the rainfall is not sufficient to insure the cultivation of crops without irrigation. The title to the soil is in the United States, and it is subject to disposal under the general land laws; but the control of the water, which is the important element in the utilization of these lands for agricultural purposes, rests with the state. Unless these two elements are combined, the land is valueless, and until the land can be brought to an agricultural condition, permanent settlement, that will advance the prosperity of the state and nation, cannot be expected. Hence the question is forced upon us, Are the laws which have operated so favorably in the disposal of the well watered and fertile lands of the Mississippi valley adequate to the conditions that confront us in the arid west?

The act of March 3, 1877, authorizing the entry of 640 acres of desert land, conditioned upon the payment of $1.25 per acre and the reclamation of the land by conducting water thereon, was designed to meet these conditions; but whether from the imperfection of the system or from the injudicious administration of the law, it has certainly failed to yield the results most to be desired, even if it has accomplished the purposes of its enactment.

It is generally conceded that the lands lying along the borders of the small streams and rivulets, which can be irrigated by the individual efforts of the settlers, have practically been appropriated by settlers under the homestead and other general land laws, and that the desirable vacant public lands unreclaimed are so situated that they cannot be reclaimed by means at the command of the individual settler. The combined efforts of labor and capital must be employed to insure a reclamation that is economical and practical. Hence the homestead law is no longer of practical application in the arid region, as its operation is rather to retard than to promote the reclamation of these lands.

But a more serious problem is, how to secure the reclamation of the largest possible portion of the 500,000,000 acres of vacant public lands within the arid region. It is estimated that only 20 per cent can, under the most favorable conditions, be reclaimed and brought to an agricultural condition, not because of the lack of irrigable land, but because of the limited supply of water, and the irrigation of this quantity can be accomplished only by the most economical and conservative use of the water and the most judicious selection of the tracts of land to be irrigated. It is therefore evident that as the solution of the problem lies in the economical and practical utilization of the water, the control and use of this element must be of paramount importance to securing title to the land.

If the waters of the perennial streams which are wasted during the winter months could be stored and reservoirs could be constructed to impound the storm waters, the area of territory susceptible of irrigation could be largely increased. As the irrigable land is far in excess of the available water supply, the land to be irrigated should also be selected with a view to the most economical use of the water, so that the available lands should be irrigated and disposed of as agricultural lands, and the remaining lands be held for disposition for other uses.

The importance of observing the strictest economy in the distribution of water and the selection of lands is forcibly stated in the minority report of the Special Committee appointed by the United States Senate in 1889 to consider the subject of the irrigation and reclamation of the arid lands. It says:

"The irrigable lands are limited in extent. The area of the arid region which can be irrigated is a small fraction of the entire region. This arises from the fact that all the waters that can be used are insufficient to serve all the possible irrigable lands. It therefore becomes necessary to select the lands to be redeemed. On the wisdom of this selection vast interests depend. It is possible to irrigate lands on the mountains and on the high plateaus, but if the water is used there it cannot be used below, and these elevated lands will not make the best homes for the people. The climate there is rigorous, and the variety of agricultural products that can be raised is limited, being chiefly hay and vegetables. To use the water on such lands is largely to waste it, and to drive agriculture into the mountains is to doom the people engaged therein to a dreary life in a subarctic climate. It is therefore manifestly to the interest of the greatest number of people that the agriculture of the arid lands should not be established in the mountain regions. The valleys and plains below are warm, salubrious, and rich, the variety of agricultural products is great, and if the waters are used on these lands they will give support to a prosperous people."

If this is the condition with which we are confronted with regard to the vacant public lands in the arid region, then it must follow that these lands should not be disposed of until they have been brought to an agricultural condition, if due regard be had to the practical and economical disposition of them, and with a view to deriving the greatest benefit for the state and nation.

This may be accomplished in three ways: (1) by the construction of reservoirs and irrigating works and the adoption of an irrigation system under the direction of the general government;

(2) through the agency of irrigation companies; and (3) by the states controlling the waters within their respective borders.

On March 20, 1888, Congress passed a joint resolution directing the Secretary of the Interior, through the direction of the Geological Survey, to make an examination of that portion of the arid region where agriculture is carried on by means of irrigation, as to the natural advantage of the storage of water, and the practicability and cost of construction and capacity of reservoirs, and such other facts as bear on the question of the storage of water for irrigation purposes. This resolution was followed by legislation making appropriations to enable the Director of the Geological Survey to make the necessary examination, and he was authorized to select sites suitable for the storage reservoirs contemplated by the resolution, which were to remain segregated and reserved from entry, occupation, and settlement until otherwise provided by law. Under this authority 120 suitable sites have been selected, and the lands covered by such selections have been reserved from entry, occupation, and settlement, but to this day no provision has been made for their utilization.

The plan of reclamation through the agency of land and irrigation companies would not, in my judgment, be commended by the people, and although it might be effective in putting under irrigation all the territory possibly susceptible of irrigation by the water that could be stored, yet it would hardly be possible to make such limitations and restrictions upon a grant of such power as would absolutely protect the settler against extortion and oppression.

The third appears to be the most feasible plan for the utilization of the arid lands. The right to the use of the water being under the absolute control of the state, it would, if it controlled the land also, be enabled so to direct and govern the appropriation of it as to secure, by a judicious selection of the lands to be irrigated, the most economical and practical use. It would enable the state to check the waste growing out of faulty construction of dams and imperfect systems of applying water. The settler on a tract of desert land who has acquired a right to the use of water is interested solely in the application of it to his particular tract, with no responsibility for its economical use. The land is abundant, but the water is scarce, and if we expect to reap advantages by utilizing the water to the greatest extent, it must be accomplished by reclaiming the lands before they are disposed of. This can be accomplished more effectively by the states than through the general government or other agencies.

The state of California has adopted a policy, based upon the principle of state or common ownership in natural waters, which provides for the ownership by communities of works for the storage and distribution of waters for irrigation purposes. This law, known as the Wright law, which has recently been declared constitutional by the Supreme Court of the United States, has been adopted, I believe, by nearly all the arid land states. It provides for the organization of irrigation districts wherever fifty or a majority of the owners of lands susceptible of one mode of irrigation from a common source and by the same system of works desire to provide for the irrigation of their holdings.

It also provides for the creation of a board of directors, who have power to purchase lands, water and water-rights, and to construct the necessary reservoirs and irrigation works. It also authorizes the issuance of bonds to raise money for the construction of such works, which bonds are to be paid out of revenues derived from annual assessments upon the real property of the district, and all such property subject to taxation by the state is liable to such assessment. I do not attempt to give details, but simply the general features of the law, to show how unjustly it would operate in a district where there was a tract of vacant public land. This land would be susceptible of irrigation by the same system and from the same common source, and would therefore be materially enhanced in value by the construction of irrigation works at the expense of the inhabitants of the district, although the government would not be liable to contribute to it, for the reason that the government lands are not subject to taxation by the state, and are therefore not liable to the assessment. This inequitable feature could be removed if the title to the lands were in the state.

In the arid region an average of about 76 per cent of the land is in the hands of the government. In Nevada about 95 per cent of the area is vacant. These lands contribute nothing to the revenues of the state. With its taxable resources so diminished it is impossible for the state to undertake a system of irrigation. They should be so disposed of as to make them available as resources from which the state may increase its revenue.

The states in the arid region have established laws for the acquisition and protection of riparian rights, based upon the doctrine of priority of appropriation. This has been rendered necessary by the failure of the general government to formulate a uniform system for the protection of the rights of parties and to secure the economical distribution of the water. Under these laws, which differ in many material respects, rights have been acquired, so that a uniform system could not now be established without involving irrigation interests in serious conflicts. It can be remedied only by giving to each state control of its arid lands, to be reclaimed and disposed of under their separate systems.

The advantages that would accrue to the state through the control of the land and water are, in a measure, attained by the act of August 19, 1894, known as the Carey Act. This law authorizes the Secretary of the Interior to contract with any of the desert land states to donate to the states, free of cost, such lands, not exceeding 1,000,000 acres in each state, as the state may cause to be irrigated, reclaimed, occupied, and cultivated by actual settlers. It also authorizes the state to make all necessary contracts for causing the lands to be reclaimed and for inducing settlement and cultivation, but the state is not authorized to lease or dispose of the lands except to secure their reclamation, cultivation, and settlement.

It is in the nature of a grant, limited in quantity, and conditioned upon reclamation and cultivation. It contemplates that the reclamation shall be accomplished by private capital, but as the land selected cannot be disposed of until it has been patented to the state, it fails to give the state sufficient control over the lands to enable it to pledge them as security for their reclamation, and hence it cannot contract for the construction of works on the most favorable terms. If this law were amended so as to provide for the granting of the lands to the state upon application, leaving the state free to contract for their reclamation and to pledge the lands as security therefor, it would be of practical benefit, and under its provisions the state might be enabled to secure the reclamation of all the lands within its limits that could be utilized. As it is, but two states have applied for its benefits, and the feasibility of the scheme for the reclamation and disposal of the arid lands is yet to be ascertained.

With this condition confronting us, can there be any valid reason urged against the cession of these lands to the states, and may we not go farther and inquire if there is any reason why the trust imposed upon the general government for the disposal of all the public lands may not safely be delegated to them? The cession of the Northwest Territory was made upon the express condition that the ceded lands should be considered as a common fund for the use and benefit of all the states and should be disposed of for that purpose and for no other purpose whatever. During the existence of the Confederation and in the earlier decades of the Republic, it was clearly contemplated that the lands so acquired, as well as those acquired by purchase and treaties, could only be disposed of for the purpose of revenue for the redemption of the public debt, and that any other disposition of them would be a violation of the trust.

But the policy has gradually changed from a system of sales for revenue only to that of free homes for the people. For the past twenty years the tendency of legislation has been to repeal all laws authorizing the purchase of the public lands by cash entry and to subject them to homestead entry only. In 1889 a law was passed withdrawing from private cash entry all the public lands, except in the state of Missouri, which was followed by the act of March 3, 1891, repealing the preëmption law and declaring that no public lands of the United States, except abandoned military or other reservations or isolated and disconnected tracts and mineral and other lands of a special nature having local application, shall be sold at public sale. Since the passage of this law isolated tracts are not subject to public sale until they have been subject to homestead entry for three years after the surrounding land has been disposed of and abandoned. Military reservations containing more than 5,000 acres are now subject to homestead entry only. The public lands are therefore no longer to be disposed of with a view to the revenue to be derived therefrom.

Besides, less than thirty years ago a great part of the vast territory west of the Mississippi river was Indian country, to which the Indian title had not been extinguished, and was practically unorganized territory. Since then all of what was commonly known as the Indian country has been ceded to the United States and become a part of the public domain. The Indian title has been extinguished as to all the territory formerly occupied as hunting grounds, in consideration of which diminished reservations of a permanent character have been established. From time to time states have been admitted into the Union, until the entire country is now divided into separate sovereignties, with all the rights, powers, duties, and privileges of the original states, except the organized territories of Arizona and New Mexico, which are knocking at the door for admission to the sisterhood.

THE MAZAMAS

There was organized on the summit of Mount Hood, on July 19, 1894, a society of mountain-climbers called the Mazamas, whose qualification for membership is the ascent of an acceptable snow-capped peak. Remarkable as it may seem, so much enthusiasm was aroused at that time that 193 people ascended 11,225 feet to attend the meeting. W. G. Steel, one of the leading spirits of the occasion, was made the first president of the organization.

The objects of the society are mountain exploration, the protection of forests and scenery, and the acquisition and dissemination of knowledge concerning them. In the summer of 1895, with Mr Steel again as president and T. Brook White as secretary, parties were organized to ascend Mounts Baker, Rainier, Adams, Hood, and Jefferson and establish intercommunication by heliotroping, but, owing to the smokiness of the atmosphere, the latter part of the program could not be carried out.

With Mr C. H. Sholes as president and Rev. Earl M. Wilbur as secretary, the society continued its enthusiastic work in the spring of 1896 by publishing the first number of a magazine called *Mazama*, a record of mountaineering in the Pacific northwest. This publication contains, besides the presidential addresses, the reports of the historian for 1894 and 1895, and other matters relating to the society, the following papers: The Flora of Mount Hood, by Thomas Howell, who mentions 272 species growing above 2,000 feet; The Elevation of Mount Adams, by Prof. Edgar McClure, who states the height of the mountain, as determined by averaging three hourly readings of a mercurial barometer compared with three synchronous readings at Seattle, Portland, and Eugene, to be *12,401.9 feet; The Heliotrope in Mountaineering, by T. Brook White, describes the instruments used and the Morse code; The Flora of Mount Adams, by W. N. Suksdorf and Thomas Howell, enumerates 480 species (excluding mosses and lichens) above 2,000 feet; in The Glaciers of Mount Adams Prof. W. D. Lyman estimates that at the timber line there are 8 or 10 glaciers, but only 3 are described as larger than those of Mount Hood. The veteran geologist of Oregon, Prof. Thomas Condon, describes the ice-caves of Mount Adams, which years ago furnished the ice for the city of Portland. He ascribes the cold-storage feature of the caves to currents of cold air descending from the mountain along the tunnels once filled with molten lava from the same source. Under the title of The Klamath Mountains the present writer calls attention to the geologic and topographic relation between the Sierra Nevada and the Cascade and Coast ranges.

The Mazama excursion of August, 1896, was to Crater lake, in connection with the Crater Lake clubs of Medford, Ashland, and Klamath Falls in southern Oregon. In all, nearly 500 people attended the meeting, a number of them also ascending Mount Pitt. By previous arrangement

*See Nat. Geog. Mag., Vol. vii, No. 4, pp. 151–153.

four government parties met the excursionists at Crater lake and endeavored in various ways to promote the success of the occasion. B. W. Evermann, of the Fish Commission, studied the fish food and spawning grounds of the lake and made some interesting observations on the lake temperature. Dr C. Hart Merriam, chief of the Biological Survey of the Agricultural Department, assisted by Vernon Bailey and Edward A. Preble, collected a large number of animals about the rim of the lake and upon the island, and Mr F. V. Coville, the Department Botanist, assisted by Mr Lieburg, made a large collection of plants. A geological party under the charge of the writer prepared a geological map of the region. The heads of all the government parties, as well as many others, were called upon for camp-fire talks, addresses, or recitations concerning matters of scientific and popular interest, especially relating to Crater lake. The proceedings were opened August 18 by the Klamath Falls club before the Mazamas arrived, but thereafter the great camp-fire of the Mazamas was the rendezvous after the excursions of the day. Among the excursionists, aside from the government parties, were a number of botanists and zoölogists, as well as geologists and professors of various departments. Many were armed with cameras to carry away permanent impressions of the lake. As a whole the excursion was a great success, and its fruits are to be found, not only in the widespread interest aroused in such proceedings, but also in the forthcoming number of the *Mazama*, which is to contain full accounts of the lake, both popular and scientific, from various contributors. J. S. Diller.

GEOGRAPHIC LITERATURE

Elementary Geology. By Ralph S. Tarr, Professor of Dynamic Geology and Physical Geography at Cornell University. Pp. xxx + 499, with 25 plates and 268 other illustrations. New York: The Macmillan Company. 1897. $1.40.

This is a refreshing book. In the first place the type is large and well leaded, and the printers have realized the true function of punctuation and largely omitted brain-wearying dots in useless places; so the eye is attracted by the clean-cut pages. In the second place illustrations are freely used to supplement the succinct text, and nearly all the pictures are photo-mechanical reproductions from nature; even the minerals and fossils are represented mainly by half-tone engravings; thus the facts of nature are represented with a vividness and brought home to the understanding with a vigor not to be attained in any other way. Again the author has realized, at least in some measure, that the progress of knowledge is ever from the remote toward the near, and he has had the courage to directly assail the last fortress of the unknown by depicting the everyday and commonplace features of the earth which every child may see, and by explaining the principles of earth-science in terms of common things; no geologic book ever written is less affected by mysticism, scholasticism, metaphysics, dialectics, and other pernicious vestiges of intellectual barbarism. Then the work must appeal to the teacher, because it is adapted to youth and because it fills a need not quite met by any previously issued text-book.

After an introductory chapter the work is divided into three parts, viz., (1) Structural geology, (2) Dynamic geology, and (3) Stratigraphic geology. Professor Tarr half apologizes in his preface for the space given to the second of these divisions; but he might well have spared the explanation and even doubled this eminently practical and useful part of the treatise. The third "part" might better have been divided in name, as it is in fact, into paleontology, or the history of life on the globe, and the geographic development of the continents; for the treatment is essentially historical and not at all stratigraphic. Then it would have been in accord with the general method of the book, which is the emphasis of the actual and the near, to give relatively more space to the life of the later ages; also, and more especially, to explain the earlier stages in geographic development of North America in terms of the later stages. Unfortunately these later stages, which are in themselves of great interest and are now well understood, receive but little attention. The chief imperfections in the work lie in incompleteness of the treatment from the point of view of the geographer, and are due to the fact that it is a complement to the same author's "Elementary Physical Geography." In the main, the facts and principles of geology are well generalized and happily expressed. W J M.

The Lessons of Erosion Due to Forest Destruction. Chart. The U. S. Department of Agriculture. Washington, 1896.

A part of the exhibit made by the United States Department of Agriculture at the International and Cotton States Exposition held in Atlanta during the autumn of 1895 was a series of three models representing (1) the soil destruction consequent on the removal of forests, (2) the processes required for reclamation in the same tract, and (3) the same tract as reclaimed and restored to pristine fertility and productiveness. These models were carefully executed by Howell, under the direction of Bernhard E. Fernow, Chief of the Forestry division, with the co-operation of several geologists, particularly W J McGee. These models attracted much attention, and their exhibition in the region in which old-field erosion is particularly active was undoubtedly productive of much good. Recently the features of the models have been reproduced by chromolithography in the form of a large wall-chart, for distribution among agriculturists and others. The reproduction, unhappily, is not equal to the models in accuracy of representation, and will hardly be serviceable for educational purposes save in a single direction, viz., in attracting attention to a subject of great economic importance in many parts of the country. W J M.

Preliminary Report on the Income Account of Railways in the United States for the Year ending June 30, 1896. Interstate Commerce Commission. Pp. 68. Washington, 1896. Prepared by the Statistician to the Commission.

During the fiscal year 1895–96 the railways of the United States, having an operated mileage of 172,369 miles of line, earned in gross $1,123,646,562.

The operating expenses were $754,971,515, leaving an income from operation of $368,675,047. Two-thirds of the gross earnings were absorbed in operating expenses, leaving one-third as income from operation. High-water mark in railway earnings, as represented by gross earnings and income from operation per mile of line, was reached in 1891–92. In that year gross earnings per mile of line were $7,213, and the income from operation was $2,404. From that time until 1894–95 the gross earnings diminished, and in that year reached their lowest point, which was $6,050 per mile. The income from operation reached its lowest point in 1893–94, when it was $1,946. In 1895–96 the gross earnings had increased to $6,519 and the income from operation to $2,139 per mile. It is evident from these figures that the lowest point in the business of transportation has been passed, and that this branch of business is on the upgrade. This gain is not confined to any one part of the country, but is shown to extend to all parts, with the exception of the states of Louisiana and Texas. The dividends declared by the roads during the year aggregated $54,983,732, an amount almost identical with that of the preceding year.

H. G.

Smithsonian Miscellaneous Collections, No. 1039. Virginia Cartography. A Bibliographical Description by P. Lee Phillips. Washington, 1896.

This is an exhaustive account of the early maps of Virginia. Special attention is given to John Wyth's map of 1585, Capt. John Smith's map of 1608, and that of Augustine Herman of 1670. Of the multitude of maps published in recent years only a few are listed, and it is difficult to see upon what basis selection was made, unless it be the fact that they happen to be represented in the Library of Congress. A singular omission is that of the sheets of the U. S. Geological Survey, which constitute the modern mother map.

H. G.

GEOGRAPHIC SERIALS

The Bulletin of the Geographical Club of Philadelphia for December comprises "A Trip to Manika Land," by J. Edward Farnum. This is a little known region in southeastern Africa, just south of Zambesi river. The article is accompanied by a sketch map.

The Journal of Geology for November-December, 1896, is of special interest from a geographic point of view. It opens with an article on "The Age of the Auriferous Gravels of the Sierra Nevada," by W. Lindgren, of the Geological Survey. These gravels were carefully studied by Prof. J. D. Whitney, who assigned them to the Pliocene age. Mr Lindgren assigns a somewhat greater age to these beds, placing them in the Miocene or even Eocene, the evidence upon which his conclusions rest being mainly derived from plant remains. Mr Harry Fielding Reid contributes an exceedingly interesting article upon the "Mechanics of Glaciers," and Prof. R. D. Salisbury a paper upon "The Loess in the Wisconsin Drift Formation." Mr Carlos Sapper contributes an article on the 'Geology of Chiapas, Tabasco, and the Peninsula of Yucatan," accompanied by a small sketch map of this little known region. Another contribution by Prof. R. D. Salisbury, entitled "Studies for Students," treats in outline of glacial phenomena.

The Scottish Geographical Magazine for January, 1897, contains as its leading article a paper by Dr John Murray on the "Temperature of the Water of the Scotch Lakes." The observations, which are tabulated in extenso, show as a rule a slight increase of temperature from the surface down to three or four fathoms, and a gradual reduction in temperature down to the greatest depths obtained, viz., 80 fathoms. The article is illustrated by diagrams, which admirably summarize the results.

The Geographical Journal for January, 1897, contains a number of articles of interest, among them being accounts of journeys and explorations in Malay, Africa, Australia, and South America. These are, "A Journey Through the Malay States of Trengganu and Kelantan," by Hugh Clifford; "Researches in Karia," by W. R. Paton and J. L. Myres; "Journeys in Gosha and Beyond the Deshek Wama," by Clifford H. Craufurd; "Lake Mweru and the Luapula Delta," by A. Blair Watson; "Journey from Western Australia to Warina, in South Australia," by W. Carr Boyd. Mr W. L. Sclater continues his series of articles on "The Geography of Mammals," the present article being devoted to the Nearctic region. Mr George G. Chisholm has an article on the "Distribution of Towns and Villages in England," especially with reference to their geologic location, an aspect which is beginning to receive attention.

The Bulletin of the Sierra Club of California opens with an ascent of Mount Lefroy, in the Canadian Rockies, which resulted in the death of Mr Philip Stanley Abbot. Mr Bolton Coit Brown contributes a pleasant sketch entitled "Wanderings in the High Sierra between Mount King and Mount Williamson." The mountain-climber is advised by Mr Howard Longley "What to Take and How to Take It." Mr J. M. Stillman writes of a "Trip to Tehipite Valley from the Kings River and Grand Cañon," and Theodore S. Solomons upon "An Early Summer Excursion to the Tuolumne Cañon and to Mount Lyell."

The Bulletin of the American Geographical Society, Number 4 of the year 1896, opens with a brief summary of the "Topographic Work of the U. S. Geological Survey in 1895." Signor Romero, the Mexican Minister to the United States, furnishes a most admirable descriptive article on the topography, climate, people, government, and resources of his country. It is well that we should have a better knowledge than we have hitherto possessed of our next-door neighbor on the south. Mr J. V. Brower has an article entitled "The Utmost Waters of the Missouri River." The region described, the headwaters of Red Rock creek, Montana, was explored twenty-five years ago, and has since been subdivided by the General Land Office, which by running a line at every mile—east, west, north, and south—surely leaves little room for geographical discovery.

The Geographical Society of Lima, Peru, publishes a report, accompanied by a map, on the "Navigability of the Eastern Rivers of Peru." The map summarizes the information contained in the report, showing, by means of symbols, the head of navigation of the rivers.

The Journal of the Tyneside Geographical Society gives considerable space to Arctic exploration, the first article being on the Jackson-Harmsworth expedition, by Mr A. Montefiore Brice, and the second upon Nansen's expedition, by Professor Mohn. "The Resources of Canada" are treated by Sir Donald A. Smith. It seems strange that with such wonderful resources of soil, climate, and minerals as Canada is said to possess, its development has been so slow. The exceedingly interesting lecture on Venezuela, delivered before the National Geographic Society by Prof. Wm. E. Curtis, is republished in this magazine. Sir Frederic Goldsmid continues in this number his papers upon "Persia and Her Neighbors."

H. G.

PROCEEDINGS OF THE NATIONAL GEOGRAPHIC SOCIETY, SESSION 1896-'97

Regular Meeting, January 8, 1897.—Vice-President Merriam in the chair. Mr J. S. Diller addressed the Society on the subject of Crater Lake, Oregon, with lantern-slide illustrations.

Special Meeting, January 15, 1897.—President Hubbard in the chair. Mr Sidney Dickinson, M. A., F. R. G. S., lectured on Picturesque New Zealand, with lantern-slide illustrations.

Regular Meeting, January 22, 1897.—President Hubbard in the chair. Mr T. S. O'Leary read a paper entitled "Winds and Their Uses, with some Types of Ocean Weather," illustrating his subject with lantern slides.

Special Meeting, January 29, 1897.—President Hubbard in the chair. Major Henry E. Alvord, C. E., read an address, illustrated by lantern slides, on the Geography of a Battle, with special reference to the battle of Cedar Creek, October 19, 1864.

Regular Meeting, February 5, 1897.—President Hubbard in the chair. Joint meeting with the American Forestry Association. Dr B. E. Fernow read a paper entitled "The Gardens, Forests, and Deserts of Arizona," with lantern-slide illustrations.

Special Meeting, February 12, 1897.—President Hubbard in the chair. Hon. Wm. L. Wilson, Postmaster General, read a paper, with incidental anecdotes and recollections, on the Development of the United States Postal Service.

Elections.—New members have been elected as follows:

January 12.—Henry Black, Jos. R. Buckalew, J. Ross Colhoun, Arthur J. Collie, Geo. E. Corson, Arthur B. Crane, Miss Ida R. Hamaker, Alvin M. Lothrop, Miss Leontine Mackay, Hon. R. E. Preston, W. C. Ralston, Miss Isabella Read, Miss Alice B. Sanger, W. A. Shaw, Dr Max West.

January 22.—Francis B. Austin, Jas. O. Broadhead, Ellwood P. Cubberly, Mrs A. M. Davis, Chief-Eng. Jas. A. Doyle, U. S. R. M., C. C. Duncanson, G. S. Hobbs, Capt. D. H. Kelton, U. S. A., Dr Fridtjof Nansen (honorary), Hon. Edward Lee Plumb, T. C. Powell, Col. Wm. H.

Powell, U. S. A., Albertus McCreary, H. D. Mirick, E. J. Shives, Edward A. Wright.

February 11.—Col. C. J. Allen, U. S. A., M. W. Baldwin, Miss M. S. Booz, Hon. Chas. A. Boutelle, M. C., Oscar Fitz Clifford, James Fraser, E. B. Grandin, Edward Graves, Gen. John P. Hawkins, U. S. A., Leander L. Hawkins, Mrs Mary A. Hepburn, Dr David J. Hill, J. Q. Kern, Frank M. Kurie, C. E., F. A. Lester, Miss Julia C. Lindsley, Miss Harriet A. Luddington, Edgar A. Lynham, Mrs Mary K. Matthews, Mrs B. S. McDonald, F. W. Pettigrew, C. E., Warren W. Phelan, J. Q. Redway, F. R. G. S., P. C. Riley, James Edgar Smith, Herbert G. Squiers, George B. Starkweather, Frank B. Taylor, Matthew Trimble, Thos. P. Woodward.

MISCELLANEA

The North American Review for February contains a valuable article by John Hays Hammond, from which the following items of interest are abstracted: From 1887 to 1895 the Transvaal produced gold to the value of $158,750,000, $144,000,000 of which came from the Witwatersrand district. The central part of this district, 27 miles of reef, is expected to produce $3,000,000,000 of gold, of which two-thirds is in the central section of 11.5 miles; its output for 1896 was $37,000,000, or about 16 per cent of that of the entire world. California produced up to January, 1897, $1,282,000,000 in gold, three-fourths being from placers. Kimberley has produced upwards of twelve tons of diamonds, representing a value of $400,000,000; the present annual production is about 2,500,000 carats, of the value of $20,000,000. A. W. G.

The Rajputs and Brahmans of India are breaking down the barriers of caste and displaying in competition with the Anglo-Saxon race that brilliance and subtlety of intellect for which they are distinguished. Prof. Jagadis Chunder Bose, of the University of Calcutta, has excited the astonishment and admiration of all Europe by his recent papers on the Determination of the Indices of Electric Refraction and of the Wave-lengths of Electric Radiation. The highest honors of the India Civil Service examinations for 1896 also fell to a Hindoo, who vanquished in a keen intellectual encounter many candidates with distinguished academic careers. In England Prince Ranjitsinhji has taken high university honors, besides securing by the brilliancy of his play the very foremost place in the great national game of cricket. Several Indian barristers have won their way into the higher ranks of the legal profession in London, an Indian physician was recently elected to the staff of one of the London hospitals, and two highly educated Indian surveyors are working in British Central Africa. In November the University of Oxford conferred the degree of Doctor of Music upon Rája Svi Sourindro Mohun Tajore, of Calcutta, the principal exponent of the theory of Indian music, who has for 31 years devoted his wealth and talents to the development of music among his countrymen. In this case, however, the recipient of the distinction was unwilling to lose caste, even temporarily, by crossing the ocean, and the degree was conferred *in absentia*. J. H.

THE NATIONAL GEOGRAPHIC SOCIETY

The Forthcoming Course of Lectures on the Effects of Geographic Environment in Developing the Civilization of the World

As supplementary to the general synopsis of this Course, published in the January number of The National Geographic Magazine, the following special synopses have been furnished by the different lecturers:

March 1. *The Effect of Geographic Environment in the Development of Civilization in Prehistoric Man*, by Hon. Gardiner G. Hubbard.

The civilization of man did not originate from within, but has ever been the effect of geographic environment, pressing from without.

While civilization has been on the whole beneficial, yet every advance has been accompanied by suffering and death. Man was originally subject to nature and depended on nature for his food and habitation, and was even less provided than many other animals.

The joy and suffering of the savage were less than those of civilized man, for care and responsibility come with civilization.

Civilization has never advanced steadily in any country or any age. After remaining stationary for ages and often retrograding, beginning in the Orient it has gradually traveled westward, save in its early progress to China in the east and to Egypt in the south.

Nearly three-fourths of the earth have always been and are now occupied by savages or barbarians and nomad races. Three-fourths of the population are civilized and occupy the remaining quarter of the globe.

The earliest remains of man are found in banks of rivers and in caves in England and France, and are accompanied by bones of animals, either long since extinct or now living in the arctic or torrid zones, showing the great antiquity of man, and his manner of life and implements of offense and defense.

Savage and barbarous nations obtain all their food from nature, and, like many animals, have no care or thought for the morrow; this uncertainty of life leads to recklessness and idleness.

The first step in advance seems to have been made by the inhabitants of central Asia, where the geographical environment furnished inducement for the life of the nomad, for here was the home of the sheep, goat, and horse. They were obliged to care for their flocks morning and night, and in summer provide for winter. Thus they were trained in ways unknown to the savage, and took the first step toward civilization. These nomads have never made further progress; they live the same life today in Arabia and central Asia that they have lived for thousands and perhaps tens of thousands of years.

The next step in civilization, and the first progressive step, was in countries like Egypt, Mesopotamia, and China, where rivers overflow their banks and irrigate the desert, and where the people were taught of necessity to dig irrigating ditches. The land yielded luxuriantly and with little labor, so a large population was soon gathered, and men were thus brought in close contact—for there can be no progressive civilization without the intimate contact of man with man. This contact is impossible where men live by hunting, or by pasturing cattle, for then one man requires for his support the same territory that will sustain many civilized men.

The civilization of Egypt and Mesopotamia was of a low order, for there could be neither liberty of thought nor of action where there were only two classes, master and servant.

Under the Patriarchal system the father was the head of the family, the children were subject to him and the property belonged to him. As the families increased, the successor of the father, the oldest or most powerful son, became in like manner the patriarch. We see these features exemplified in the life of Abraham, who had absolute control over the life of Isaac.

The continuance of this despotism and slavery in Babylon led to luxury, decay, and the extinction of civilized life.

It was not until civilization reached Greece that personal freedom, with liberty of mind and body, was obtained, and only then was the commencement of arts, science, and true civilization.

March 8. *Babylonia*, by William Hayes Ward, D. D., LL. D., of *The Independent.*

It is still uncertain whether civilization began in the Nile or the Euphrates valley. Babylonian history must now be pushed back a thousand years or more beyond Sargon of Agane, who lived 3800 B. C. It is generally asserted that civilization must begin in a river bottom which affords abundant food for a dense population and compels division of labor. Record of civilization begins with writing: all progress before it is prehistoric. Writing was independently invented in these two valleys. The Nile and Euphrates valleys had important differences, though alike in climate and fertility. The Nile valley is accessible only at its lower end, protected on the sides by desert and at the upper end by cataracts. The Euphrates valley is easily attacked from the north towards Syria and Armenia, and from the east towards Elam, and was liable to be overrun by barbarous hordes. The composite Euphrates and Tigris valley differs from the Nile valley in the nature of its floods. The Tigris flood comes first, and the flood is not so much welcomed as guarded against. Irrigation by canals is of first importance. Babylonia is a land of natural swamps, where the mounds of old cities and the banks of great canals are the chief feature of the landscape. As soon as irrigation ceases all returns to desolation. The valley has advanced more than a hundred miles into the Persian gulf since its first cities were built.

In the Nile valley the date palm was first cultivated, while wheat and barley came probably from the Euphrates region. Very ancient monuments show gods adorned with grain and honored with the plow. The native fauna included the buffalo, the wild ox, the ass, the sheep, and the goat, all domesticated in the earliest times and providing an unequaled basis for incipient civilization.

These natural advantages allowed a dense population, but the danger of invasion, especially from Elam, compelled the population, which from the beginning had had to fight lions, leopards, and wild oxen, also to fight their neighbors. This developed a more warlike race than inhabited Egypt. Barbaric invasions also gave a more composite population, and necessitated civil wars. From the beginning of history we find Babylonia attacking Elam on the east and reaching, to the north and west, as far as the Mediterranean. Before the eighteenth Egyptian dynasty Egyptian influence had hardly entered Asia, while Babylonia ruled as far as Cyprus, and it was Babylonian culture which controlled Asia Minor and all the coast, created the Assyrian and Hittite people, and through these and the Phœnician trade gave the chief impulse to Greek civilization.

March 15. *Syria*, by Rev. Dr. Thomas J. Shahan, of the Catholic University of America.

Syria: Its human interest; from time immemorial a battlefield; the scene of West Asiatic conquest and defeat. The empires of Egypt and Africa. The Lombardy of the Orient. The forum of eastern and western civilizations. The converging point of far Eastern trade. Emporium for other Mediterranean nations and the far West. The Phœnician era. Tyre and Sidon. Colonies. The place of ancient Syria in letters, art, and politics.

Orographical formation: Rivers; Table-lands; The Great Steppe. Vegetation.

Geological formation: Cretaceous limestone of the plateaux. Basaltic peaks. Alluvial lands. Clay soils of the Steppe.

Political geography: Pre-Egyptian inhabitants. Egyptian conquest. A subject state of Assyria, Babylonia, Persia. The inheritance of the Greek generals of Alexander. Armenian and Parthian masters. Becomes part of the world-empire of Rome. Chief bazaar and art-museum of the empire. The causes of its decline and early conquest by Arab invaders. Islam and Syria.

March 22. *Tyre and Sidon*, by Professor Thomas Davidson, M. A., of Brooklyn, N. Y.

The Phœnicians a branch of the Semites. The Semitic character and form of social union. Religion. Devotion to industry and trade. The extent of Semitic civilization. Homeric Greece and the civilization of Agamemnon Semitic.

The Semitic character as affected by surroundings; by the desert (Arabs); by the fertile land (Babylonians, etc.); by mountains and sea (Phœnicians). Phœnicians unwarlike but enterprising. Nature of their civilization, industry, and trade.

Two phases of Phœnician civilization, represented by Sidon and Tyre. In the west, we can trace the former by the deities Poseidon (*i. e.*, Baal-Sidon) and Amphitrite (*i. e.*, Aphrodite); the latter Heraklês (Melcarth) and Pallas (*i. e.*, Baalat) Athenâ. The quarrel between Poseidon and Pallas: the Parthenon group. The Olympia metopes.

The extent of the Phœnician trade, and its effect upon the countries visited. They double the Cape of Good Hope. The Phœnician colonies, Carthage, etc., and their civilization: its strength and weakness. Want of idealism and political sense. The dangers of a merely industrial civilization. Why Carthage succumbed to Rome.

The world's debt to Phœnicia, as an example of industrial enterprise, unrelieved by art, literature, or science.

March 29. *Greece*, by Professor Benjamin Ide Wheeler, LL. D., of Cornell University.

Greece: how its geography explains its history.

Its position. The outpost of Europe; though removed from it by its peninsular form, not severed from connection with it. Greek ideas are representative occidental ideas. The contrast of occidentalism and orientalism. Joined to Asia by a bridge of islands and by the navigable Ægean. Hence open to the reception of eastern ideas and motives, but secured in its capability of assimilating them. The extent and nature of eastern influence. Surrounded by the Mediterranean, hence a distributing medium. Its primacy in Mediterranean civilization. Relations of this civilization to modern European civilization.

Its geography. The irregularity of its coastline. Proximity of all its parts to the sea. Abundance of sheltered beach-harbors. Absence of great rivers. Contrast with the great river civilization of Egypt and Mesopotamia. Partition into districts by mountains. Features of mountain chains: not impassable barriers. Plains of limited size: these encourage particularism and a consciousness of the power of individual initiative. Plains mostly accessible to the sea. Communication by sea rather than by land encouraged. Opened outward rather than inward, motive to union lessened. Variety in relative location of the plains productive of variety in conditions of life, and hence of social and political ideas. Greece a mosaic. The islands so numerous as to set a standard of political and material existence. Extension of the analogy to the Athens of Themistocles and Pericles. Citadels treated as islands.

Its size and the distances between its ports. Superficial area. Distance between important points. Routes and methods of communication. Effect of dimensions upon the Greek sense of proportion and upon the stimulation of individual energy.

Climate and products. Temperature and contrast of seasons. Outdoor life. Sociability. Democracy. Interest in athletics. Winds. Effect on commerce. Rainfall and fertility. Products of soil. Bent toward commerce rather than agriculture. Urban life and attitude toward farmers.

Important sites. Cities: Sparta, Thebes, Corinth, Athens, and their geographical characteristics. Battlefields: Marathon, Mantinea, Chæronea, Salamis. Festal places: Olympia, Delphi.

Impressions of Greek scenery.

April 5. *Rome*, by Rev. Dr ALEX: MACKAY-SMITH, of Washington, D. C.

The name: its significance in history. Differentiation from other world-forces. Its position. The people who founded it. Environment. Mixture of races. The resultant in terms of character. The opportunity of Rome. Clearing the way. The enlargement of power. What the sea did for Rome. What Rome did for man. Evolution and involution. Its growth in certain virtues. The vice of those virtues. The virtue of those vices. The wings and claws of the eagle. The culmination of glory. The sphere of influence. Why the Republic became an Empire, and the Empire waned. Roots and fungi. The Imperial City: its splendor; what it stood for. The upheaval of new forces. Readjustment. The turning over of Europe. Fresh foci. The barbarian at the gates. Mediæval Rome. Its influence. Its rationale. Its weakness and power. The renaissance. Old foes with new faces. Its meaning in Art and Religion. Reverence and contempt. The dust-heap and ant-hill. The city of today. The "hiding of its power." What it means to the scholar, to the artist, to the traveler. Characteristics. The strength of ruins. The palimpsest of history.

April 12. *Constantinople*, by Prof. EDWIN A. GROSVENOR, of Amherst College.

Rome, though able to build up a universal empire, could no longer retain her place as the world's capital under conditions existent at the end of the third century. A change of site was absolutely necessary. A new world-capital must be planted on some spot possessed of four requisites: the positional, the strategic, the material, and the sentimental. Former emperors had perceived this fact, but the undertaking was beyond their power. The name of Constantine is immortalized and his statesmanship demonstrated in that he took definite and decisive action. Only after years of disappointed examination did he recognize the one preëminent site. "No city chosen by the art of man has been so well chosen and so permanent." The history and influence, the whole being of none other, has been so determined by physical causes, by environment. The spot once selected, the city was the creation of nature rather than the result of imperial decree. In the hands of its environment it was a passive and by means of its environment an active factor. It gave strength to the empire rather than derived strength from the empire. From 330 to 1204 it was the queen-city of the world. During those tumultuous nine centuries, while every other continental city was captured more than once, Constantinople did not once succumb to foreign attack.

The crowned heir of Rome and Italy, it was inevitably the heir of Athens and Greece. Hellenismos, deserting the Ilyssos and Kephissos, found its focal center on the banks of the Bosphorus, and under the name Byzantine was distinctly Greek.

When the world's front changed, Constantinople lost for a time its undisputed preëminence, but has never descended to a lower rank than that of capital of an empire. During the last centuries its political importance, because of its political possibilities, has constantly increased. Today the most stupendous problem of statecraft is the ultimate fate of Constantinople in case of modifications in the east. Its transference from the hands of the Ottomans involves a reorganization and readjustment of European interests no less momentous than resulted from the wars of the Reformation or of the French Revolution. There are but three possible solutions of the problem, none of them satisfactory to all and each distasteful to some one or more of the powers most directly concerned. Between these three time is to choose.

The lecture will treat as fully as possible of the many-sided city, but the central thought will be its political prominence and destiny.

April 19. *Venice and Genoa,* by Prof. William H. Goodyear, of the Brooklyn Institute of Arts and Sciences.

The German precision and the Byzantine culture in western Europe. The position of Italy in mediæval history as mediator for Byzantine influence in Europe. The Italian towns which were active in this influence. Predecessors of Venice and Genoa. The monuments of Genoa. The monuments of Venice. The painters of Venice.

April 26. *America.* Arrangements not completed.

(*These lectures will be delivered in the Columbia theater, Washington, D. C., on nine successive Monday afternoons, commencing March 1. Each lecture will be accompanied by lantern-slide illustrations.*)

"FROM FROST TO FLOWERS."

"The Chariot . . .
. . . of the Sun"

SUNSET LIMITED is the Southern Pacific's great train, running through solid from New Orleans to the Pacific Coast.

SUNSET LIMITED leaves New Orleans every Monday and Thursday, at 10 o'clock in the morning.

SUNSET LIMITED covers the 2006 miles to Los Angeles in 58 hours, and the 2489 to San Francisco in 75 hours.

SUNSET LIMITED is vestibuled throughout, steam heated and gas lighted.

SUNSET LIMITED has a ladies' parlor the full width and a third the length of a car, equipped with fine library, escritoire and writing materials, large easy chairs, etc.

SUNSET LIMITED has an equally commodious smoking and reading room for gentlemen, supplied in a similar manner.

SUNSET LIMITED has bath room, barber shop and buffet—luxuries the tourist will appreciate.

SUNSET LIMITED has a car containing seven drawing rooms, which can be used separately or *en suite*, each having private lavatory and toilet facilities.

SUNSET LIMITED has a sumptuous diner, which goes through with it and in which meals are served *à la carte*.

SUNSET LIMITED is accompanied by a maid whose services are at the disposition of lady passengers.

SUNSET LIMITED traverses a road where snow never falls and blockades and blizzards are unknown, and through a region of marvelous interest.

SUNSET LIMITED is at your service, and any Southern Pacific Agent will be glad to tell you all about it, or if you want to know more, send 10 cents in stamps to the General Passenger Agent, and a beautiful book of 205 pages, that will tell you all about the route, will be sent you.

S. F. B. MORSE,

General Passenger and Ticket Agent,

NEW ORLEANS.

Among the Contents of Forthcoming Numbers of

THE NATIONAL GEOGRAPHIC MAGAZINE

WILL BE THE FOLLOWING:

A Winter Voyage through the Straits of Magellan,

By ADMIRAL R. W. MEADE, U. S. N.;

Weather Forecasts and Storm Warnings,

By PROF. WILLIS L. MOORE,

Chief of the Weather Bureau;

A Summer Voyage to the Arctic,

BY G. R. PUTNAM;

The Siberian Transcontinental Railroad,

BY GENERAL A. W. GREELY,

Chief Signal Officer, U. S. Army,

—— AND ——

Down the Volga, from Nijni Novgorod to Kazan,

BY PROF. FREDERIC W. TAYLOR.

JUDD & DETWEILER, PRINTERS, WASHINGTON, D. C.

ol. VIII MARCH, 1897 No. 3

The National Geographic Magazine

AN ILLUSTRATED MONTHLY

Honorary Editor: JOHN HYDE

Honorary Associate Editors

A. W. GREELY W J McGEE HENRY GANNETT
C. HART MERRIAM ELIZA RUHAMAH SCIDMORE

CONTENTS

WASHINGTON
PUBLISHED BY THE NATIONAL GEOGRAPHIC SOCIETY

AGENTS IN THE UNITED STATES AND CANADA
THE AMERICAN NEWS COMPANY, 39 AND 41 CHAMBERS STREET, NEW YORK
PARIS: BRENTANOS, 37 AVENUE DE L'OPERA

Price 25 Cents $2.50 a Year

Entered at the Post-office in Washington, D. C., as second-class mail matter

THE

National Geographic Society

ORGANIZED, JANUARY, 1888

President

GARDINER G. HUBBARD

Vice-Presidents

MARCUS BAKER
WILLIAM H. DALL
G. K. GILBERT
A. W. GREELY
C. HART MERRIAM
HERBERT G. OGDEN

Treasurer

CHARLES J. BELL

Recording Secretary

EVERETT HAYDEN

Corresponding Secretary

HENRY GANNETT

Managers

H. F. BLOUNT
C. W. DABNEY, Jr.
DAVID T. DAY
JOHN HYDE
W J McGEE
F. H. NEWELL
W. B. POWELL
J. B. WIGHT

SECRETARY'S OFFICE, 1517 H STREET N. W., WASHINGTON

The National Geographic Society, the object of which is the increase and diffusion of geographic knowledge, has a paying membership of 1,400. Its membership is not restricted to practical geographers, but is open to any person in good standing who may be sufficiently interested in its work to seek admission. The annual subscription is: for active members, $5.00 per annum; for corresponding members, $2.00 per annum. Active members pay also an entrance fee of $2.00 on election. The National Geographic Magazine is sent regularly to all members, both active and corresponding.

Donations for the founding of Prize Medals and Scholarships are respectfully solicited.

MAP OF THE KOOTENAI

THE most complete map of the rich mining region of the **Kootenai** and adjacent territory in **Washington and British Columbia** has just been published by the

NORTHERN PACIFIC RAILWAY.

It is just what is needed by those going to that country or who desire to study and know about it.

The map is made in relief, is **25** by **18** inches in size between borders, and has in connection with it—on the same page—two smaller maps that show the relation of the region to the world at large.

SMELTER, TRAIL, B. C.

The principal drainage of the country is laid down in blue, the trails and roads are shown, the railways plainly indicated, the names of important towns printed in large black letters, and the topography is represented in brown. As far as the ore deposits are known, they are indicated in a general way by red lettering.

The country shown upon the map includes particularly the **Slocan, Kootenai Lake, Cariboo Creek, Deer Park, Nelson, Salmon River, Trail** or **Rossland**, and the **Boundary Creek regions.** It also shows the **Arrow Lakes** and **Lardeau country** and some portion of the **Okanogan region.**

The map is compiled from reliable and official data and shows the **Mining District Subdivisions** and the elevations of the mountains and lakes.

The opposite side of the sheet contains an accurate statement and description of the country, showing its discovery and development to the present time. The folder will be sent to any address, together with a copy of

WONDERLAND, '97,

our new tourist book, upon receipt of **six cents in stamps.**

CHAS. S. FEE,

General Passenger Agent, St. Paul, Minn.

SOUTHERN RAILWAY

GREATEST

SOUTHERN SYSTEM.

Penetrates with its main line or branches eight States South of the Ohio and Mississippi Rivers, and in conjunction with its friendly allied connections reaches all the commercial centers of the South and Southwest . . .

DOUBLE DAILY VESTIBULED LIMITED TRAINS

. . . BETWEEN . . .

Washington and Nashville via Salisbury, Asheville, Knoxville and Chattanooga.
Washington and Tampa via Columbia, Savannah and Jacksonville.
Washington and Memphis via Atlanta, Birmingham and K. C. M. & B.
Washington and New Orleans via Atlanta, Montgomery and Mobile.
Norfolk and Chattanooga via Salisbury, Asheville and Knoxville.

Pullman Sleeping Cars—Dining Cars—Day Coaches.
Additional Trains for local travelers . . . .

The direct line to the Winter Resorts of { FLORIDA, GULF COAST and TEXAS, ... MEXICO and CALIFORNIA,

—AND THE BEST—

Through Car Line to and from Asheville and Hot Springs—"The Land of the Sky."

Write for Map Folders.

R. D. CARPENTER, General Agent, 271 Broadway, New York City.
L. S. BROWN, General Agent Passenger Department, Washington, D. C.
J. H. WINGFIELD, Passenger Agent, Norfolk, Va.

S. H. HARDWICK, Assistant General Passenger Agent, Atlanta, Ga.
C. A. BENSCOTER, Assistant General Passenger Agent, Chattanooga, Tenn.
W. H. TAYLOE, Assistant General Passenger Agent, Louisville, Ky.

J. M. CULP, Traffic Manager. W. A. TURK, General Passenger Agent.

FLORIDA

THE SHORTEST, QUICKEST, MOST ATTRACTIVE ROUTE

IS BY THE LINES OPERATED OVER THE

Florida Central & Peninsular R. R.

THE FLORIDA CENTRAL AND PENINSULAR RAILROAD begins on the north at Columbia, runs through Savannah, Jacksonville, Ocala, Tampa, Fernandina, Gainesville, Orlando, and Tallahassee.

It is the direct route to take for St. Augustine, Lake Worth, and all East Coast points; for Miami, Key West, and Nassau; also for points on the Gulf of Mexico and Havana and for all the principal interior points in Florida. Three trains daily from New York during the tourist season, passing through Philadelphia, Baltimore, and Washington.

One of the finest trains in the country is the **NEW YORK AND FLORIDA LIMITED**, with Compartment Cars, Pullman Sleepers, Observation Cars, Dining Cars, and Passenger Coaches. This train leaves New York at **12.10** noon and arrives at Jacksonville at **3.30** p. m. next day, St. Augustine at **4.30** p. m.

The **CINCINNATI AND FLORIDA LIMITED**, another very elegant vestibuled train, makes the run in about **24** hours between Cincinnati and Jacksonville, via Chattanooga, Atlanta, Macon, and Everett.

The **ASHEVILLE ROUTE** is the scenic route (over the Carolina mountains) between Cincinnati and Jacksonville, via Knoxville, the Mountain Resorts, Columbia, and Savannah.

The **KANSAS CITY** through car route is by this road, via Fort Scott, Memphis, Holly Springs, Birmingham, Atlanta and Everett.

The **NEW ORLEANS** through sleeper route runs from New Orleans by Pensacola on this route and via the beautiful Middle Florida Country.

Remember that the **FLORIDA CENTRAL AND PENINSULAR** does not only go to Jacksonville, but distributes passengers by close connections all over the State.

Get **THE BEST INDEXED MAP OF FLORIDA** from any of our agents or from the General Passenger Agent.

J. L. ADAMS, Genl. Eastern Agt., 353 Broadway, New York.
W. B. PENNINGTON, Genl. Western Agt., 417 Walnut Street, Cincinnati, O.
WALTER G. COLEMAN, Genl. Trav. Agt., 353 Broadway, New York.
N. S. PENNINGTON, Traffic Manager, **A. O. MacDONELL**, Genl. Pass. Agt., Jacksonville, Fla.

FLORIDA

The Great Hotels OF THE East Coast Railway.

AT

ST. AUGUSTINE,
ORMOND,
PALM BEACH
AND
MIAMI.

KEY WEST AND MIAMI . . . STEAMSHIP CO.

THE BEAUTIFUL ROUTE TO

KEY WEST.

Ten Hours from Miami along the Florida Keys in daylight.

See local time card for sailing dates.

MIAMI AND NASSAU STEAMSHIP SERVICE

BETWEEN

Miami and Nassau, N. P.
(Bahama Islands),

Will be inaugurated about JANUARY 15th for the WINTER TOURIST SEASON OF 1897.

See advertisements for sailing dates.

For map of Florida and book Florida East Coast, address—

J. R. PARROTT, *Vice-President.* J. P. BECKWITH, *Traffic Manager.* J. D. RAHNER, *Ass't General Pass'r Agent, St. Augustine, Fla.*

CHESAPEAKE & OHIO RY.

THE F. F. V. LIMITED is one of the finest trains hauled over any railway track in America. It runs solid between Cincinnati and New York, the route from Washington being over the Pennsylvania system. It has every modern convenience and appliance, and the dining-car service has no superior if it has an equal. The road-bed is literally hewed out of the eternal rocks; it is ballasted with stone from one end to the other; the greater portion is laid with one-hundred-pound steel rails, and although curves are numerous in the mountain section, the ride is as smooth as over a Western prairie.

One of the most delightful rides in all the route is that through the New River valley. The mountains are just low enough to be clad with verdure to the very top, and in the early spring every variety of green known to the mixer of colors can be seen, while the tones in autumn take on all the range from brown to scarlet.

These facts should be borne in mind by the traveler between the East and the West.

H. W. FULLER, *Genl. Pass. Agent, Washington, D. C.*

The Mutual Life Insurance Company

OF NEW YORK,

RICHARD A. McCURDY, President,

IS

The Largest and Best Life Insurance Company in the World.

Assets over $220,000,000.

The Mutual Life has Paid since Organization . . . . Over $388,440,897 to Policy-holders.

The New Instalment Policy issued by this Company is admirably adapted to the wants of the Insuring Public.

EVERY DESIRABLE FORM OF POLICY IS ISSUED BY

THE MUTUAL LIFE INSURANCE COMPANY OF NEW YORK.

Burlington Route

TO

ST. PAUL
MINNEAPOLIS

BEST LINE
CHICAGO OR ST. LOUIS

Ripans Tabules cure headache.

The Fastest and Finest Train in the West . . . .

IS

The Overland Limited

......TO......

UTAH and CALIFORNIA.

UNION PACIFIC
THE OVERLAND ROUTE
WORLD'S PICTORIAL LINE

FROM 16 TO 20 HOURS
SAVED BY USING

"THE OVERLAND ROUTE."

Double Drawing-Room Pullman Sleepers.
Free Reclining Chair Cars.
Pullman Dining Cars.
Buffet Smoking and Library Cars.

Send for Descriptive Pamphlet "49-96,"
Folders and other Advertising Matter.
(Mention this publication.)

E. L. LOMAX,
General Passenger and Ticket Agent.
OMAHA, NEB.

National Geographic Monographs

On the PHYSICAL FEATURES OF THE EARTH'S SURFACE, designed especially to supply to teachers and students of geography fresh and interesting material with which to supplement the regular text-book.

LIST OF MONOGRAPHS COMPRISING VOLUME I:

GENERAL PHYSIOGRAPHIC PROCESSES	J. W. Powell
GENERAL PHYSIOGRAPHIC FEATURES	J. W. Powell
PHYSIOGRAPHIC REGIONS OF THE UNITED STATES	J. W. Powell
BEACHES AND TIDAL MARSHES OF THE ATLANTIC COAST	Prof. N. S. Shaler
PRESENT AND EXTINCT LAKES OF NEVADA	Prof. I. C. Russell
APPALACHIAN MOUNTAINS—NORTHERN SECTION	Bailey Willis
APPALACHIAN MOUNTAINS—SOUTHERN SECTION	C. Willard Hayes
MT. SHASTA—A TYPICAL EXTINCT VOLCANO	J. S. Diller
THE NEW ENGLAND PLATEAU	Prof. W. M. Davis
NIAGARA FALLS AND ITS HISTORY	G. K. Gilbert

Price for one set of ten monographs, **$1.50**. Five sets to one address, **$6.00**. Single monographs, **20c.**

Remit with order to AMERICAN BOOK COMPANY,

New York - Cincinnati . Chicago

Ripans Tabules assist digestion.

WHENEVER YOU VISIT WASHINGTON . .

YOU ARE INVITED TO INSPECT THE

MAMMOTH DRY GOODS ESTABLISHMENT

OF

WOODWARD & LOTHROP

Where the **LATEST PARIS NOVELTIES** are always on Exhibition. The attention of those who anticipate purchasing . . . .

BRIDAL TROUSSEAUX

Is invited especially to extreme PARIS NOVELTIES in matched sets of French Hand-made Lingerie, including Gowns, Skirts, Chemises, Drawers, Corset Covers, &c. These can be furnished in any number of pieces desired. . . . .

HAND-MADE BRIDAL TROUSSEAUX, personally selected in Paris and exclusive in style and design: Three or more pieces . . . . . **$10 to $250.**

CORRESPONDENCE SOLICITED. MAIL ORDERS RECEIVE PROMPT AND CAREFUL ATTENTION.

TENTH, ELEVENTH, AND F STREETS N. W. . . . . WASHINGTON, D. C.

THE CHICAGO, MILWAUKEE AND ST. PAUL RAILWAY

..RUNS..

Electric Lighted and Steam Heated Vestibuled Trains between **Chicago, Milwaukee, St. Paul and Minneapolis** daily.

Through Parlor Cars on day trains between **Chicago, St. Paul and Minneapolis.**

Electric Lighted and Steam Heated Vestibuled Trains between **Chicago and Omaha and Sioux City** daily.

Through Sleeping Cars, Free Reclining Chair Cars and Coaches between **Chicago and Kansas City, Mo.**

Only two hours from Chicago to Milwaukee. Seven fast trains each way, daily, with Parlor Car Service.

Solid trains between **Chicago** and principal points in **Northern Wisconsin** and the **Peninsula of Michigan.**

Through Trains with Palace Sleeping Cars, Free Reclining Chair Cars and Coaches between **Chicago** and points in **Iowa, Minnesota, Southern and Central Dakota.**

The **finest Dining Cars** in the World.

The **best Sleeping Cars. Electric Reading Lamps in Berths.**

The best and latest type of **private Compartment Cars, Free Reclining Chair Cars, and buffet Library Smoking Cars.**

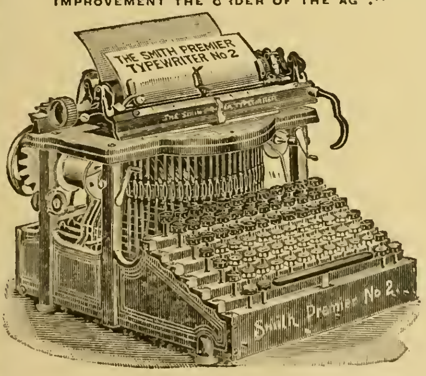
Everything First-class. First-class People patronize First-class Lines.

Ticket Agents everywhere sell tickets over the Chicago, Milwaukee and St. Paul Ry.

GEO. H. HEAFFORD,
General Passenger Agent, Chicago, Ill.

A VITAL POINT

"IMPROVEMENT THE ORDER OF THE AGE."



A TYPEWRITER'S PRINTING MECHANISM

MUST BE SCIENTIFICALLY CONSTRUCTED. THIS POINT IS OF UTMOST IMPORT FOR

EASY OPERATION AND PERFECT EXECUTION.

The Smith.. Premier Typewriters

Superior on This Point as Well as on All Others.

ONLY CORRECT PRINCIPLES EMPLOYED.

The Smith Premier Typewriter Co.,
SYRACUSE, N. Y., U. S. A.

Catalogues and Information at Washington Office, No. 1416 F Street.

AN IMPROVED METHOD OF KEEPING THE SCORE IN

DUPLICATE WHIST, COMPASS WHIST, STRAIGHT WHIST AND EUCHRE.

Since Duplicate and Compass Whist have come into fashion there has been an unprecedented revival of interest in the game, due to the fact that mere *luck* is to a large extent eliminated by a comparison of the scores made in the play of the same hands by different players.

The one thing needed to perfect the new method has been a convenient device by means of which the score made on the first round can be concealed until after the replay of the hands, as a knowledge of the first score often enables a good player to make a decisive gain, and matches are lost and won on just such little chances.

A Washington player has at length invented and put upon the market at a very low price a little device which admirably answers the purpose, and at the same time serves as a pretty and useful table ornament, marker, and pencil rest. It is called the "COSMOS COUNTER," and consists of a little polished wood tablet with a metal keyboard that can be clamped down on the score in such a way as to bring 24 little metal plates over the 24 spaces in the "score" column of the card, for use in concealing each first score as soon as recorded and until the hand is replayed (in duplicate whist) or the entire series finished (in compass whist).

Whist players will at once see the advantage of this new method of keeping the score, as it effectually prevents their opponents at the same or another table from taking advantage, either by accident or design, of a knowledge of what the hand is capable. The trouble with duplicate whist, especially, is that the replay is liable to be influenced by memory of the cards and score, and anything that helps to confuse such recollection is a great gain to fair play.

The "Cosmos Score Card," prepared for use with the counter, shows several new features, such as a heading for both Duplicate and Compass Whist and (on the reverse) for Straight Whist, Euchre, &c., thus enabling the same counter and score to be used for any game of cards.

Cosmos Counters, with tablet of quartered oak, maple, or birch, and metal in either gold or silver finish, 50 cts. apiece; 6 for $2.75; 12 for $5; by mail, 4 cts. apiece extra. Cosmos Score Cards, 25 cts. per package of 50; 12 packages for $2.50; by mail free of postage.

Ask to see samples at any stationer's, or order direct from the General Agents.

Cosmos Duplicate Whist Score

N .... E ....

S .... W ....

HAND		COMPASS WHIST: SCORE	TOTALS	TRUMP	OPPONENTS		HAND
		DUPLICATE WHIST: SCORE	GAIN	TRUMP	GAIN	SCORE	
1							1
2							2
3							3
4							4
5							5
6							6
7							7
8							8
9							9
10							10
11							11
12							12
13							13
14							14
15							15
16							16
17							17
18							18
19							19
20							20
21							21
22							22
23							23
24							24
TOTALS							TOTALS

Copyright, 1895, by Everett Hayden, Washington, D. C. For use with the Cosmos Duplicate Whist Counter, patented July 7, 1896.

...., 189......

E. MORRISON PAPER CO., 1009 Penna. Avenue, Washington, D. C.

THE

National Geographic Magazine

Vol. VIII | MARCH, 1897 | No. 3

STORMS AND WEATHER FORECASTS

By Professor Willis L. Moore,

Chief of the United States Weather Bureau

While the practical application of meteorological science to the making of weather forecasts will never reach the degree of accuracy attained by theoretical astronomy in predicting the date of an eclipse or the return of a comet, meteorology has made during the last century such substantial progress as to seriously engage the attention of thoughtful man and cause him to make special effort to apply the knowledge gained to the commerce and industry of the world.

Comparing meteorology with astronomy, we may say that it passed through the Chaldæan and Ptolemaic periods with the invention of the barometer and thermometer early in the 17th century; that it reached the Copernican stage with the discovery of the rotary and progressive motion of storms, and that it now awaits the genius of a Kepler or the magic intuition of a Newton to unravel the mysteries that still baffle the student.

But it is doubtful whether any other branch of science, unless it be electricity, has shown more wonderful progress during the past quarter-century. Where man but a few years ago, on account of his limited range of vision, thought that chaos reigned supreme, we are now able, by the aid of daily meteorological observations and the wonderful telegraph joining our cities by an electrical touch, to trace out the harmonious operations of many physical laws that previously were unknown.

Practical meteorology is to some extent a tentative work. It may be placed upon a plane with the theory and practice of medicine and surgery. The forecaster is in a degree guided in his calculations by symptoms, and he is able to diagnose the atmospheric conditions with about the same degree of accuracy that the physician is able to determine the bodily condition of the patient. He is able to forecast changes in the weather with rather more certainty than the skilled physician can predict the course of a well-defined disease.

As to the genesis of weather forecasting, it must be said that to the immortal Franklin belongs the credit of divining that storms have a rotary motion and that they progress in an easterly direction. To be sure, without the aid of the telegraph and of simultaneous observations his discovery was little more than a speculation; nevertheless it was one of those sagacious anticipations of coming knowledge which mark the true scientific genius. Grand as a patriot, able as a statesman and diplomat, he was no less great as a student in the broad domain of science; he was one of the isolated figures that stand so far in advance of the knowledge of their day as often to be imperfectly understood. His idea of drawing the lightning from the clouds and identifying it with the electric currents of the earth was capable of physical demonstration, but his contemporaries did not appreciate his philosophy of storms, written in a fragmentary manner before 1750, and so it remained for Redfield, Espy, Henry, Loomis, Maury, and other Americans, 100 years later, to gather the data and completely establish that which the great Franklin so accurately had outlined. American meteorologists can justly take pride in the achievements of these their countrymen.

In 1855 Professor Joseph Henry, of the Smithsonian Institution, collected, by telegraph, observations from a number of stations and displayed a large map showing the meteorological conditions at these points, but the breaking out of the civil war caused him to suspend his reports. He made oral forecasts and used his charts for the purpose of demonstrating the utility of a government meteorological service and the feasibility of making forecasts from daily, telegraphic, synchronous observations. If there were no other achievements to the credit of this great institution, the work of Professor Henry in connection with practical meteorology would alone be sufficient to command the admiration of all who love knowledge because of the benefits it confers upon man. As we glance into the past and hastily note the mileposts along the highways of science, the lives and actions of those who gave new thoughts, or who by their discoveries opened up useful and diverging paths, stand like lofty beacon towers, marking the rugged pathway pursued by advancing civilization.

Professor Buys-Ballot, of Utrecht, induced Holland to establish a weather service, with telegraphic reports and forecasts, in 1860; England followed with a similar service in 1861, and France in 1863. The United States was the fourth government to establish a permanent weather service, although its scientists were the pioneers in discovering the progressive character of storms and in demonstrating the practicability of weather services. In 1869 Professor Cleveland Abbe published a weather bulletin and forecast at Cincinnati, based upon simultaneous observations secured by telegraph from about 30 stations.

From the introduction of the electro-magnetic telegraph in 1844 down to 1869 intermittent and desultory advocations for a government weather service were made by many in this country. Finally Dr Increase A. Lapham, of Milwaukee, student, scientist, and philanthropist, so aroused the property and industrial interests of the country by the facts that he presented relative to the destruction of life and property by storms on Lake Michigan that Congress, under the provisions of a bill introduced by General Halbert E. Paine, was induced to appropriate money to initiate such a service. To General Albert J. Myer, Chief Signal Officer of the United States Army, was intrusted the duty of inaugurating a tentative weather service by deploying over the country as observers the military signalmen of his command.

The system by which the United States Weather Bureau collects meteorological observations and makes weather forecasts may be briefly described as follows. This morning at 8 o'clock, Washington time—which, by the way, is about 7 o'clock at Chicago, 6 o'clock at Denver, and 5 o'clock at San Francisco—the observers at about 150 stations scattered throughout the United States were taking their observations, and, from carefully tested and standardized instruments, noting all the elementary conditions of the air at the bottom of the great aerial ocean in which we live, and which, by its variations of heat and cold, sunshine, cloud, and tempest, affects not only the health and happiness of man, but his commercial and industrial welfare.

By 8.25 a. m. the necessary mathematical corrections have been made, the observations have been reduced to cipher, and each has been filed at the local telegraph office. During the next 30 or 40 minutes these observations, with the right of way over all lines, are speeding to their destinations, each station contributing its own observations and receiving in return, by an ingenious system of telegraph circuits, such observations from other stations as it may require. The observations from all stations are received at such centers as Washington, Chicago, New York, and other large cities, and nearly all cities having a Weather Bureau station receive a sufficient number of reports from other cities to justify the issuing of a daily weather map.

Before examining the accompanying charts, it may be well to glance at the Central Office in Washington, while the observations are coming in, so as to get an idea of how the charts are made for the study of the forecast official. From these he gets a panoramic view, not only of the exact conditions of the air over the whole country at the moment of taking the observations one hour before, but of the changes which have occurred in those conditions during the preceding 24 hours. As fast as the reports come from the wires they are passed to the Forecast Division, where a reader stands in the middle of the room and translates the cipher into figures and words of intelligible sequence. A force of clerks is engaged in making graphic representations of the geographical distribution of the different meteorological elements. On blank charts of the United States each clerk copies from the translator that part of each station's report needed in the construction of his particular chart. One clerk constructs a chart showing the change in temperature during the preceding 24 hours. Broad, red lines separate the colder from the warmer regions, and narrow red lines inclose areas showing changes in temperature of more than 10 degrees. The narrow lines generally run in oval or circular form, indicating (as will be shown subsequently) that atmospheric disturbances move and operate in the form of great progressive eddies; that there are central points of intensity from which the force of the disturbance diminishes in all directions.

A second clerk constructs a chart showing the change that has occurred in the barometer during the past 24 hours. As in the construction of the temperature chart, broad, heavy lines of red separate the regions of rising barometer from those of falling barometer. Narrow lines inclose the areas over which the change in barometer has been greater than one-tenth, and so on.

Here, for instance, throughout a great expanse of territory, all the barometers are rising—that is to say, the air cools, contracts, becomes denser, and presses with greater force upon the surface of the mercury in the cisterns of the instruments, thereby sustaining the columns of liquid metal at a greater height in the vacuum tubes. Over another considerable area the barometers are falling, as increasing temperature rarefies and expands the volume of the air, causing it to press upon the instruments with less force. This chart is extremely useful to the forecaster, since, in connection with the general weather chart, it indicates whether or not the storm centers are increasing or decreasing in intensity, and, what is of more importance, it gives in a great measure the first warning of the formation of storms.

A third clerk constructs two charts, one showing the humidity of the air and the other the cloud areas, with the kind, amount, and direction of the clouds at each station. It is often interesting to observe at a station on the cloud chart high cirrus clouds composed of minute ice spiculæ moving from one direction, lower cumulo-stratus composed of condensed water vapor moving from another direction, and the wind at the surface of the earth blowing from a third point of the compass. Such erratic movements of the air strata are only observed immediately before or during rain or wind storms.

A fourth clerk constructs a chart called the general weather chart, showing for each station the air temperature and pressure, the velocity and direction of the wind, the rain or snow fall since the last report, and the amount of cloudiness. The readings of the barometer on this chart are reduced to sea-level, so that the variations in pressure due to local altitudes may not mask and obscure those due to storm formation. Then lines, called isobars, are drawn through places having the same pressure. By drawing isobars for each difference in pressure of one-tenth of an inch the high- and the low-pressure areas are soon inclosed in their proper circles. The word "high" is written at the center of the region of greatest air pressure and the word "low" at the center of the area of least pressure. Under the influence of gravity the air presses downward and outward in all directions, thus causing it to flow from a region of great pressure toward one of less. The velocity with which the wind moves from the high toward the low will depend largely on the difference in air pressure. To better illustrate: If the barometer read 29.5 at Chicago and 30.5 at Bismarck, North Dakota, the difference of one inch in pressure would cause the air to move from Bismarck toward Chicago so rapidly that after allowing for the resistance of the ground there would remain a wind at the surface of the earth of about 50 miles per hour, and Lake Michigan would experience a severe "northwester."

The forecaster knows that high-pressure and low-pressure areas drift across the country from the west toward the east at the rate of about 600 miles daily, or about 37 miles per hour in winter and 22 miles per hour in summer; that the highs are attended by dry, clear, and cooler weather, and that they are drawing down, by a vortical action of their centers, the cold air from great altitudes above the clouds and causing it to flow away laterally along the surface of the earth in all directions from the center, and that the high-pressure areas sometimes become so intense in their vortical motion as to draw down such vast volumes of cold air that we call them cold waves.

In the downward movement of the air in cold waves we must concede that the loss of heat by radiation through a cloudless atmosphere is much greater than that dynamically gained by compression, or else we must assume that the air possesses such intense cold at the elevation from which it is drawn that notwithstanding the heat gained by compression in its descent it is still far below the normal temperature of the air near the surface of the earth.

The forecaster knows that although these intense high-pressure areas first appear in the extreme northwest, they do not depend on the land of their birth for the cold they bring to us, and that cold waves are not simply immense rivers of air which have been chilled by flowing over the great snow and ice fields of the Arctic regions, as was once thought. He is also familiar with the fact that in the low-pressure areas the conditions of the air and its various movements are exactly the reverse of what they are in the high; that the air is much warmer and moister, and that it is drawn spirally inward from all directions instead of being forced outward, as in the high; that it ascends as it approaches the center of the depression, sometimes causing rain or snow as it cools by expansion during its ascent, or as it encounters and mixes with air strata of lower temperature than its own.

We know that while our atmosphere expands upward to an altitude probably of 50 miles, it is so elastic and its expansion is so rapid as it recedes from the earth that half of its mass lies below the 3-mile level, and that our storms and cold waves are simply great swirls or eddies in the lower stratum of probably not more than 5 miles in thickness; that the air above the 6-mile level probably flows serenely eastward in these latitudes without being disturbed by our most severe storms.

The forecaster is further aware of the fact that our high-pressure and low-pressure areas alternately drift eastward in periods that average about 3 days each; that they are not in any sense the product of chance, but are part of that great divine economy that provides for seed-time and harvest, for by the action of the lows the warm, vapor-bearing currents are sucked inland from the Gulf and the ocean and carried far over the continent, so that their moisture is condensed and scattered over the plains, rendering them tillable and suitable for the habitation of man; that the highs, in drawing down the cool, pure air from above, scatter and diffuse the carbonic-acid gas exhaled by animal life and the fetid gases emanating from decaying organic matter; that the cold waves created by these high-pressure areas are among the most beneficent gifts of nature, for their clear, dense air not only gives us more oxygen with each inspiration of the lungs, but the abnormally high electrification that always accompanies such air invigorates man and all other animal life; that the cold, north wind, if it be dry, as it usually is, brings physical energy and mental buoyancy in its mighty breath; that four-sevenths of all our storms come from the north plateau region of the Rocky mountains and pass from this arid or subarid region easterly over the Lakes and New England, producing but scanty rainfall; that the greater part of the remaining three-sevenths have their inception in the arid region of our southwestern states, and that as they move northeastward they can nearly always be depended on to give bountiful rainfall, and that many of them cross the Atlantic and affect the continent of Europe; that a few, and by far the most severe, wind and rain storms that touch any portion of our country originate in the West Indies and travel in a northwesterly direction until they touch our Gulf or South Atlantic coast, when they recurve to the northeast and sweep along our Atlantic seaboard.

During the prevalence of droughts in the great central valleys all the low-pressure or storm conditions form in the middle or north plateau region of the Rocky mountains. When such droughts are broken, it is usually accomplished by lows that form in Arizona, New Mexico, or Texas.

From many years spent in daily watching the formation, progression, and dissipation of storms, the forecaster well knows that at times, by an accretion of force not shown by observations taken at the bottom of the ocean of air, storms suddenly develop dangerous and unexpected energy or pursue courses not anticipated in his forecast, or that the barometer at the center of the storm rises without any premonition and gradually dissipates the energy of the cyclonic whirl.

These are a few of the generalizations of which the forecaster takes cognizance and which guide him in his deductions. In brief, he carefully notes the developments and movements in the air conditions during the preceding 24 hours, and from the knowledge thus gained he makes an empirical estimate of what the weather will be in the different sections of the country the following day. By preserving the weather charts each day and noting the movements of the highs and the lows, any intelligent person can make an accurate forecast for himself, always remembering that the lows, as they drift toward him from the west, bring warm weather and sometimes rain or snow, and that as they pass his place of observation the highs following in the tracks of the lows will bring cooler and probably fair weather.

We will now examine the accompanying charts and, after a brief review of the Weather Bureau river service, will endeavor to trace the inception and progression of the different classes of storms.

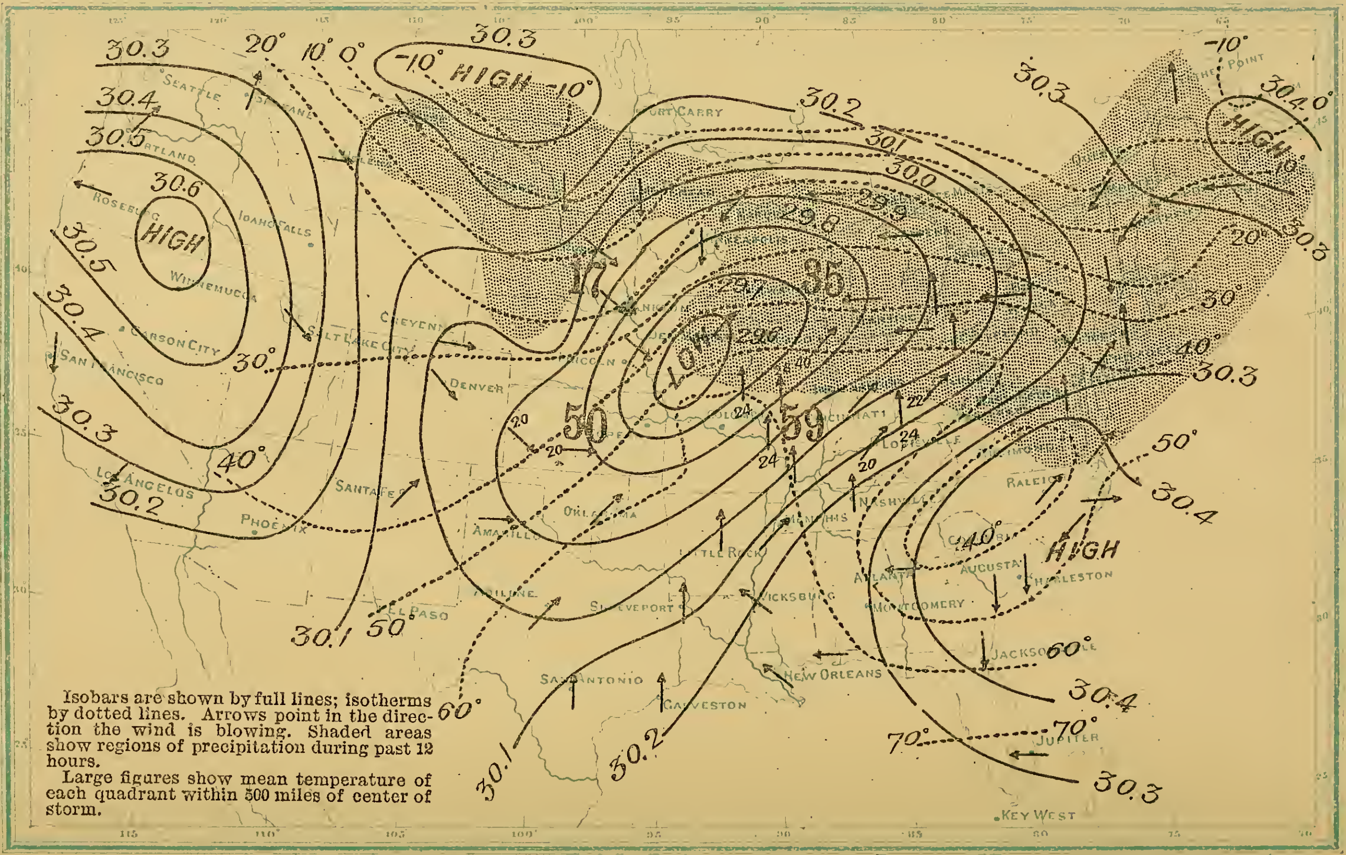
The stations from which the Weather Bureau issues and rapidly distributes forecasts and flood warnings are shown on Chart I. Small radial lines are drawn to each central station from upriver points in the various watersheds; from these points daily telegraphic measurements of rainfall and temperature are sent to their respective centers, in addition to observations from many of the full meteorological stations of the Bureau not shown on this chart.

With our many thousands of miles of navigable rivers flowing through one of the most extensive and fruitful regions of the world, daily forecasts of the height of water in the various sections of each river are of enormous benefit to navigation, and the warnings issued when the precipitation is so heavy as to indicate the gathering, during the next two or three days, of flood volumes in the main streams, are often worth many millions to navigators and to those having movable property on low grounds contiguous to the streams.

The feasibility of making accurate forecasts as to the height of water several days in advance at any station of the system is

Chart I. River Stations.

Chart II. Winter Storm, December 15, 1893, 8 a. m.



Isobars are shown by full lines; isotherms by dotted lines. Arrows point in the direction the wind is blowing. Shaded areas show regions of precipitation during past 12 hours.

Large figures show mean temperature of each quadrant within 500 miles of center of storm.

no longer questioned. The forecaster at each river center considers the rainfall, the temperature, the melting of snow, if there be any, the area and slope of the watershed, and the permeability of the soil. From a study of floods in former years, he knows the time necessary for the flow of the water from the tributaries to the main stream and the time required for the passage of the flood-crests from one city to another. The forecasts are, of course, empirically made, but still they are sufficiently accurate to possess great value to the people of the river districts. Some idea of the vast destruction of property due to floods may be gathered from the statement that the floods of 1881 and 1882 caused a loss of not less than $15,000,000 to the property interests of the Ohio and Mississippi valleys. There was also a loss of 138 lives. In 1884 the region about Cincinnati alone suffered a loss of over $10,000,000 in property.

Chart No. II shows a winter storm central in Iowa at 8 a. m., December 15, 1893. The word "low" marks the storm center. It is the one place in all the United States where the barometer reading is the lowest. The heavy, black lines, oval and nearly concentric about the low, show the gradation of air-pressure as it increases quite uniformly in all directions from the storm center outward.

The arrows fly with the wind, and, as will be seen, are almost without exception moving toward the low or storm center, clearly demonstrating the effect of gravity in causing the air to flow from the several regions marked high, where the air is abnormally heavy, toward the low, where the air is lighter. As the velocity of water flowing down an inclined plane depends both on the slope of the plane and on the roughness of its surface, so the velocity of the wind as it blows along the surface of the earth toward the storm center depends on the amount of the depression of the barometer at the center and the resistance offered by surfaces of varying degrees of roughness. The small figures placed at the end of the arrows indicate high wind velocities. At Chicago, where the wind is blowing at the rate of 40 miles per hour, the anemometer is 270 feet high, while at Minneapolis, where the instrument is so low as to be in the stratum whose velocity is restricted by the resistance encountered in flowing over forests to the northward, the rate is not great enough to be marked by a special figure.

Now picture in your mind the fact that all the air inside the isobar (heavy black line) marked 30.2 as it moves inward is rotating about the low in a direction contrary to the movement of the hands of a watch and you have a very fair conception of an immense atmospheric eddy.

Have you ever watched the placid water of a deep running brook and observed that where it encountered a projecting crag little eddies formed and went spinning down the stream? Well, our storms are simply great eddies in the air which are carried along by the general easterly movement of the atmosphere in the middle latitudes of the northern hemisphere. But they are not deep eddies, as was once supposed. The low marks the center of an atmospheric eddy of vast horizontal extent as compared with its thickness or extension in a vertical direction; thus a storm condition extends from Washington to Denver in a horizontal direction and yet extends upward but four or five miles. The whole disk of whirling air four or five miles thick and 1,500 miles in diameter is called a cyclone or cyclonic system. It is important that a proper conception of this fundamental idea be had, since the weather sequences experienced from day to day depend almost wholly on the movement of these traveling eddies, cyclones, or areas of low pressure.

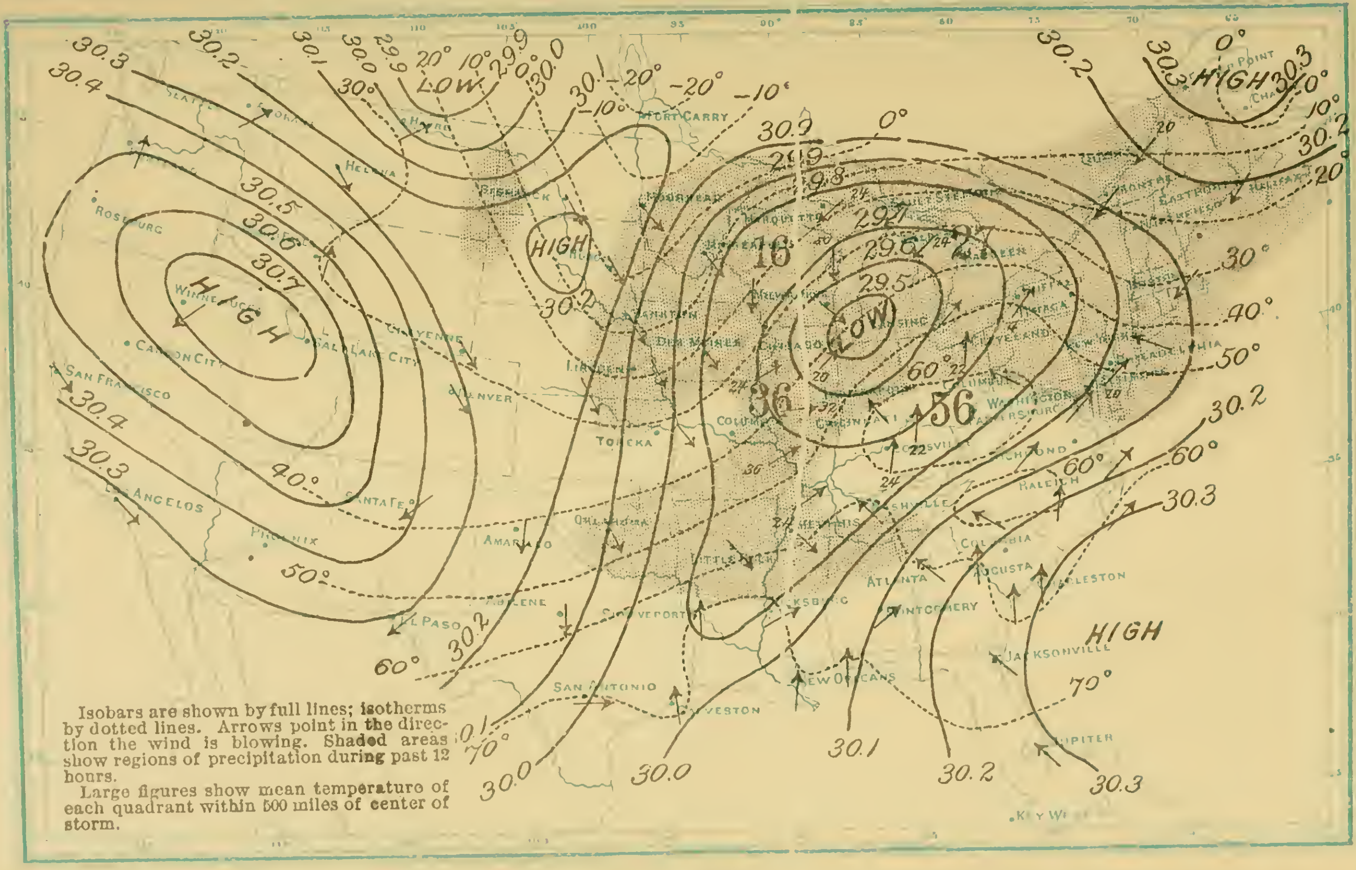
The large figures in the four quarters of the cyclone show the average temperature of each quadrant. The greatest difference is between the southeast and northwest sections. This is due in part to the fact that in the southeast quadrant the air is drawn northward from warmer latitudes, and in the northwest quadrant the air is drawn southward from colder latitudes. The shaded area shows the region of rain or snow fall during the preceding 12 hours. Unfortunately for the science of forecasting, precipitation does not show that relation to the configuration of the isobars that temperature, wind velocity, and wind direction do.

Chart III, constructed from observations taken 12 hours later, shows that the storm or cyclonic center, as indicated by the word "low," has moved from central Iowa since 8 a. m. and is now, at 8 p. m., central over the southern point of Lake Michigan. The shaded areas show that precipitation has occurred during the past 12 hours in nearly the entire region covered by the cyclone.

Chart IV, 12 hours later, shows that the precipitation has been general throughout the entire area swept by the cyclonic whirl.

Chart V is quite dissimilar, in the information it conveys, to any other of the charts accompanying this paper. From July 28 to August 10, inclusive, 1896, there was a remarkable hot wave in the United States, extending from the Rocky mountains to the

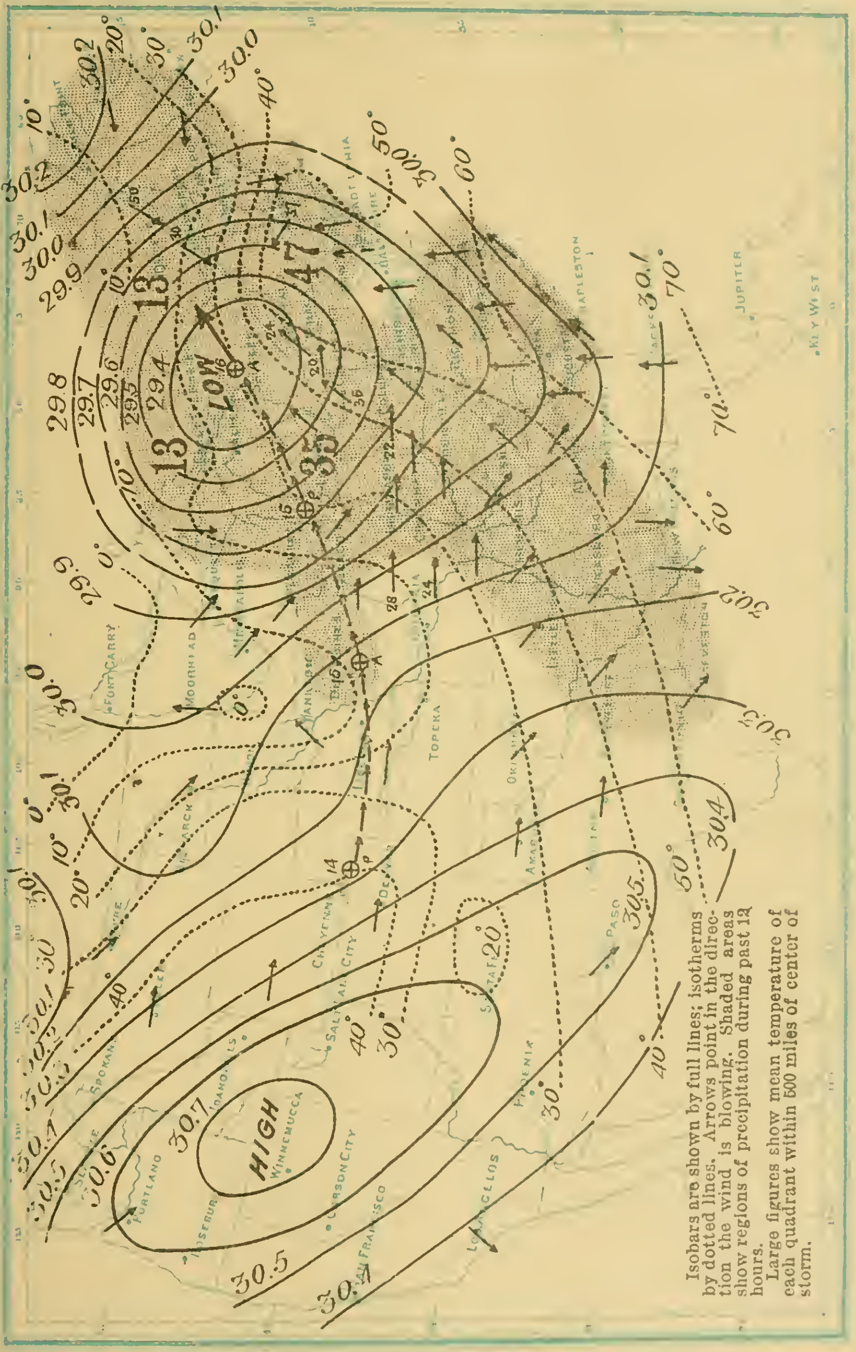
Chart III. Winter Storm, December 15, 1893, 8 p. m.



Isobars are shown by full lines; isotherms by dotted lines. Arrows point in the direction the wind is blowing. Shaded areas show regions of precipitation during past 12 hours.

Large figures show mean temperature of each quadrant within 500 miles of center of storm.

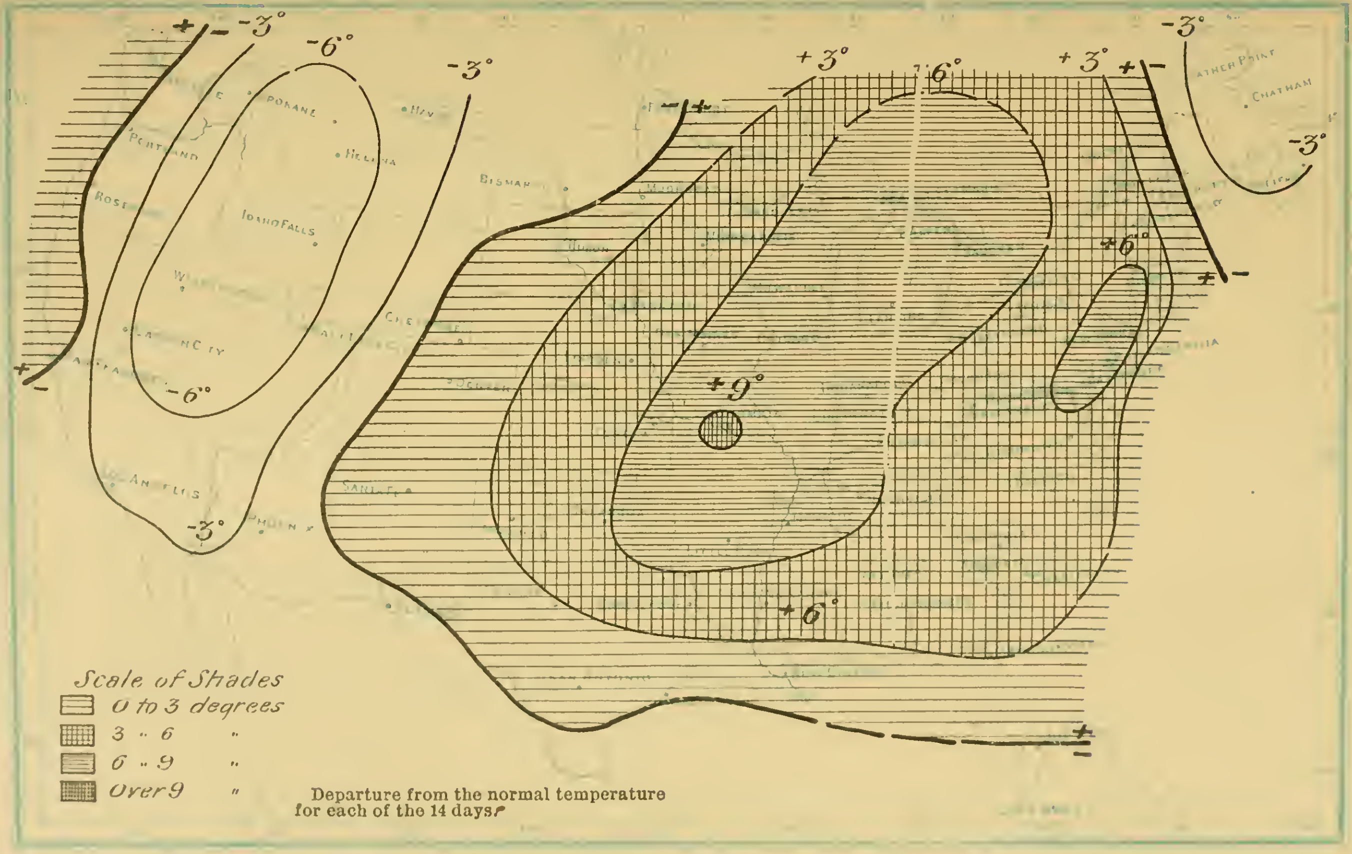
Chart IV. Winter Storm, December 16, 1893, 8 a. m.



Isobars are shown by full lines; isotherms by dotted lines. Arrows point in the direction the wind is blowing. Shaded areas show regions of precipitation during past 12 hours.

Large figures show mean temperature of each quadrant within 500 miles of center of storm.

Chart V. Hot Wave, July 28 to August 10, 1896, inclusive.



Departure from the normal temperature for each of the 14 days.

Atlantic ocean. The mortality from this cause amounted to many thousands. The hottest region, as shown by the dark shading, was in the middle Mississippi and Ohio valleys and the Lake region, where the temperature averaged from six to nine degrees above the normal for each one of the 14 days. During this same period, strange as it may seem, the temperature over the vast Rocky Mountain plateau was markedly below the normal, and the cold was not due to altitude, for often we find these conditions geographically reversed. The weather charts showing the movements of highs and lows during the period of this abnormal heat are not shown in this paper. Chart V is simply intended to show graphically the area and degree of the heat.

For some unexplained reason there come, in summer, periods of almost absolute stagnation in the drift of the highs and lows. At such times if a high rest over the southeastern part of the country and a low over the northern Rocky Mountain region, there will result what is popularly known as a warm wave, for the air, on account of its slightly greater specific gravity, will slowly and steadily flow from the southeast, where the pressure is greater, toward the northwest, where the pressure is less, and receiving constant accretions of heat from the hot, radiating surface of the earth, without any whirls or eddies to mix the upper and lower strata, will finally attain a temperature almost unbearable to animal life. This superheated condition of the lower stratum in which we live continues until the low-pressure area in the northwest begins to actively gyrate as an eddy and move eastward, mixing in its course strata of unequal temperatures, and precipitating the cool and welcome thunder-showers.

It is a pertinent inquiry whether such adjacent areas of abnormal heat and abnormal cold can possibly be due to cosmic influences. The only cosmic influences that meteorology is sure of are the radiation of heat from the sun to the earth and the reception, by space, of the heat that is radiated back by the earth and atmosphere. In the long run, these two balance each other. It is inconceivable that solar insolation, passing outward from the sun along true radial lines, could fall so unequally upon the United States as to cause excessive heat on one side and extreme cold on the other. It follows from the preceding that we must be slow to ascribe any of the local peculiarities that are observed in terrestrial weather to cosmic influences. Weather variations, irregular, annual, and diurnal, all probably have their causes at the earth's surface or in the earth's atmosphere, and depend wholly on the mechanics of the latter. The problem, however, is so complex that it would be hazardous to undertake to explain the great differences in temperature shown on this map of departures for July and August, 1896.

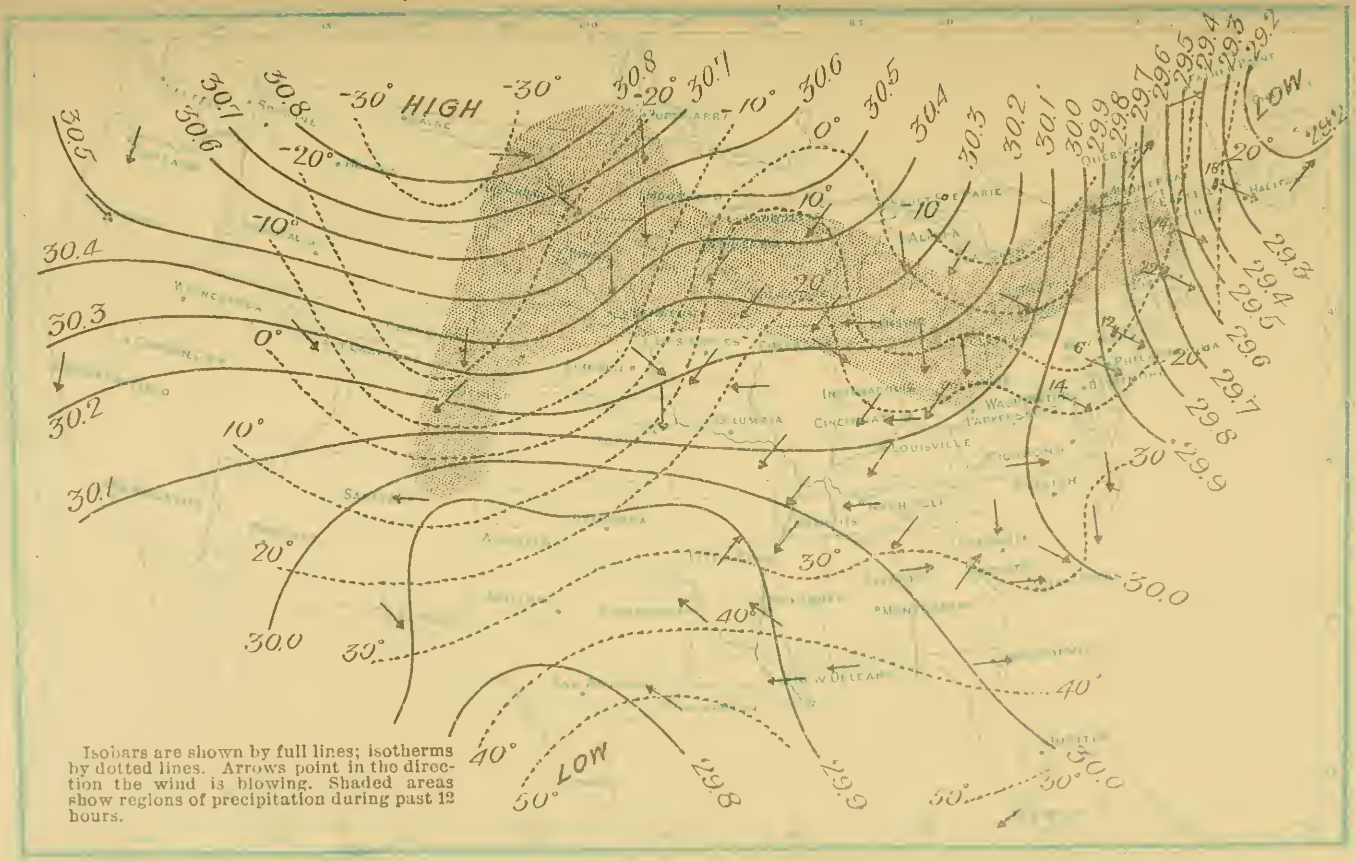
Think of the atmosphere as a mass of air about 50 miles deep, whose upper surface maintains nearly the same configuration and temperature and is almost entirely without motion relative to the earth's surface. The solar radiation and the terrestrial radiation penetrate this upper region without appreciable absorption, and the ascending and descending currents of air rarely or never disturb this region, but cease before they reach it. Our weather and climate depend on the changes going on in the middle and lower atmospheres, and among these changes that which affects our surface temperature most is the *motion* of the atmosphere. The great contrast in temperature between two regions lying close together, as shown by Chart V, is therefore probably not due to any special cosmic influence, but to the flow of air as determined by the distribution of air pressure day by day.

Chart VI shows the beginning of a cold wave in the northwest on the morning of January 7, 1886. Observe that the heavy, black isobar passing through Montana is marked 30.8, while the isobar curving through southern Texas is marked 29.8, a difference of one inch in the air-pressure between Montana and Texas. The dotted isothermal line in Montana is marked 30 degrees below zero, while the isotherm on the Texas coast indicates a temperature of 50 degrees.

Chart VII is auxiliary to Chart VI, and by varying degrees of shading shows the fall of temperature during the preceding 24 hours attendant on the high-pressure area of the northwest. A considerable area covered by the darkest shade indicates a fall of 40 degrees in temperature during the past 24 hours.

The people of the Gulf states, with a morning temperature of 40 to 50 degrees, knew nothing of the great volume of extremely cold air to the northwest of them; but from the distribution of air pressure shown by Chart VI, the forecaster anticipated that the very cold air of the northwestern states would, on account of its great weight, be forced southward to the Gulf and eastward to the Atlantic ocean; or, more accurately speaking, that the conditions causing the cold in the northwest would drift southward and eastward. He therefore issued the proper warning to the threatened districts.

Chart VI. Cold Wave, January 7, 1886, 7 a. m.



Isobars are shown by full lines; isotherms by dotted lines. Arrows point in the direction the wind is blowing. Shaded areas show regions of precipitation during past 12 hours.

Chart VII. Cold Wave, January 7, 1886, 7 a. m. Temperature Change in Preceding 24 Hours.

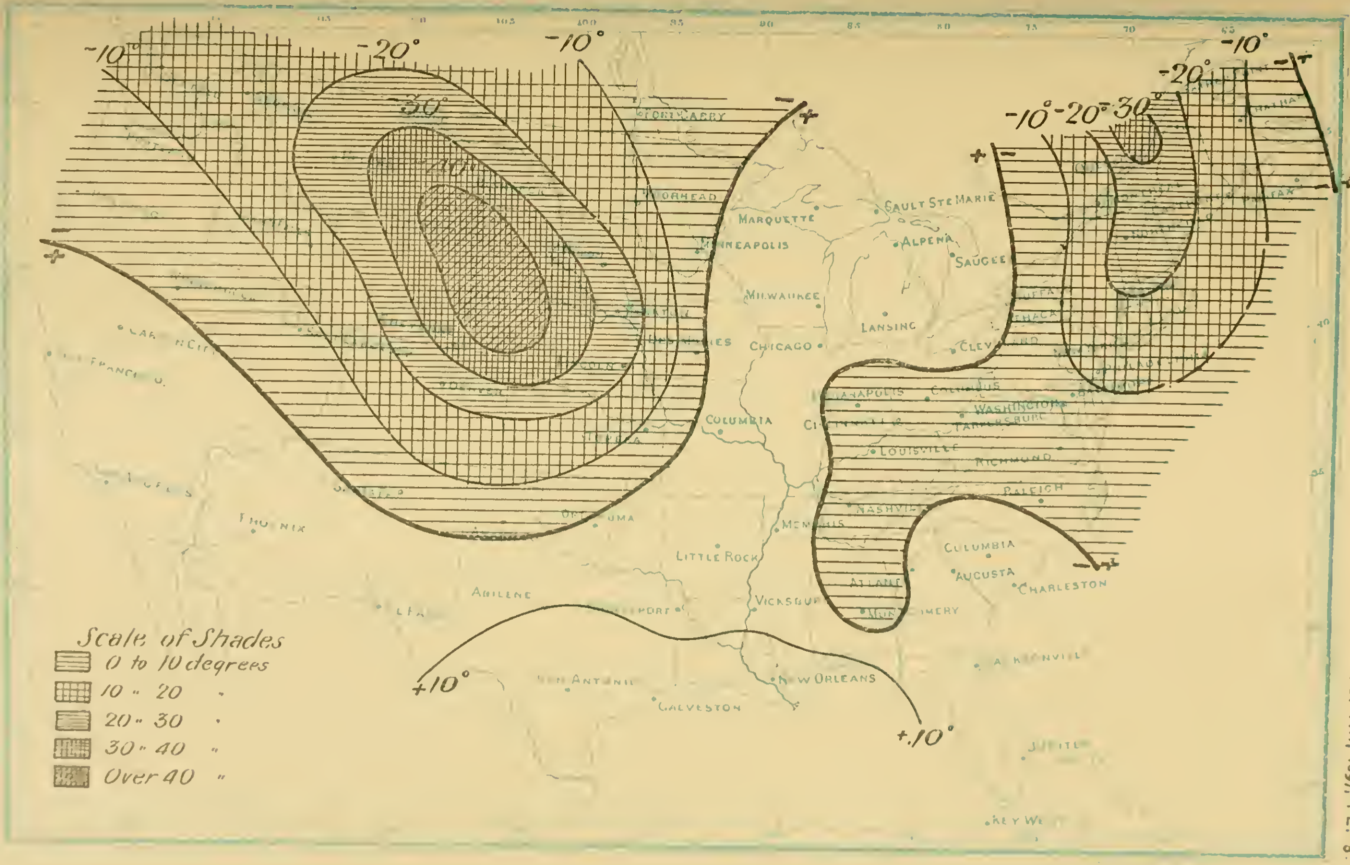
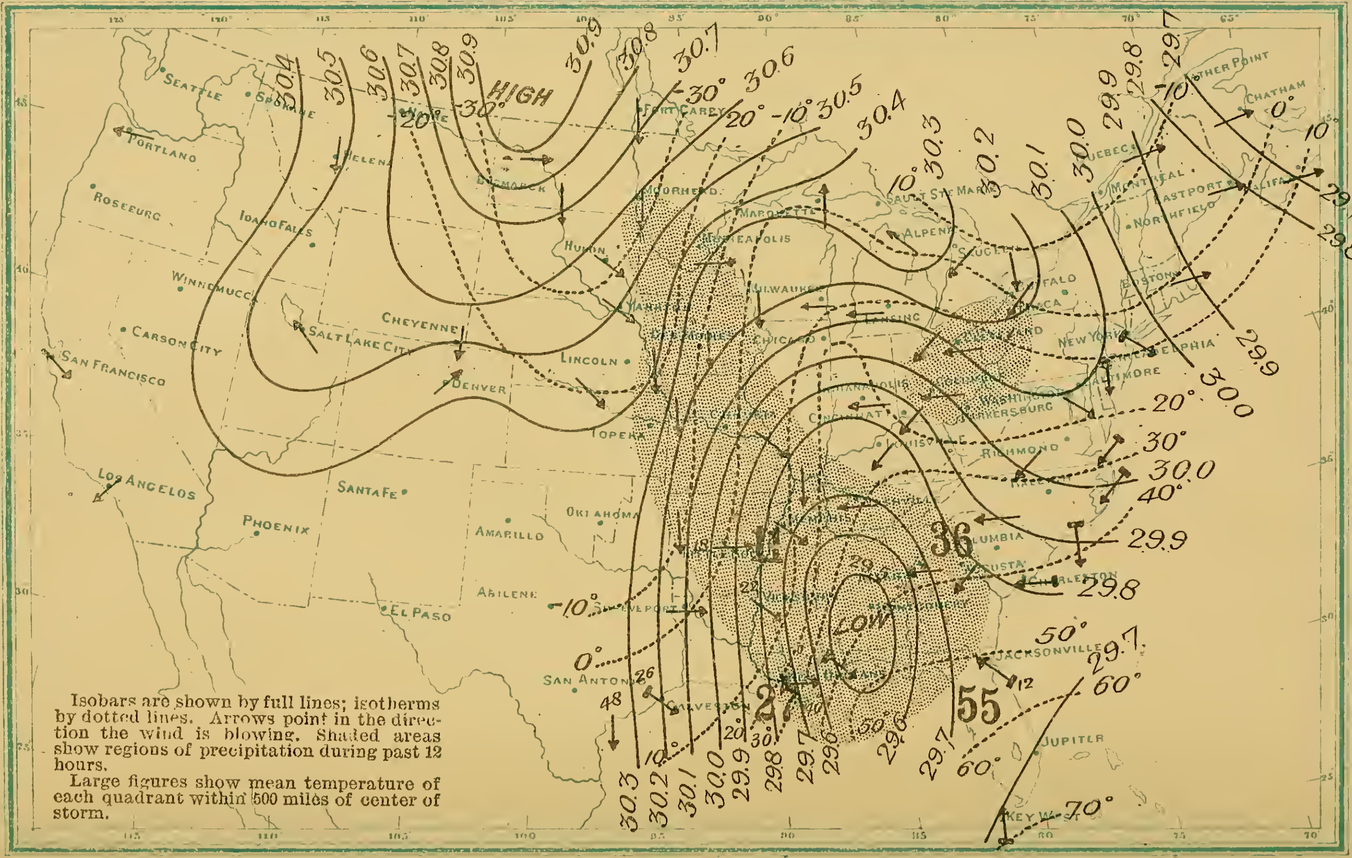


Chart VIII. Cold Wave, January 8, 1886, 7 a. m.



Isobars are shown by full lines; isotherms by dotted lines. Arrows point in the direction the wind is blowing. Shaded areas show regions of precipitation during past 12 hours.

Large figures show mean temperature of each quadrant within 500 miles of center of storm.

Chart IX. Cold Wave, January 8, 1886, 7 a. m. Temperature Change in Preceding 24 Hours.

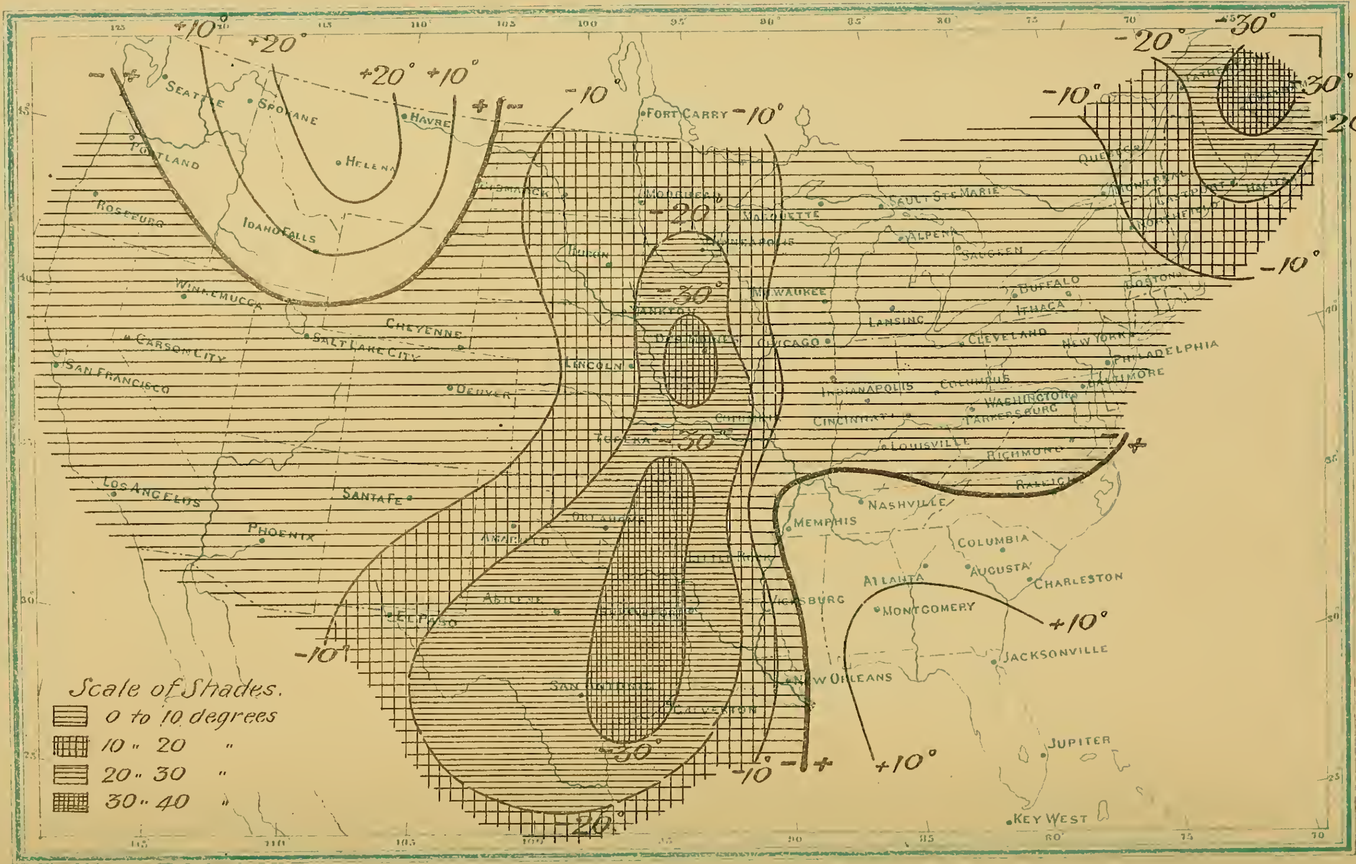
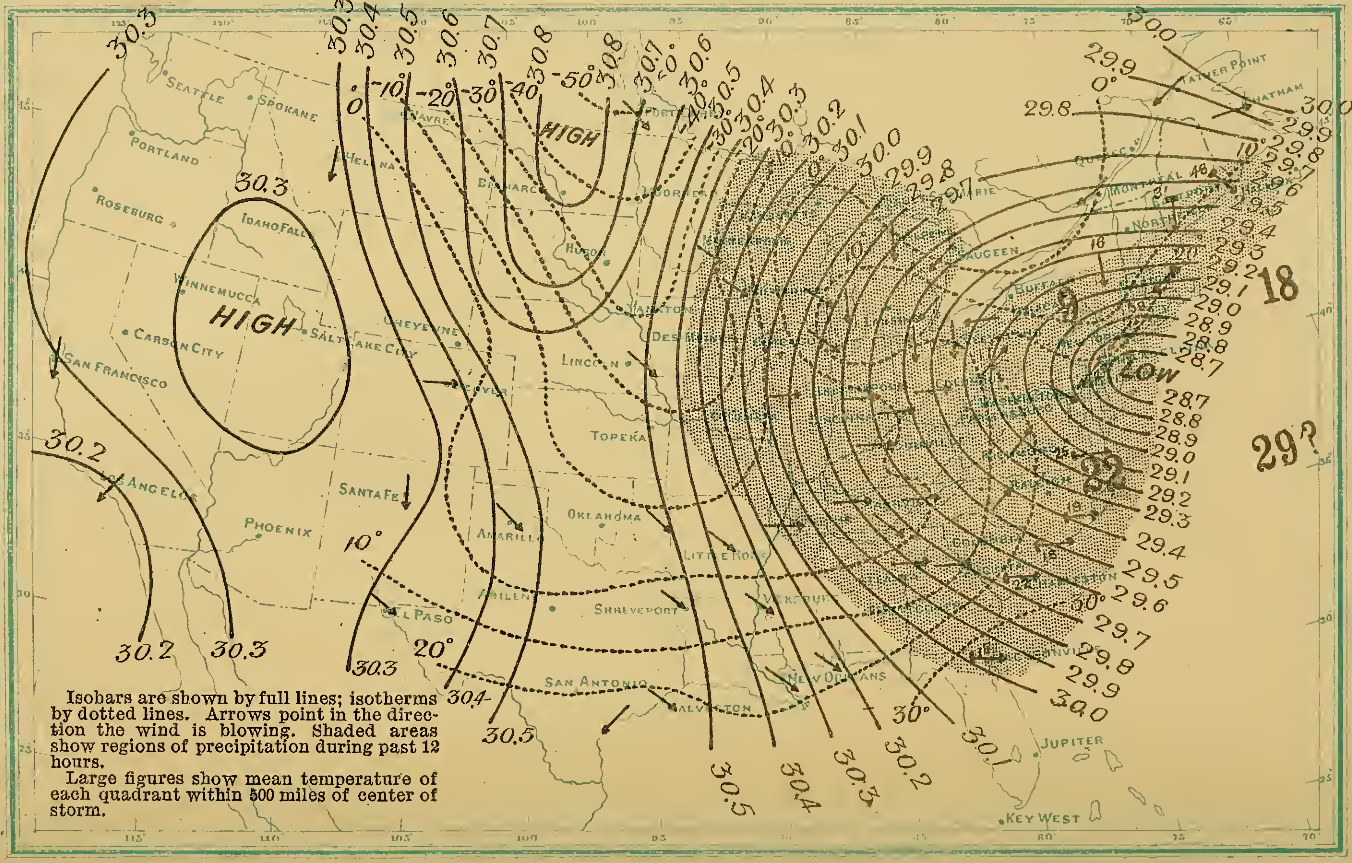


Chart X. Cold Wave, January 9, 1886, 7 a. m.



Isobars are shown by full lines; isotherms by dotted lines. Arrows point in the direction the wind is blowing. Shaded areas show regions of precipitation during past 12 hours.

Large figures show mean temperature of each quadrant within 500 miles of center of storm.

Chart XI. Cold Wave, January 9, 1886, 7 a. m. Temperature Change in Preceding 24 Hours.

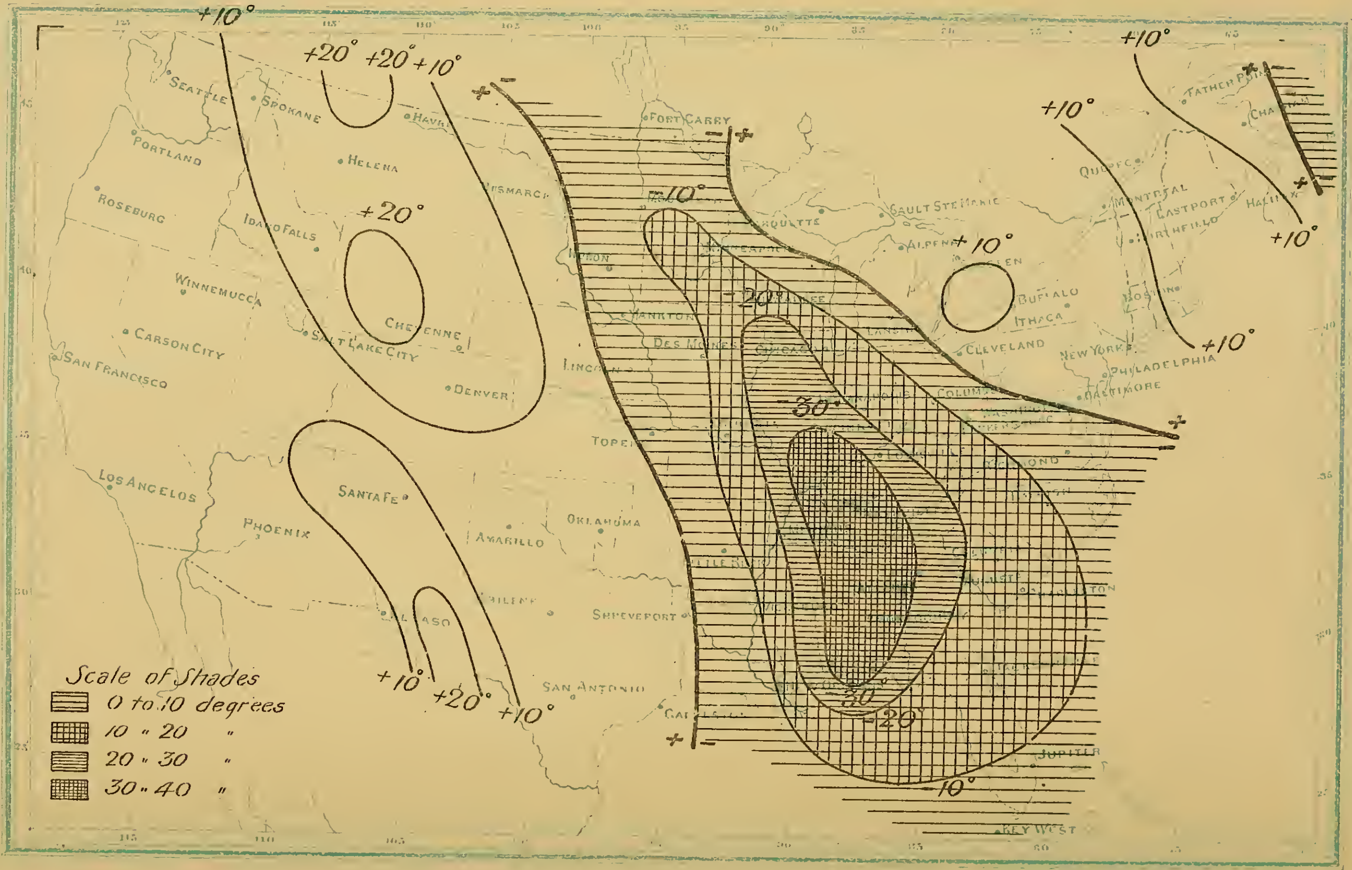
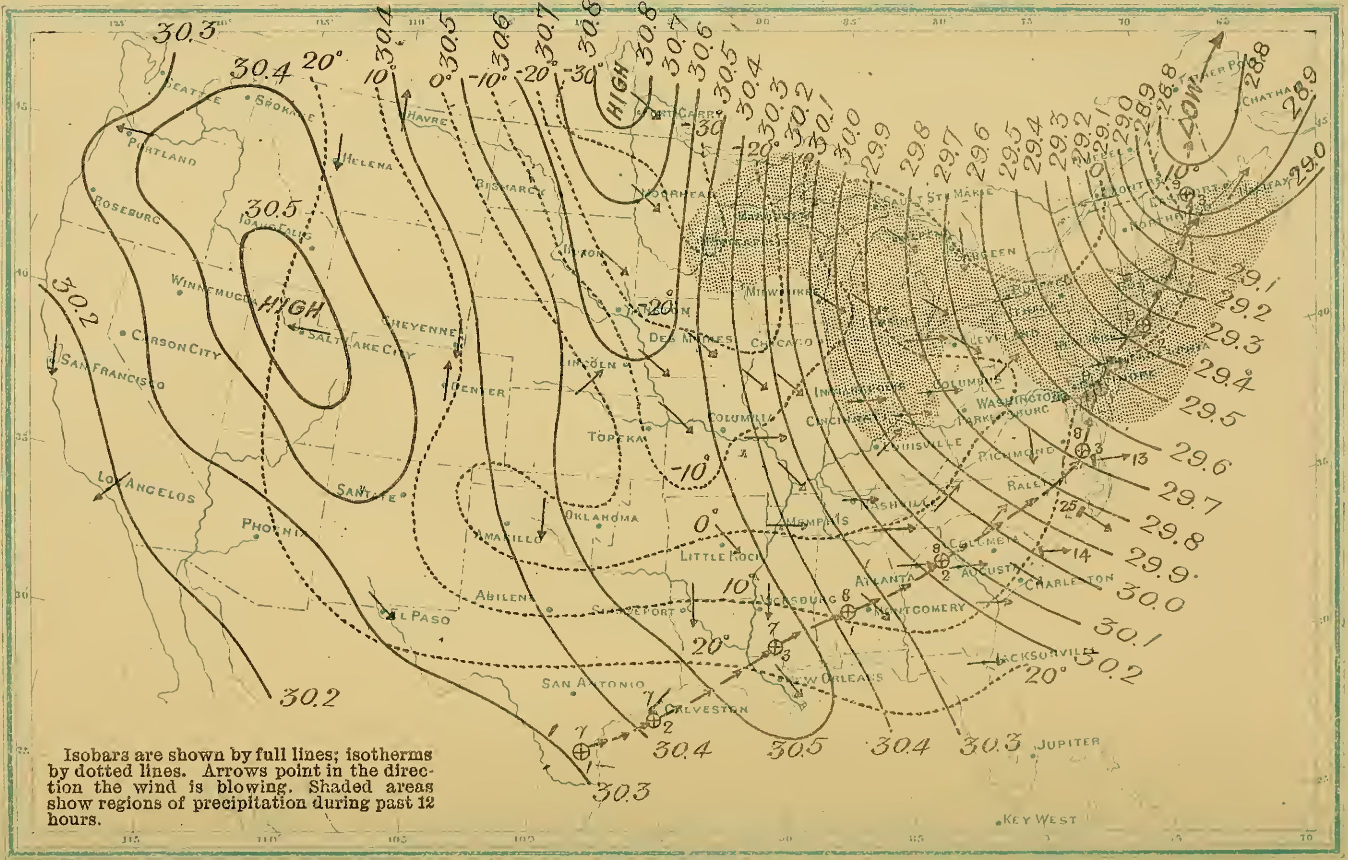
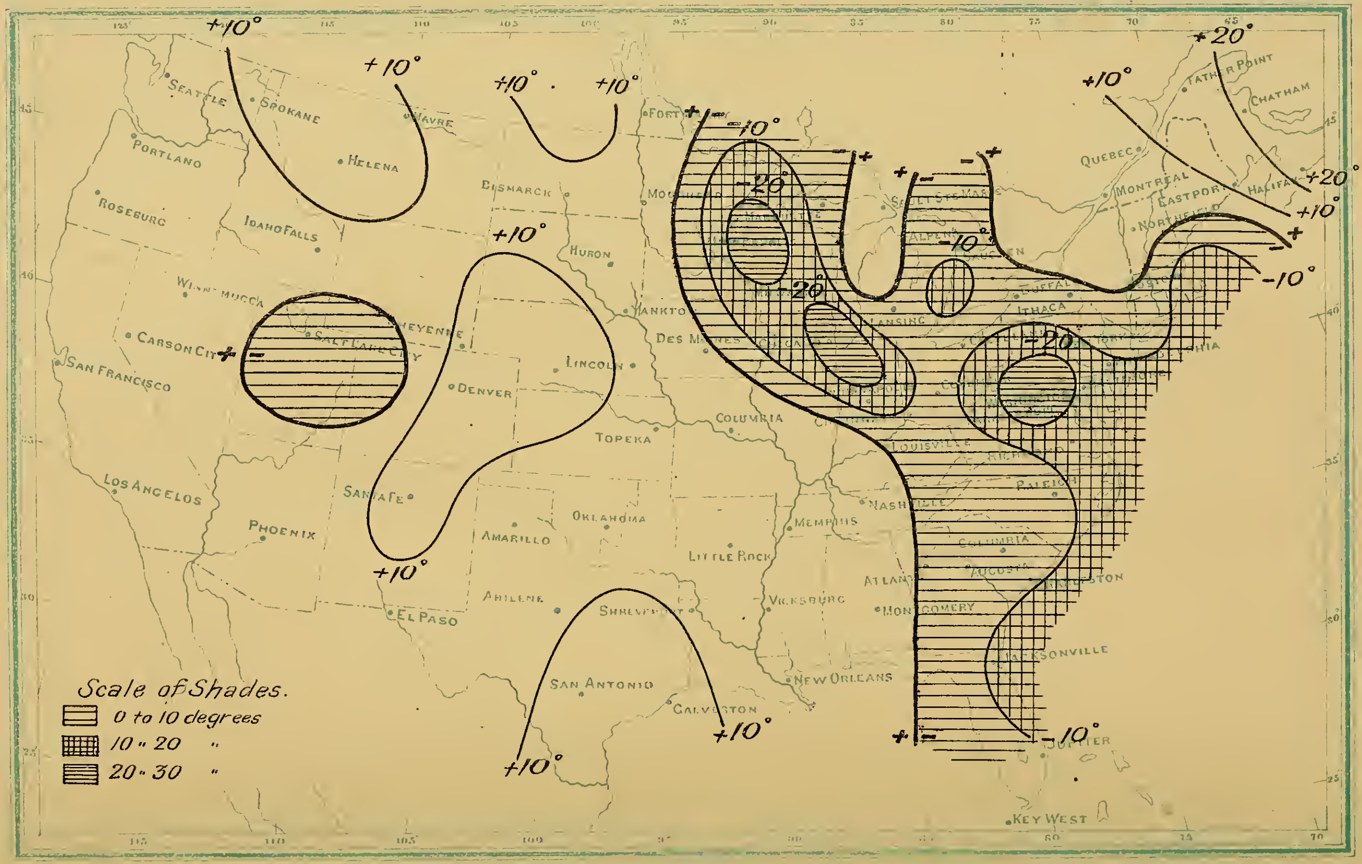


Chart XII. Cold Wave, January 10, 1886, 7 a. m.



Isobars are shown by full lines; isotherms by dotted lines. Arrows point in the direction the wind is blowing. Shaded areas show regions of precipitation during past 12 hours.

Chart XIII. Cold Wave, January 10, 1886, 7 a. m. Temperature Change in Preceding 24 Hours.



Now turn to Charts VIII and IX of the following morning and it will be seen from the latter that the cold wave has covered the entire Mississippi valley. The low shown on the preceding chart as being central in southern Texas has moved northeastward to Alabama, and on Chart VIII appears as a fully developed storm. The difference in pressure between the central isobar of the low and the central isobar of the high is now 1.4 inches. Precipitation has occurred, as shown by the dark shading.

Special attention is called to the large figures placed in the four quarters of the low-pressure area, about 300 miles from the center. They indicate the average temperatures of their respective quadrants, and strikingly illustrate how great may be the difference in temperature under cyclonic influence between regions separated by but short distances. It is certain that as the low or cyclonic whirl moves toward the northeast, along the track usually followed by storms in this locality, the cold of the northwest quadrant, by the action of the horizontally whirling disk of air, will be thrown southeastward toward Florida, lowering the temperature in the orange groves to below the freezing point.

Chart X shows that the center of the cyclone or low-pressure system has moved during the preceding 24 hours northeast to the coast of New Jersey, with greatly increased energy, the barometer at the center showing the abnormally low reading of 28.7 inches. Cold, northwest winds, as shown by the arrows, are now blowing systematically from the high-pressure area of the northwestern states southeast to Florida and the South Atlantic coast. The dotted isotherm of 30 degrees passes through the northern part of Florida, where, on the day before, the temperature was over 50 degrees. The cyclonic gyration of this storm extends 1,000 miles inland and probably to an equal distance out to sea. Heavy snow or rain has fallen throughout the area under its influence, seriously impeding railroad travel, and a gale of hurricane force has prevailed on the coast. But when, on the day preceding, the storm was central in Alabama all these conditions were foreseen and the necessary warnings issued.

Chart XI shows the temperature changes caused by the rapid movement of the storm center.

Charts XII and XIII show the conditions 24 hours later. The storm center has been three days in passing from southern Texas to the mouth of the St Lawrence. The temperature has fallen still lower on the Atlantic coast and in Florida as the result of uninterrupted northwest winds, and no material rise in temperature can occur until the high pressure of the northwest is replaced by a low pressure, and convectional currents are drawn toward the northwest instead of being forced southward from that region.

To summarize in regard to cold waves, it may be said that when the charts indicate the formation of a body of dense, cold air in the northwest, as shown by the barometer readings, the skilled forecaster is on the alert. He calls for special observations every four hours from the stations within and directly in advance of the cold area, and as soon as he becomes convinced that the cold wave will sweep across the country with its attendant damage to property, destruction to animal life, and discomfort to humanity, the well-arranged system of disseminating warnings is brought into action, and by telegraph, telephone, flags, bulletins, maps, and other agencies the people in every city, town, and hamlet, and even in farming settlements, are usually notified of the advancing cold twelve, twenty-four, or perhaps even thirty-six hours before it reaches them.

Charts XIV and XV show the cyclonic systems prevailing at 8 p. m. on the days of the Louisville and St Louis tornadoes. Several tornadoes occurred on each day; their tracks are shown by rows of crosses in the southeast quadrants of each cyclone.

Especially do I wish to emphasize the distinction between the cyclonic storm and the tornado. The press and nine out of ten people who should know better use these terms as synonymous. The cyclone shown on Chart XIV, which is fairly typical of all cyclones, is a horizontally revolving disk of air, covering the whole United States from the Atlantic ocean westward to and including the Mississippi valley, with the air currents from all points flowing spirally inward toward the center, while the tornado is a revolving mass of air of only 500 to 1,000 yards in diameter, and is simply an incident of the cyclone, nearly always occurring in its southeast quadrant. The cyclone may cause moderate or high winds through a vast expanse of territory, while the tornado, with a rotary motion almost unmeasurable, always leaves a trail of death and destruction in an area infinitesimal in comparison to the area covered by the cyclone.

The tornado is the most violent of all storms, and is more frequent in the central valleys of the United States than elsewhere. It has characteristics which distinguish it from the thunderstorm, viz., a pendent, funnel-shaped cloud and a violent, rotary motion in a direction contrary to the movements of the hands of a watch, together with a violent updraught in the center.

Chart XIV. Tornado at Louisville, Ky., March 27, 1890. Weather Map 8 p. m. of that date.

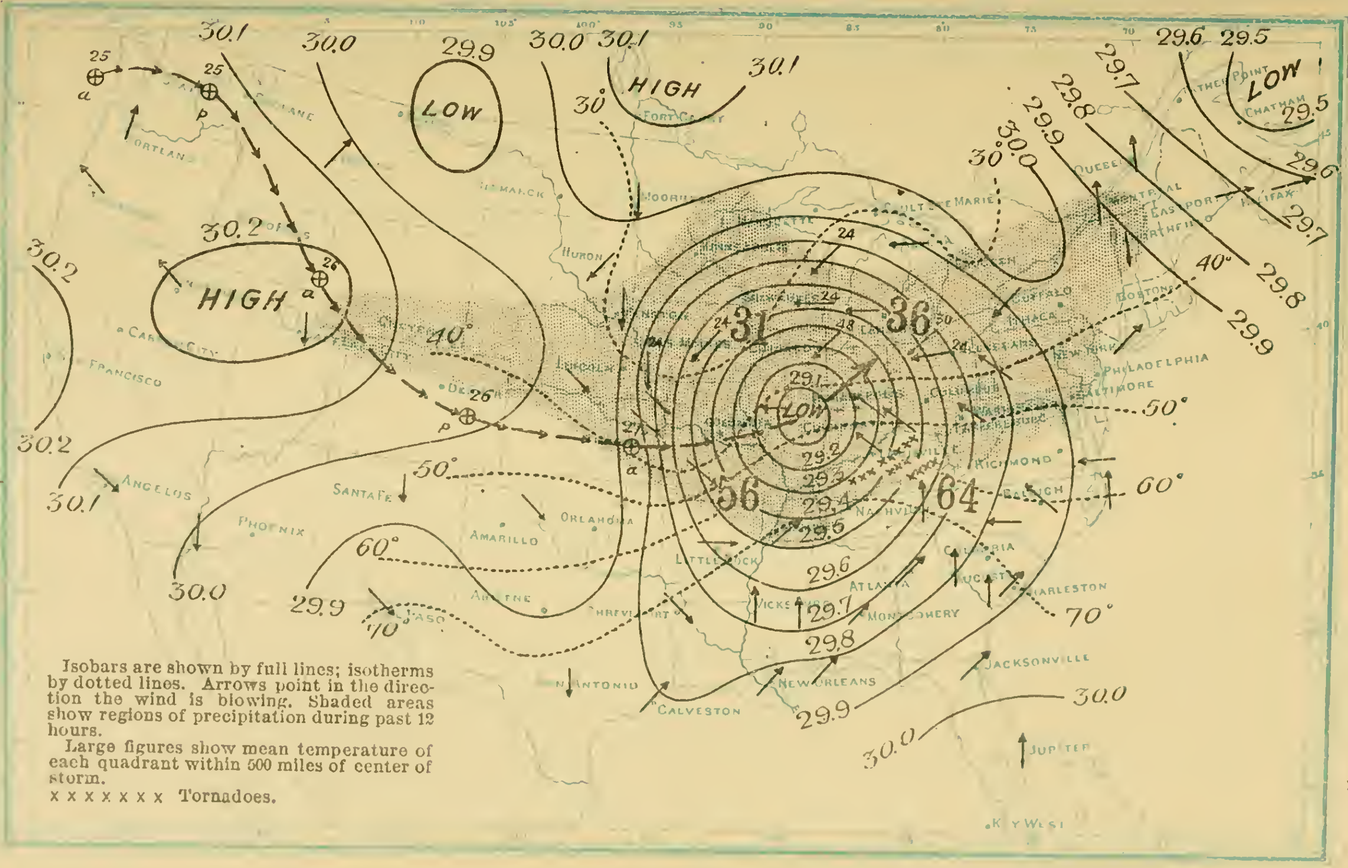
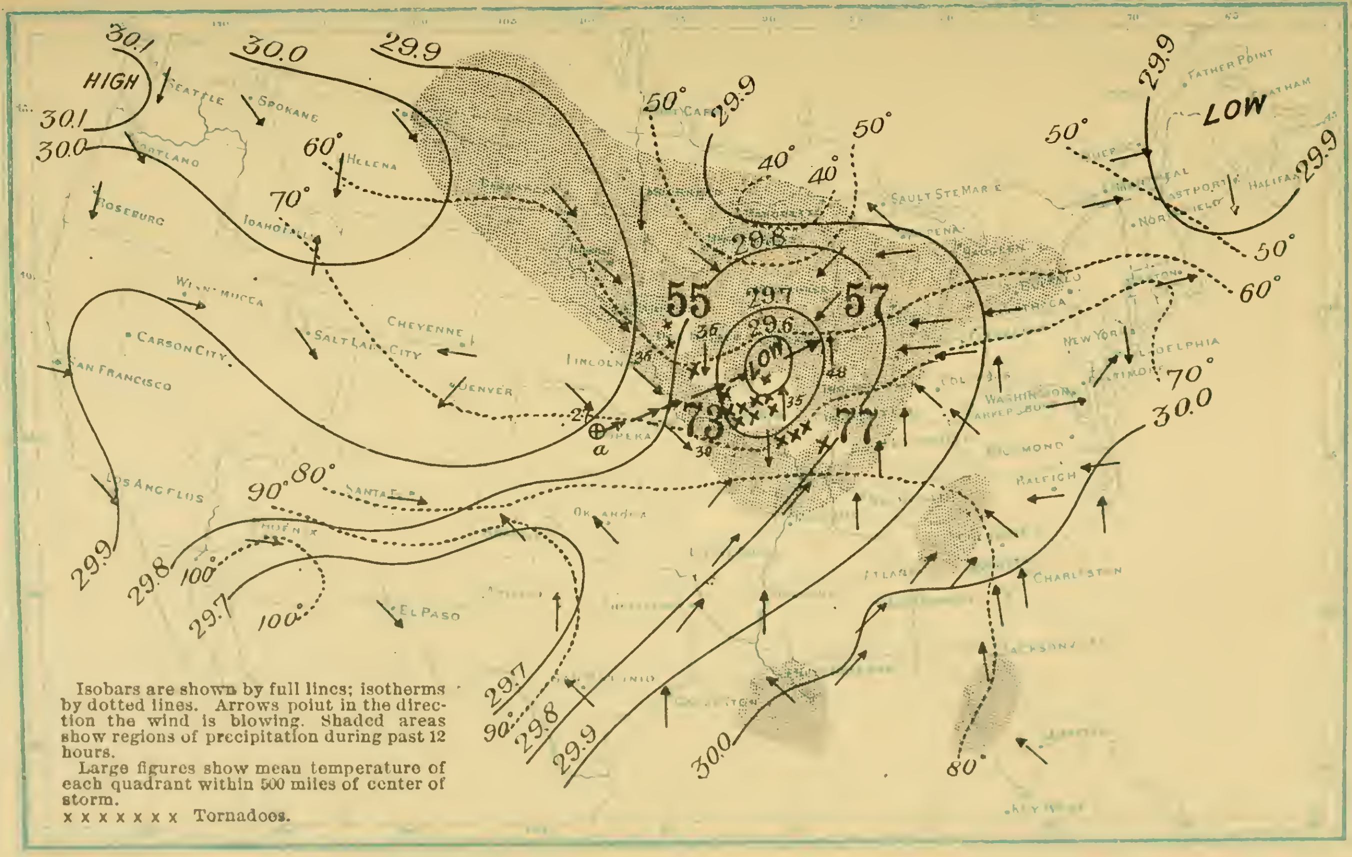


Chart XV. Tornado at St. Louis, Mo., May 27, 1896. Weather Map 8 p. m.



The three conditions essential to the formation of tornadoes are clearly as follows: (1) A cyclone or area of low pressure, the center of which is to the north or northwest, with a barometric pressure not necessarily much below the normal; (2) a temperature of about 70 degrees on the morning map; (3) a great humidity, and (4) that the time of year be March 15 to June 15. These conditions may and often do exist separately; one or two of them may be found coexisting; but so long as the third is absent, tornadic formation is not likely to occur.

I am satisfied that the number of these storms is not increasing; that the breaking of the virgin soil, the planting or cutting away of forests, the drainage of land surfaces by tiles, the stringing of thousands of miles of wire, or the laying of iron or steel rails have not materially altered the climatic conditions or contributed to the frequency or intensity of tornadoes. As well might one by the casting of a pebble attempt to dam the mighty waters of the majestic Mississippi as attempt the modification or restriction by the feeble efforts of man of those tremendous forces of nature which surround our earth and control our storms and climate. To be sure, as towns become more numerous and population becomes more dense, greater destruction will ensue from the same number of storms.

It is not possible with our present knowledge of the mechanism of storms to forewarn the exact cities and towns that will be visited by tornadoes without alarming some towns that will wholly escape injury; but we know that tornadoes are almost entirely confined to the southeastern quadrant of the cyclone, and that when the thermal, hygrometric, and other conditions are favorable, the spot 300 to 500 miles southeast from the cyclonic center is in the greatest danger.

Chart XV shows the conditions on the evening of the St Louis tornado, two hours after its occurrence. The abnormal heat, humidity, and other conditions of the rather small and weak cyclonic system shown by the morning chart were sufficient to justify the Weather Bureau in distributing at 10 a. m. danger warnings throughout the whole of Missouri and eastern Kansas. I am informed that the schools of St Louis were dismissed at once on the receipt of the warning forecast. What is urgently needed is a system by which weather signals may be sent simultaneously from telephone headquarters to all subscribers by a stroke of a telegraph key; then a whole city could be warned in a minute's time.

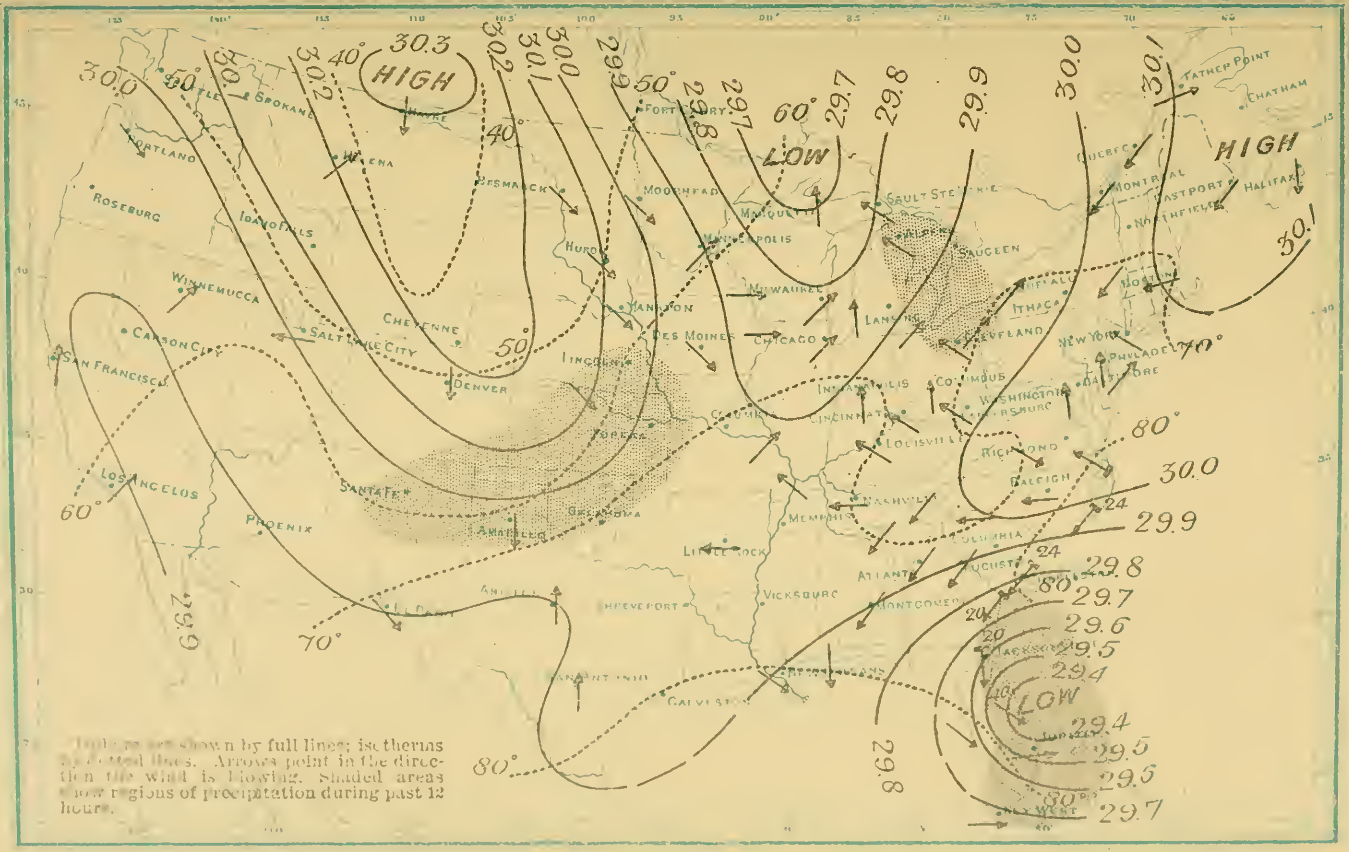
The writer visited St Louis the day after the storm, and was especially impressed with the fact that hundreds of buildings were burst outward at their upper stories, indicating that they were at the time of their destruction near the center of the rotating mass of air, where centrifugal force instantly had reduced the air pressure on the outside to such an extent that the expansion of the air in the upper stories of the houses whose windows and doors were closed had produced an explosion of the building. In one case all the four walls of the upper story of a house were thrown outward, leaving the lower story intact and the roof resting in proper position one story lower than in the original building. Again, great structures seemed to have been crushed over or taken up bodily and scattered in all directions.

The fact that this tornado traveled with destructive force through several miles of brick buildings and yet left the city with greater force than it possessed on entering it illustrates the futility of planting forests to the southwest of a city for the purpose of protection, as some have advocated. It is probable that the strongest trees would offer but little more resistance to this terrific force than would so many blades of grass.

Whenever the forecast contains the statement that conditions are favorable for severe local storms, it is well for the residents of a city receiving such forecast to observe carefully the formation of portentous clouds and be ready to seek places of safety in the cellars of frame buildings. We have no record of any person having been killed in the cellar of a frame building.

Chart XVI shows a West India hurricane just making its advent on the Florida coast. A number of stations in the West Indies report to Washington by cable whenever hurricanes pass over their region. Sometimes a hurricane composed of a rapidly revolving eddy of air of only two or three hundred miles in diameter passes between the observation stations on the islands of the West Indies without getting near enough to affect their instruments. Then, if it move rapidly northwest toward our Gulf coast, it may reach our seaboard unannounced. Fortunately such cases are rare, and in case the storm does reach any ports unexpectedly danger signals will be displayed in advance of its coming throughout the remainder of its course until it leaves our shores. At times hurricanes remain several days in the Gulf of Mexico, and the only indication we have of their proximity is a strong suction drawing the air briskly over some of our coast stations toward the center of the Gulf. Again, a

Chart XVI. West India Hurricane, August 27, 1893, 8 a. m.



Isobars are shown by full lines; isotherms by dotted lines. Arrows point in the direction the wind is blowing. Shaded areas show regions of precipitation during past 12 hours.

Chart XVII. Change in Air Pressure in Preceding 12 Hours, August 27, 1893, 8 a. m.

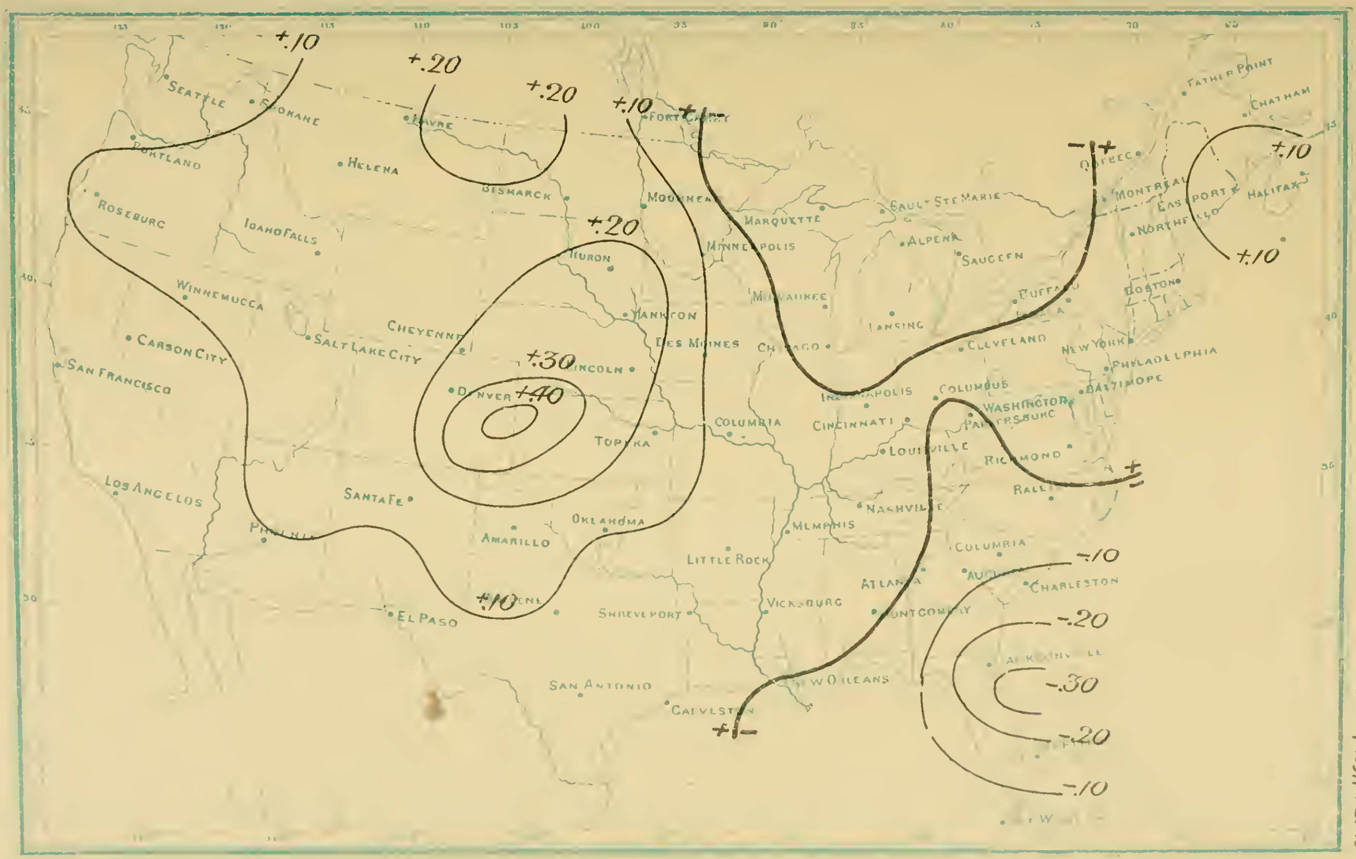


Chart XVIII. West India Hurricane, August 27, 1893, 8 p. m.

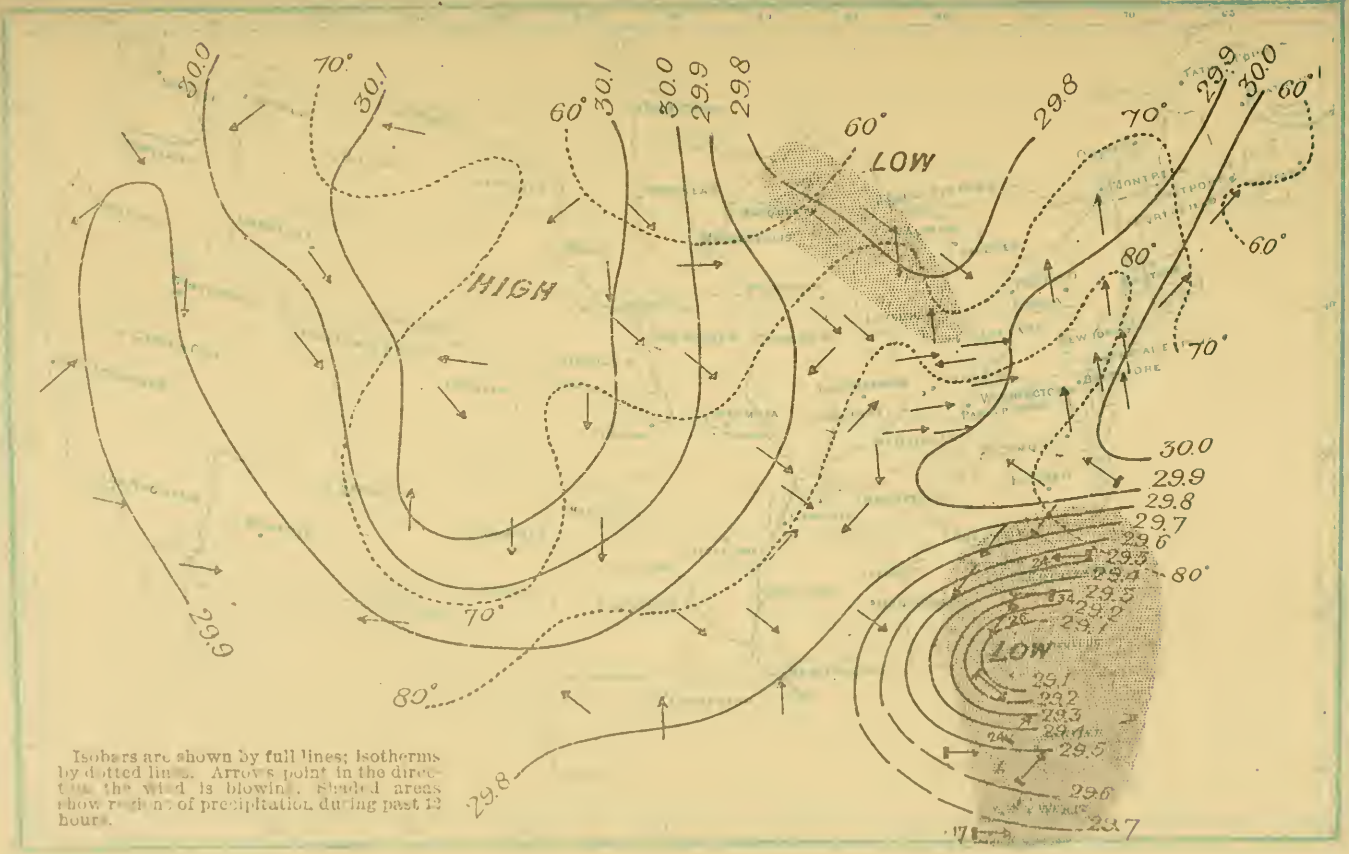


Chart XIX. Change in Air Pressure in Preceding 12 Hours, August 27, 1893, 8 p. m.

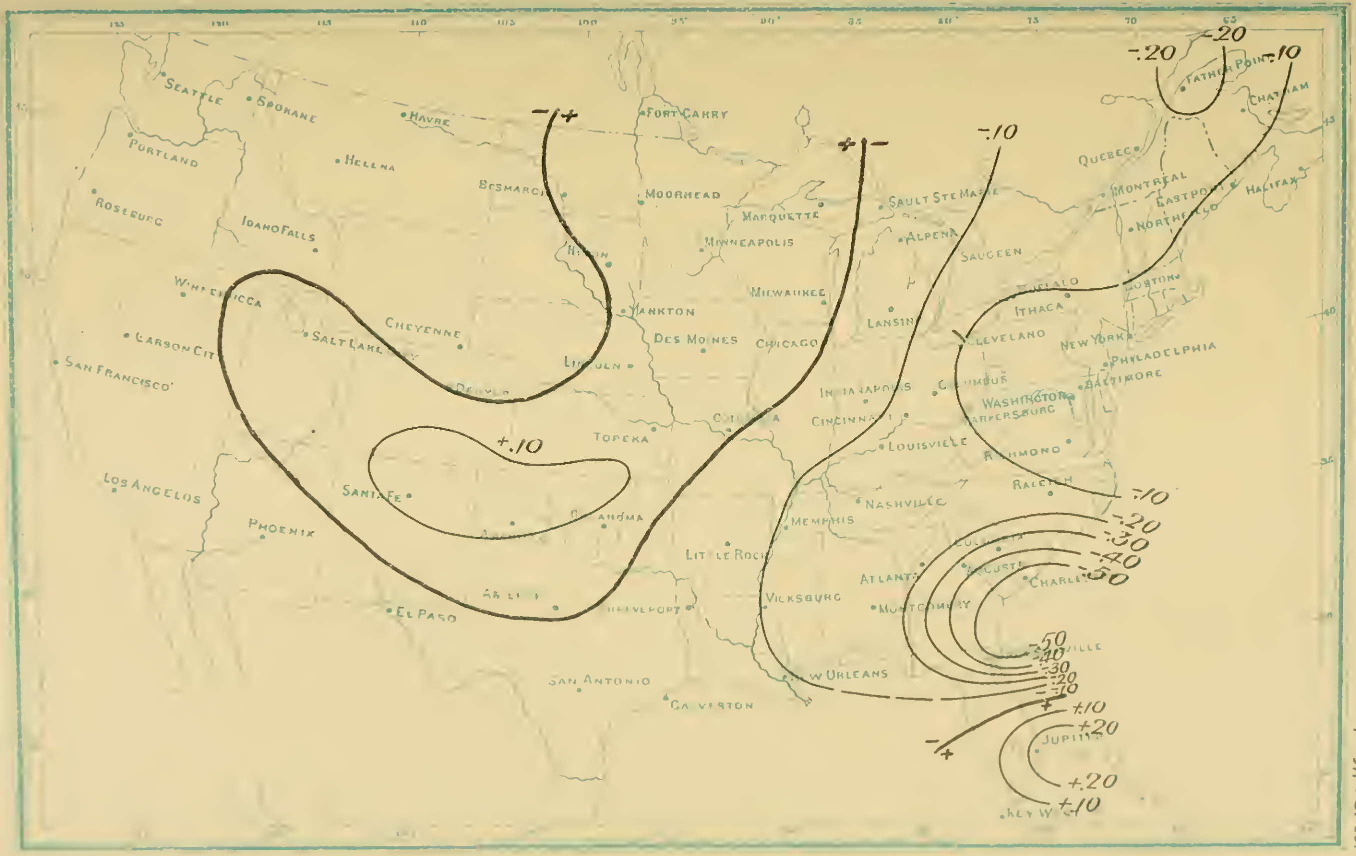
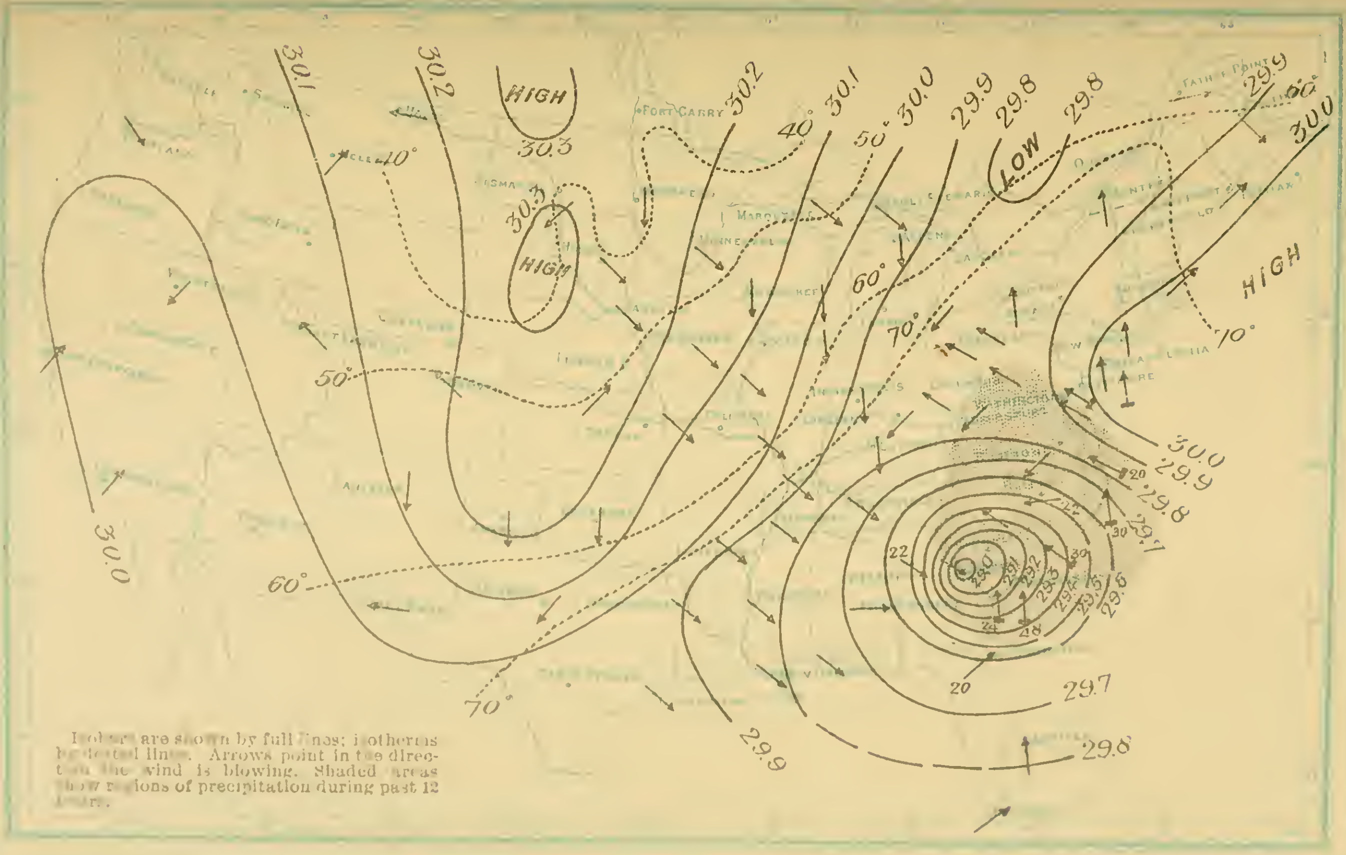


Chart XX. West India Hurricane, August 28, 1893, 8 a. m.



VOL. VIII, 1897, PL. 22.

Chart XXI. Change in Air Pressure in Preceding 12 Hours, August 28, 1893, 8 a. m.

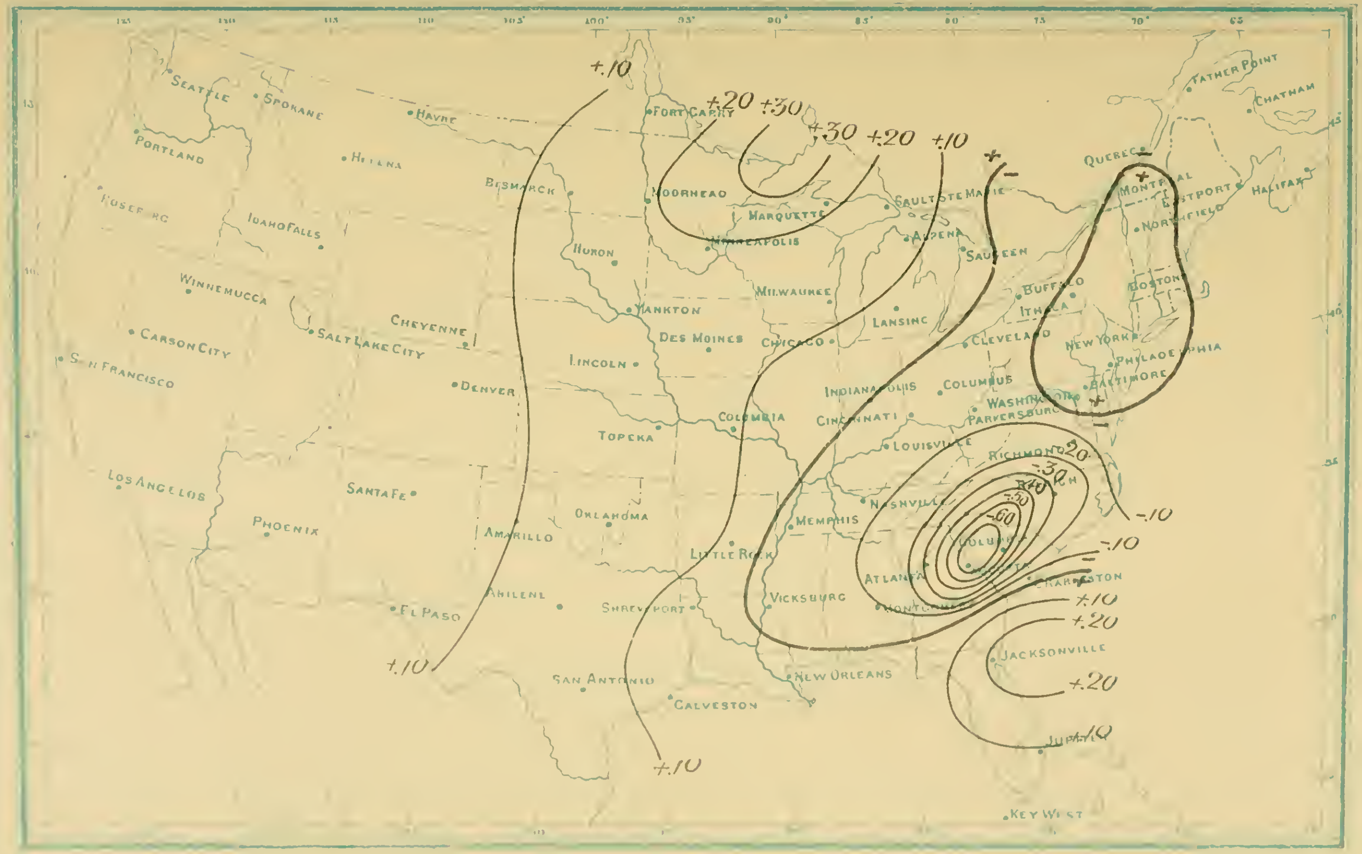
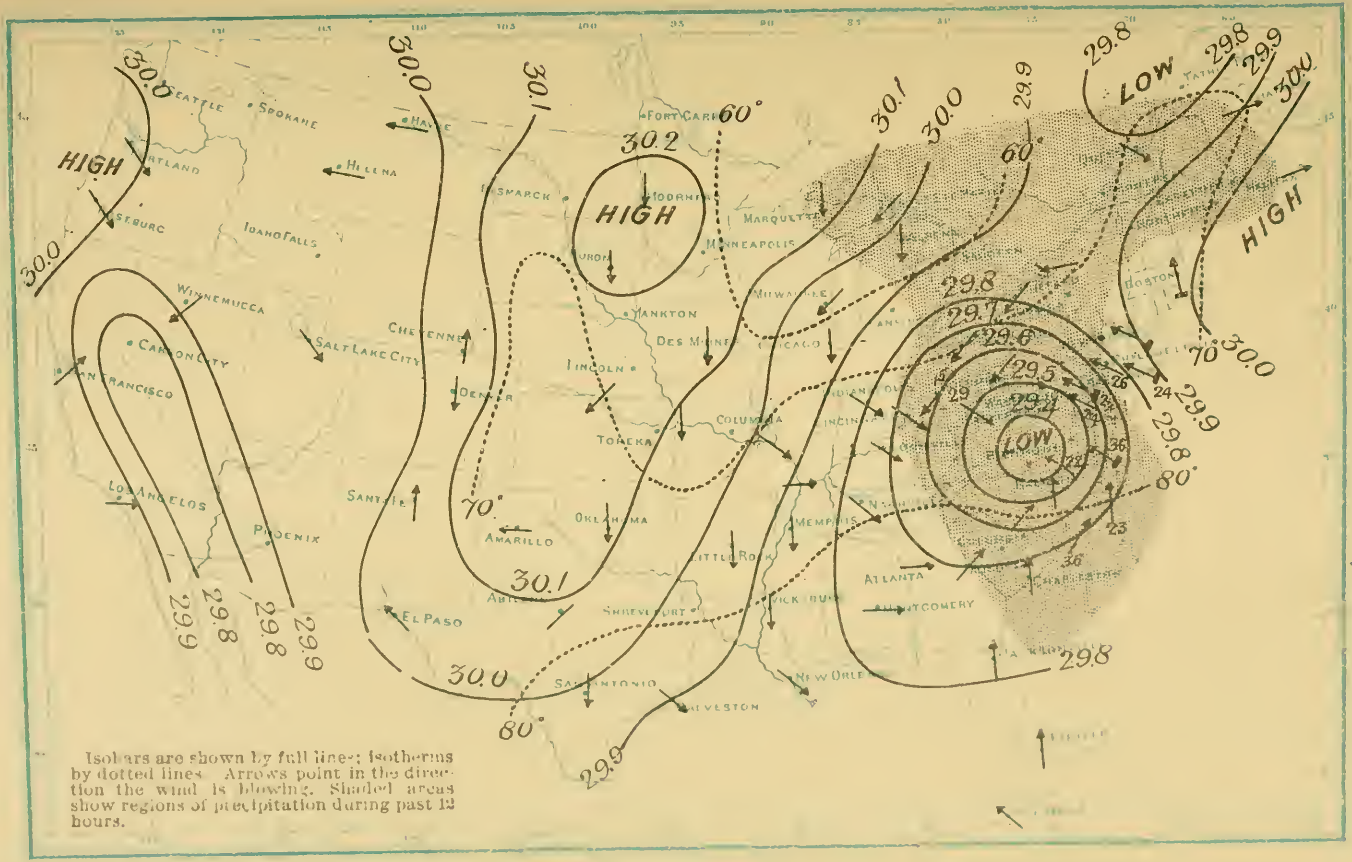


Chart XXII. West India Hurricane, August 28, 1893, 8 p. m.



Isobars are shown by full lines; isotherms by dotted lines. Arrows point in the direction the wind is blowing. Shaded areas show regions of precipitation during past 12 hours.

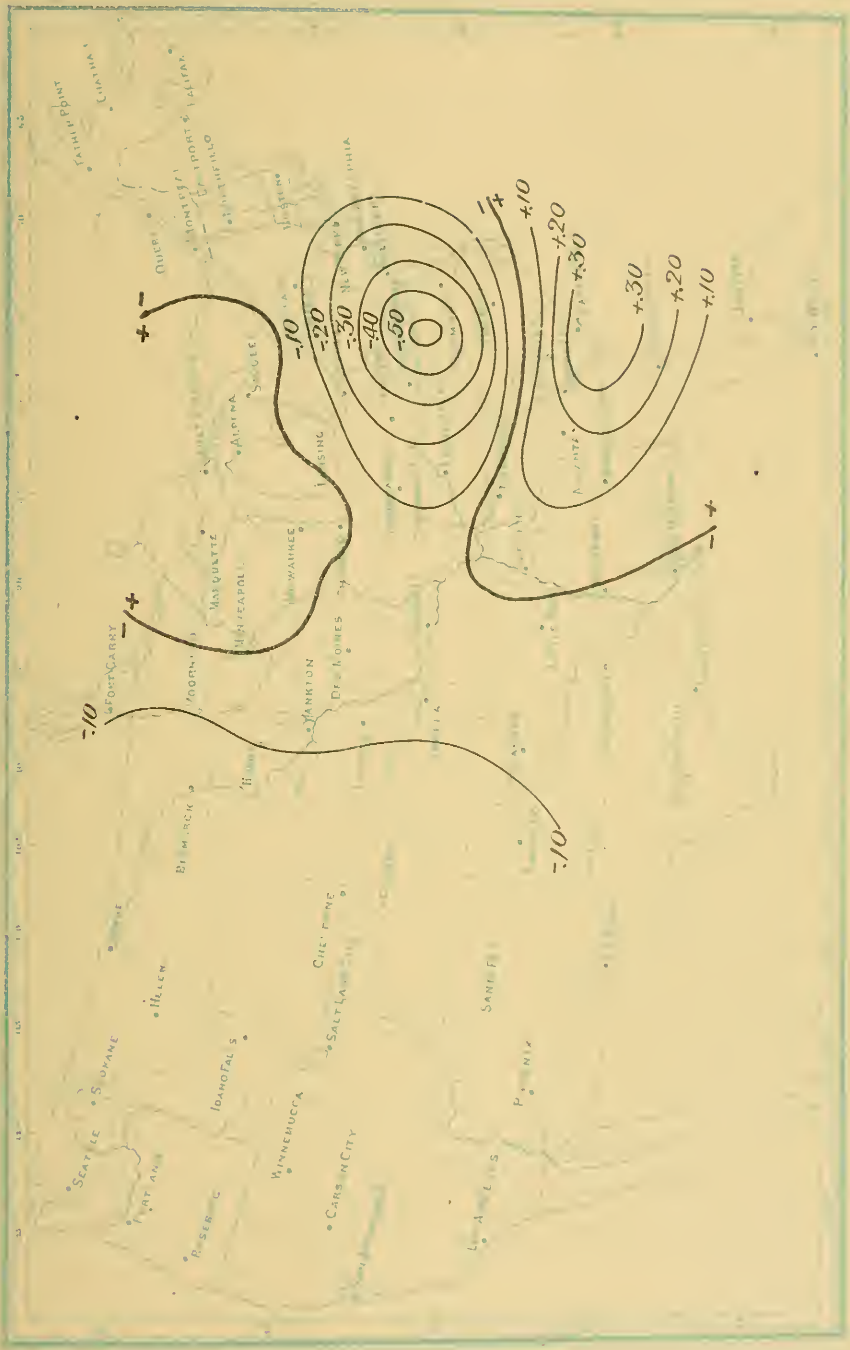
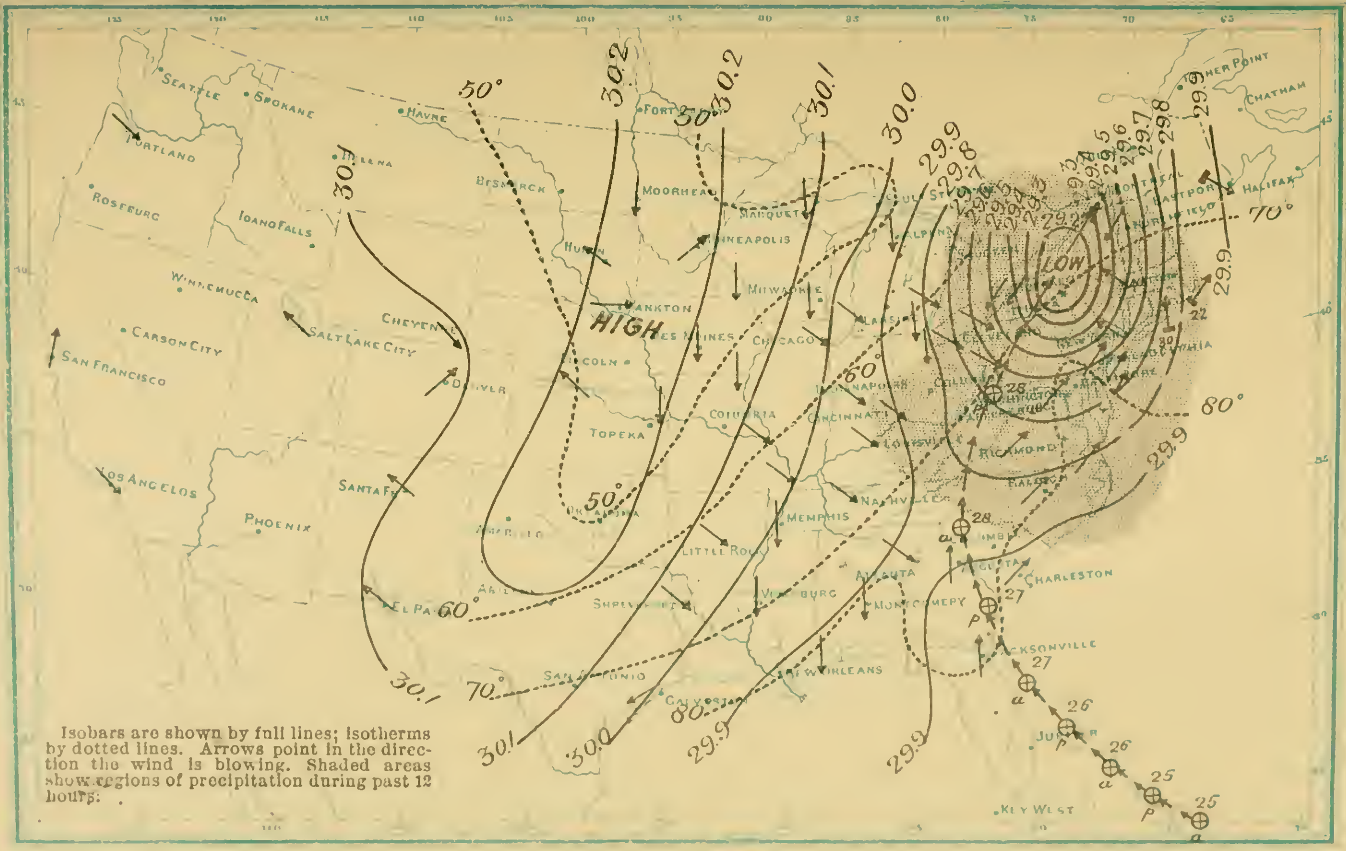


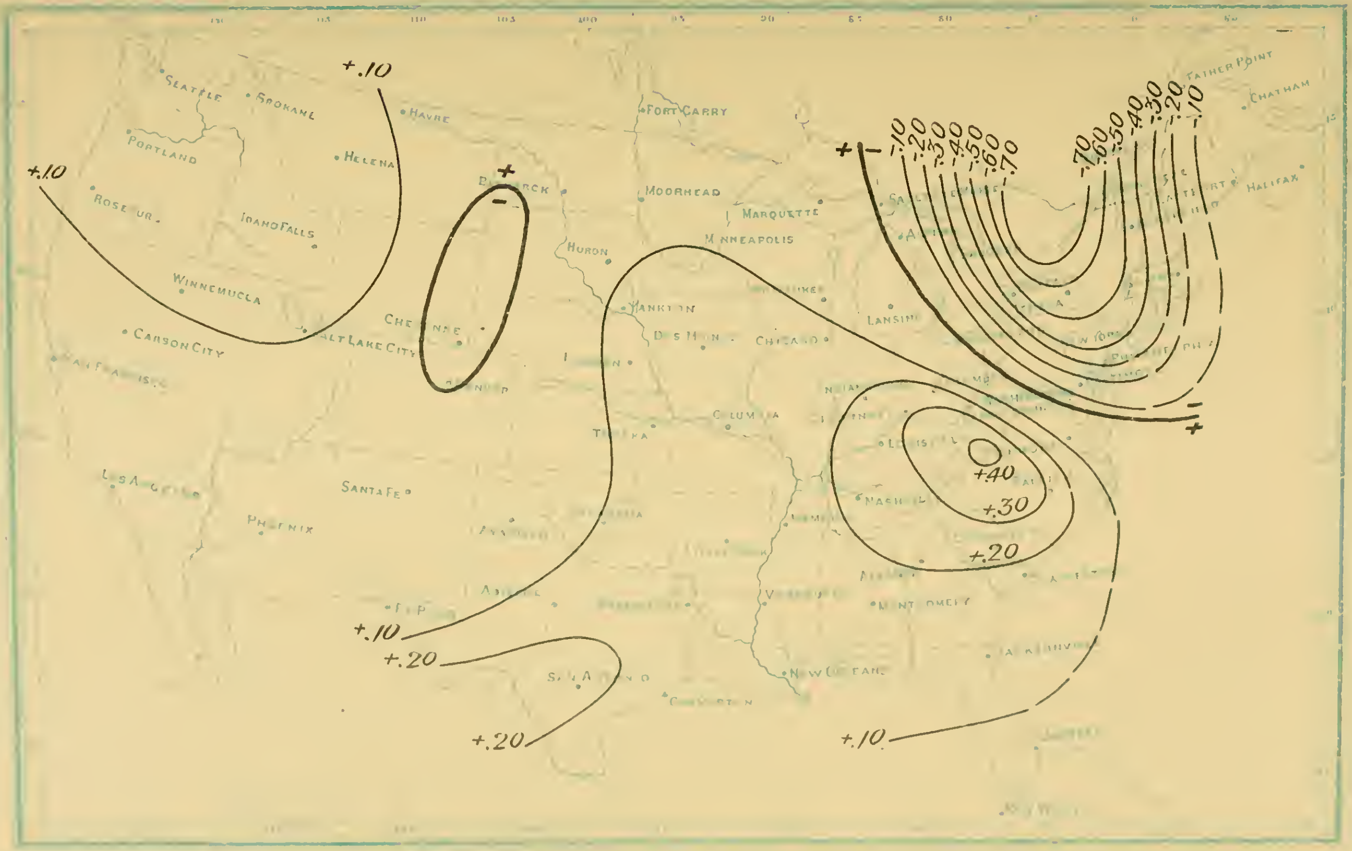
Chart XXIII. Change in Air Pressure in Preceding 12 Hours, August 28, 1893, 8 p. m.

Chart XXIV. West India Hurricane, August 29, 1893, 8 a. m.



Isobars are shown by full lines; isotherms by dotted lines. Arrows point in the direction the wind is blowing. Shaded areas show regions of precipitation during past 12 hours:

Chart XXV. Change in Air Pressure in Preceding 12 Hours, August 29, 1893, 8 a. m.



heavy ocean swell may be caused by the friction of the rapidly gyrating air on the surface of the water, and when the hurricane has a slow progressive movement this swell may be propagated outward from the center of the storm faster than the storm is moving and reach the coast several hours before either the barometer or the wind movement gives any indication of the coming storm.

The tracks of West India hurricanes are always in the form of a parabola. These storms come from the southeast, but on reaching the latitude of our Gulf coast recurve to the northeast along or off our coastline. An examination of the auxiliary chart on the adjoining page shows that the air pressure in the region of the storm has decreased .10 to .30 of an inch during the past 12 hours, and the little bars on the arrows shown on Chart XVI, from Norfolk southward, indicate that the forecast official at Washington has ordered up the storm signals in anticipation that the storm will move up the coast and increase in energy.

Chart XVIII, twelve hours later, shows that his warnings were timely, as the storm center has moved slowly northward to Jacksonville, with greatly increased energy, the barometer at the center reading 29.1 inches, which is about .9 of an inch under the normal air pressure. The auxiliary chart shows that the air pressure has decreased more rapidly during the past 12 hours than during the similar period next preceding. The most potent force in accelerating the motion of the eddy or hurricane was the vast amount of heat energy liberated by condensation in the whirling mass.

Danger signals have been carried northward to Norfolk, and ports north of the storm center have been warned that the dangerous winds will come from the northeast. I wish to make plain that the storm coming from the southwest causes northeast winds to flow in at its front. On the Georgia and Florida coasts the signals have indicated that the wind will blow from the northwest for a few hours, as the air whirls in behind the receding storm center. It will now be seen how it is possible for storms to progress against the wind.

In thunder-storms this rule does not hold, as there is a horizontal rolling of the atmosphere, caused by cold and heavy air from above breaking through into a light and superheated stratum next the earth. This rolling motion throws forward the cool air in the direction in which the cloud is moving.

Chart XX shows a slight aberration in the northeast course of the storm, which places the center inland, so that the whole eddy can be charted.

West India hurricanes are cyclonic in character, but on account of the fact that the diameter of the whirling eddy is much less and the velocity of rotation much greater than in the average cyclone, it is customary to designate them as hurricanes. In other words, the hurricane is a cyclone of small area but of powerful vortical action, and consequently of great destructive force. To get a rough idea of the difference between storms, we might classify them according to the diameter of the revolving mass of air under their influence as follows:

Cyclones, 1,000 to 2,000 miles; hurricanes, 200 to 500 miles, and tornadoes one-half mile to one mile. Then if a great quantity of heat energy is liberated by profuse condensation of aqueous vapor near the storm centers, we might imagine their vortical action and their destructive force to increase as their diameters of rotation decrease.

Charts XX to XXV show the progress, in twelve-hour intervals, of the hurricane northeastward to New England. It will probably leave the American continent at Nova Scotia and in three or four days cross the Atlantic and make its appearance on the northwest coast of Europe.

Twenty-five years ago mariners depended on their own weather lore to warn them of coming storms; then, although the number of boats plying the seas was much less than it is now, every severe storm that swept across them left death and destruction in its wake, and for days afterward the dead were cast up by the subsiding waters and the shores were lined with wreckage. Happily this is not now the case; the angry waters and the howling winds vent their fury the one upon the other, while the great mass of shipping, so long the prey of the winds and waves, rides safely at anchor in convenient harbors.

The United States has the most extensive weather service in the world, and its enormous practical utility is now universally recognized. Careful estimates based on reports from interested parties indicate that cold-wave signals effectively displayed in advance of one severe cold wave sweeping across our country result in a saving of over $3,500,000, while responsible marine representatives declare that each West India hurricane passing up the Atlantic seaboard would destroy not less than $2,000,000 worth of property and many lives if danger signals were not displayed well in advance of its coming.

RUBBER FORESTS OF NICARAGUA AND SIERRA LEONE

By General A. W. Greely,
Chief Signal Officer, United States Army

The increasing commercial demands for raw rubber and the steady diminution of caoutchouc produced by existing rubber forests give special interest to any information bearing on future supplies of caoutchouc pending the discovery of compounds that shall supplant it. In 1892 the Department of State published a Special Consular Report on rubber and rubber manufactures, which has lately been supplemented by additional information.

The india-rubber trees, of which there are several profitable varieties, will produce annually from 10 to 40 pounds of caoutchouc for many years, if they are tapped judiciously. It is, however, an almost universal complaint, from Africa, America, and Asia, that the greed and carelessness of the native collectors, who seek to obtain the greatest immediate quantity by the least laborious methods, are rapidly destroying the rubber-bearing plants. Trees are either felled or so deeply and roughly incised as to speedily die.

The fresh rubber juice, resembling cream in color and consistency, has an ammoniacal odor, which rapidly disappears, leaving the caoutchouc odorless and tasteless. Trees yield the milk copiously for several months each year, and the coagulated rubber averages about 30 per cent of the original juice, two pounds of caoutchouc to the gallon.

Brazil is the principal source of raw rubber, and that from Para is the best. In 1890 the receipts of caoutchouc at Para reached 16,570 tons, according to the report of Consul J. O. Kerbey, whose account of rubber-gathering may be of interest:

"The rubber-gatherer rolls out of his hammock as soon as it is light in the morning, and takes his gulp of rum and his calabash of coffee and starts out to visit his rubber trees. He wears a short pair of breeches and sometimes a shirt. He goes barefoot, for he must wade through the swamp mud and ooze of the tide up to his knees, and often up to his waist in water. He takes a basketful of earthenware gill cups, a hunk of adhesive clay, and a little, narrow-bladed hatchet.

"If he adopts the most approved method of tapping the trees, he reaches as high as he can with his hatchet, making an incision in the bark, but not reaching through to the wood. The milk immediately begins to issue in rapid drops or little streams. With a spat of the adhesive clay he immediately fastens one of his little gill clay cups just below the bleeding gash, and molds the clay so as to make all the rubber milk flow into the cup. Three such gashes, at equal distances around the tree and at equal height, is the rule. The next day he will make three more gashes in the same way, just a little below these three, and so continue, until by the end of the season he will have reached the level of the ground. Each of his 100 or 150 trees is treated in the same way, and he returns home, after having traveled from 3 to 5 miles, barefoot and almost naked, through thorny thicket and malarial, steaming swamp.

"When he reaches his hut, he again takes another gulp from the demijohn, snatches a breakfast of salt fish and mandioca meal, which are often moldy from the reeking damp of the swamp, and then he starts out again with his calabash buckets to gather the milk, which by this time has ceased to flow. His gill cups are full, or nearly so, and when he reaches home he has milk enough to make four kilos of rubber, on an average. The next task is the coagulation of the milk. For this purpose he has a jug-shaped furnace, made of earthenware, called a *boião*, open at bottom and top, and with a small aperture at the side to admit the air for the combustion. In this piece of furniture he builds a fire, or rather a smudge, with the nuts of the inija or urucury palm. The dense, black smoke which rolls from the open top of the *boião* is the reagent which coagulates the milk. For this purpose the rubber-gatherer has a circular-bladed paddle, like the paddle of a canoe, which he smears over with clay, so that the rubber will not adhere to it. This is suspended by means of a cord from the limb of a tree just above the smudge, the milk is poured over the blade of the paddle, which is then turned over and around about in the smoke; and in a few moments the film of rubber is coagulated. The same process is repeated of wetting with milk and smoking the growing lump until it reaches the weight of from 5 to 25 kilos or more. Then it is slipped off from the paddle as a mitten is pulled off from one's hand. This ball is the crude rubber."

RUBBER PROSPECTS IN NICARAGUA

A later report from Consul J. Crawfords contains the following information. Recently, many persons in western Nicaragua have declared their intention to plant and cultivate elastic rubber-yielding (some varieties of the *juno* are but slightly elastic) trees and vines in the eastern part of the state. Such estates are locally named *haciendas de hule*. These persons are inquiring concerning the localities having the most suitable lands and climate, the species and varieties of trees and vines that annually or biennially yield the largest quantity of good rubber, the proper distance apart for planting the trees and vines, the best modes of cultivation, and how many years must elapse before it is proper to commence the annual or biennial collection of rubber, etc.

Many of the valleys in central and northeastern Nicaragua contain all the natural conditions for a full yield of an excellent quality of elastic rubber. They are localities supporting numerous groves of large-sized trees yielding rubber until about fifteen years ago, when nearly all the trees had been killed by too severe scarifying by irresponsible collectors. Localities in Nicaragua south of latitude 15° north, and in low valleys where the soil is alluvial or vegetable humus and sand, capable of being rapidly drained, and in a climate that is uniformly warm and humid, suit the largest rubber-yielding varieties of trees and vines. Some varieties, giving an excellent quality of very elastic rubber, are indigenous to a higher, drier climate and soil.

There are several of the natural orders—*Urticaceae*, *Sapotaceae*, *Moraceae*, *Apocynaceae*, and *Euphorbiaceae*—indigenous in Nicaragua, which, when scarified deeply, exude a milk-like sap from which rubber of various degrees of elasticity is separated. The annual quantity and the quality in elasticity differ usually with the species and with different conditioned localities. Some prefer the low alluvial lands under a humid atmosphere, while other varieties flourish best in more elevated, sandy, and decomposed vegetable matter—lands rich in potash, as the volcanic valley districts south of Lake Nicaragua. The most desirable varieties for quantity per annum and quality of rubber are the *Siphonia elastica* and *Castilloa elastica*, habitants of well-drained, low, alluvial valleys, kept warm by a humid atmosphere. The second best rubber-producers are of the ficus family, a variety locally known as matapala, an epyphite having numerous bodies from aerial roots (like the banyan tree). It is also an inhabitant of low, fertile, well-drained lands. By cultivation this tree would probably equal the other low-valley varieties in quality and annual output of rubber. It has the advantage that if one of its trunks is deadened by excessive drainage of the sap, it has several other live trunks from which to obtain supplies of rubber. Another good variety is the *manihot balano*, locally known as the "arbolde vaca" (cow-milk tree), a large, hardy, indigenous kind found at altitudes of 1,000 to 2,000 feet above the ocean.

The annual yield of elastic material depends on the bulk of the bast or lactiferous tissues that exist or that can be developed. Some trees of 2 or 3 feet diameter and 35 to 50 feet tall will give annually 20 to 40 pounds of good rubber. The quality of rubber depends largely upon the form of the cells composing the bast, and in part in the process used to separate the elastic material from the emulsion-like sap. Quality and quantity are responsive to cultivation.

According to very recent reports from Nicaragua, the leaves yield a purer juice, and more copiously, than the bast. If this proves true, the supply of rubber can be largely increased without permanent injury to the tree.

The shoots should be transplanted to a nursery when one year old, and thence removed to their permanent place when 3 years of age, in rows—say, 64 Matapala, 81 Siphonia, and 100 Castilloa trees per acre.

Cultivation consists in ditching the land so as to drain it at will, keeping it moist without permitting water to stand. Keep all undergrowth cut down and the land "hilled up" around the trees. Fell other varieties of trees and vines until they shade but a very small part of the land. Commence during the sixth or seventh year to collect rubber by small area incisions through the bast, taking, if the trees have matured properly, 8 to 12 pounds of rubber from each tree biennially, but after the tree is 12 years of age a sufficient quantity of sap could be annually extracted to yield 10 to 15 pounds of good elastic rubber.

The two following modes of incision are preferable to other processes: (1) Cut with a curved, sharp instrument channels through the lactiferous tissues similar to those made in pine trees in turpentine orchards in the United States; (2) drive tubes cut from the internodes of bamboo (abundant in Nicaragua) through the bast, first making a slanting cut of a part of the circumference of the tube, and drive the sharpened end, 1½ to 2 inches long, into the tree; then, when the collecting season is passed, "plug up" the tubes of that season with wood that has been dipped in some liquid insecticide and saw off the tube and its wooden core even with the thin exterior bark of the tree.

The coagulation of the milk-like exudation and the separation from it of the elastic material can be effected by heating to 167 to 175 degrees F. and stirring in a hot decoction of some species of convolvulaceae, as morning glory, or stirring into the emulsion, when fresh and hot, the smoke from burning palm or other oleaginous nuts, which are abundant in rubber-yielding districts.

Secondary crops, planted between the rows of rubber-producing trees, could be the Liberia coffee tree, bananas, or such fibrous plants as hennequen, sisal, etc., of the agave family; also, the vanilla bean, one vine to each rubber tree, which would yield an annual crop equal in value to the rubber product. While the vanilla vine needs trees of this class for sustenance, yet it is probable that the vanilla would not materially reduce the flow of sap or the quantity of elastic material from the tree.

A comparative estimate of the annual value per acre in Nicaragua of coffee trees and rubber trees at nine years of age and thereafter, at present (1896) prices, gives $192 net profit from an acre in rubber trees.

RUBBER FORESTS OF SIERRA LEONE

The following information concerning the undeveloped rubber forests of Sierra Leone is drawn from the address of His Excellency Colonel Cardew to the legislative council of Sierra Leone on his journeys, aggregating 1,300 miles, in the hinterland and protectorate of Sierra Leone in 1894–'95.

There are large forests with abundance of rubber awaiting exploitation by intelligent and systematic methods and that will yield wealth to the first enterprising comer. An extensive rubber forest lies between Makali and Kruto, covering the greater part of the district between the Seli and Bagwee rivers. This area comprises portions of the Kuniki and Koranko districts, and the extent of the rubber forests is estimated at 600 square miles. The portion of the forests seen is composed of rubber trees about ten years old, called "Kewatia." These trees grow rapidly, and in ten years attain a girth of two or three feet, but under present methods they are felled by the rubber-gatherer. Two vines, the "nofe" and the "lilibue," yield rubber, the latter of the choicest quality. The "nofe" is invariably cut up and destroyed for its rubber, and the "lilibue" generally so.

The native processes of rubber-gathering are crude and wasteful in the extreme. If intelligent and economical methods were adopted, there would be far greater yields than formerly, and the west African rubber would command a higher price. Unless better methods of extracting rubber are introduced, it is safe to predict that under the increasing demand for rubber one of the most thriving industries of Sierra Leone will be ruined by the extinction of the plant. At present, for the purpose of extracting a few pounds of rubber, large trees are totally destroyed.

The forests in the Kuniki and Koranko districts are quite accessible, it being about seven days' march to Makali, where the woods are entered. Water carriage for light canoes is possible down the Rokel river from Benkia, two marches from Makali.

These forests, however, are small compared to those on the Anglo-Liberian frontier along the Morro and Mano rivers, which extend nearly a thousand miles. The exploitation of these forests has been impracticable for the last twenty years, owing to border raids, but under present conditions of peacefulness it is now possible to open up these forests, which abound in rubber and elephants, and the southern portions of which are within two days' journey of Sulina.

A protectorate will shortly be proclaimed over the British sphere of influence in the interior, and under the proposed arrangement of five districts, each to be under a competent commissioner, it is hoped there will be a rapid development of the interior, especially in the way of opening up communications and fostering trade.

RECENT EXPLORATIONS IN EQUATORIAL AFRICA*

Africa is fast losing its title of the Dark Continent, and if explorations continue at their recent rate for a few years longer it will be as well known as other parts of the globe. Three young men recently crossed it from east to west, following, in the main, the route taken by Stanley, and correcting a few of the slight mistakes made by that explorer, as the

* In studying the geography of the Dark Continent it should be borne in mind that owing to the interchangeability of the letters r, l, and d in many of the African dialects and to the fact that explorers of various nationalities have applied to the names of the different tribes and geographic features of the regions they have visited the orthographic forms peculiar to their own languages, the geographic nomenclature, even of such portions of the interior as are now mapped in more or less detail, is far from being definitely established. In some cases the variation in spelling is so great as almost to preclude identification, and not even in the case of names of European origin is there that uniformity of orthography which is so much to be desired. J. H.

result, probably, of his rapid marching. These travelers were M. Maurice Versepuy, who has since died of fever, the Baron de Romans, and M. Sporck, an artist, accompanied by an escort of 20 riflemen and 130 carriers engaged at Zanzibar. They secured a large collection of weapons from different tribes, of indigenous seeds, flowers, and timber, of skins of various mammalia; also a live leopard and a large number of photographs, and of water-color and other drawings. They traveled 4,000 kilometers on foot and 2,000 by boat, and their very complete itinerary of their travels contains much interesting geographical information.

The explorers left Zanzibar on July 6, 1895, sailing thence for Mombasa. Thence they crossed a barren, rocky country and reached Lake Jipé, where they hunted a while. They ascended the slope of the Kilimanjaro to the German post of Moshi, at an elevation of 1,200 meters. The Kilimanjaro is an imposing mass, nearly 6,000 meters high and covered with eternal snows. The confluence of the rivers Tsavo and Useri was located and the party crossed to the north of Kilimanjaro, a volcanic country entirely uninhabited, and passed by Lake Ngiri. Taking an entirely new route, they made for the English post of Kikuyu, across the plains of Kapoteï, where they successfully hunted elephants, rhinoceros, zebras, and antelope. These plains were entirely devoid of vegetation and their rivers were dried up. Kikuyu was reached in November, at which time the Masaï were in open rebellion. This brave and fearless tribe is known and feared from the Kenia to German East Africa. They are tall and well-built, are mostly naked, wear their hair long, and smear their faces and shoulders with grease and red clay. They wear war feathers about the head and carry spears and shields, but while warlike and nomadic they raise some cattle. It was at this time that an English caravan, composed of 1,200 Wakikoyus, was attacked by the Masaï, who killed 700 of them. A Scotchman, named Dick, who was traveling with another caravan, left Kikuyu the day before the three French travelers, but hearing of the massacre he fell back and sent a letter to Kikuyu for assistance, which was refused. The Frenchmen joined forces with him and they were furiously attacked by the Masaï in the Kedong valley. The attack was repelled, but Dick was killed.

Leaving the Kedong valley, the party passed to the east of the small lakes Naivasha, Nakuro, and Elmetéita, and on December 5 reached the English fort of Ravine. The next day they crossed the deep ravine of the Eldoma river, passed the Mau foothills to the country of the Wanandis, across the north of the Kavirondo country, to the Nzoia river, from the banks of which the Victoria Nyanza could be seen. The Usoga, a rich and thickly inhabited country, was next passed and the Nile was reached. The Ripon falls, about 800 meters wide and 10 meters high, were greatly admired. Crossing the Bay of Napoleon brought the travelers to Uganda, where the natives are sufficiently civilized to have built roads and bridges. Their capital is Mengo, which the travelers left on February 22, 1896. Passing by Lake Mitiana, which is more of a swamp than a lake, Lake Ruheron was reached. It lies to the northeast of Lake Albert Edward, which is itself to the southwest of Mount Ruwenzori.

According to Stanley, there is a high peak, which he named Gordon Bennett, to the north of this lake, but the travelers were unable to discover it. Mount Ruwenzori is about 5,000 meters high, and at night numerous lights were seen on its slopes. On April 11 the explorers were at Kasagama, whence they started for Katoné, to the north of Lake Albert Edward, and on the frontier between British territory and the Kongo Free State. During this march they noticed that Lake Ruherou is not connected with Lake Albert Edward by a large bay, as Stanley says, but by a small stream. The two lakes are 40 kilometers apart and have a difference of 200 meters in elevation.

On April 17 Katoné was left behind, the thirtieth meridian was crossed, and the caravan camped right under the equator for the third time since leaving Mombasa. Continuing westward, they entered the Kongo Free State and crossed the foothills of the Ruwenzori, visited by Captain Lugard a few years ago, and entered the Semliki valley. The Semliki river is about 200 meters wide and has a very swift current. The next halt was made at the village of Mbéné, where Stokes was captured. From this place to Leopoldville the country is covered with an almost impenetrable forest, on the edge of which is the Arab village of Kissangué, an auxiliary post of the Kongo State. It is the duty of the chief of the village to warn the Kongolese authorities of the presence of strangers on their territory. After a ten days' march through the forest Kuamkubi was reached. In this part of the country traces of Arab civilization are everywhere apparent; these Arabs speak the Zanzibar dialect. Leaving this post, the Kongo basin was next entered. The march through the forest was exceedingly difficult, compass and ax being alike indispensable. Finally the Ibina, a branch of the Ituri river, was reached. Twenty days more along the banks of the Ibina brought the travelers to the Ituri itself, which they crossed in canoes, and then took a guide, who conducted them to the Kongolese military post of Kilongalonga. They were well received by the Belgian officers, the first Europeans they had met for several weeks, and after a short rest and the laying in of supplies they left for the next post. Recrossing the Ituri, they followed its left bank as far as Moussa, a small village opposite the mouth of the Ipulo. Here the Ituri is swift and narrow. Eight days more through the forest brought the travelers to Avakubi, where for the fourth time the Ituri had to be crossed. Avakubi is a post and market of some importance. Here the travelers saw a few specimens of the race of pygmies whose existence has by many writers been doubted. The stature of these pygmies is about 1 m. 20, they are absolutely naked, their noses are very flat, and their looks somewhat ferocious. Their weapons are spears and arrows, which are proportionate to their stature. They hunt a great deal and attack even the elephant. They build no huts, but live scattered about the forest, and their habitations are holes. Their suspicious nature renders them very difficult to meet, and it is only once in a while that a few of the least wild among them venture to go to the nearest post to exchange the products of their hunt for bananas or sweet potatoes.

From Avakubi the travelers proceeded in canoes as far as Stanley Falls.

Here they embarked on a small steamboat and descended the Kongo, which at Bumba has a width of 30 kilometers. On August 3 they sailed for Europe, and M. Versepuy died shortly after his return to France.

ERNEST DE SASSEVILLE.

PARIS, *January 22, 1897.*

GEOGRAPHIC LITERATURE

Laboratory Practice for Beginners in Botany. By William A. Setchell, Ph. D., Professor of Botany in the University of California. Pp. XIV + 199. New York: The Macmillan Company. 1897. 90 cents.

That school instruction in botany is emerging from the dilettanteism and dry terminologyism of "manuals" on the one hand, and the proud but narrow microscopism of the usual "laboratory guides" on the other, is evidenced by the appearance of Professor Setchell's Laboratory Practice for Beginners in Botany. It is a book in which technical names for the parts of plants and machinery for handling and examining specimens are given a subordinate place, while the gross structure of plants is examined with the question constantly in mind, "How does the plant make use of the organs, and in what way are the modifications in different plants adapted to their special requirements?" The book contains 16 chapters on the anatomy of seeds, seedlings, roots, stems, leaves, buds, flowers, inflorescence, and fruits, and interspersed chapters on protective structures, storage of food, climbing and insectivorous plants, vegetative reproduction, pollination, seed dispersion, and other similar subjects. The book cannot fail to go a long way toward placing the student—and, we may add, the teacher also—in the attitude of keenly observing the relation of structure to function, a kind of observation in which Charles Darwin and Sir John Lubbock have been our chief masters, and which will ultimately give the science of botany the acute scientific interest and real educational value in secondary schools to which it is so well adapted and so fully entitled.

F. V. C.

An Introduction to Geology. By W. B. Scott, Blair Professor of Geology and Palæontology in Princeton University. Pp. XXVII + 573, with numerous illustrations. New York: The Macmillan Company. 1897. $1.90.

Students and teachers are to be congratulated on the appearance of another elementary work on geology. As explained by the author, the treatise "had its origin in the attempt to write an introductory work, dealing principally with American geology, upon the lines of Sir Archibald Geikie's excellent little 'Class Book.' * * * The book is intended to serve as an introduction to the science of Geology, both for students who desire to pursue the subject exhaustively, and also for the much larger class of those who wish merely to obtain an outline of the methods and principal results of the science." The contents suggest that the treatise is an expansion of Professor Scott's lectures on geology in Princeton University.

The book has the attractive air due to the excellent editing, clear typography, and photo-mechanical illustrating adopted of late by The Macmillan Company. In matter it is eminently conventional, and in manner of presentation thoroughly conscientious. It must appeal strongly to the honest student of earth-making. In general, the author has abstracted and condensed in admirable fashion the substance of the geologic literature of the last quarter-century; thus there is nothing of the sensational, and except in vertebrate paleontology little of the novel, between title-page and index. Perhaps the chief weakness of the work—if weakness it can be called—grows out of the author's desire to avoid extremes. On mooted points both or all sides are stated judicially, and this even when one interpretation is old or speculative and the other new or more directly observational, so that many of the chapters smack of class-room rather than field. An example will suffice: In discussing the distribution of earthquakes it is noted that "The great earthquakes which shook the Mississippi valley in 1811-'12 are among the very few instances of violent and long-continued shocks in a region far from any volcano," and the obsolete Humboldtian notion of connection with West Indian volcanoes is quoted approvingly, while the notable shocks that have devastated both sides of the Indian peninsula far from volcanoes, though about the depositing grounds of great rivers, and even our own Charleston earthquake—which, through the studies of Dutton, threw more light on seismism than any other recorded in history—are ignored! It is chiefly on the dynamic side, or the side of agency, that the old and the new are thus confused. On the descriptive side the chapters are generally up to date, while in paleontology, especially in connection with vertebrate fossils, the work stands in the van of modern knowledge. On this ground alone it will be invaluable to both classes for whom it is designed, since it is the first general work to really vivify fossil skeletons and to compel readers to conceive them as of living things.

The main divisions are (1) Dynamical Geology, (2) Structural Geology, (3) Physiographical Geology, and (4) Historical Geology. The classification is one of the conventional features suggesting that the author's platform is built of planks carefully selected from platforms of a dozen predecessors. To escape consequent difficulties an excellent introduction, with a chapter on rock-forming minerals, is prefixed. A useful classification of animals and plants is appended, and the value of the book is multiplied by an excellent index. As is usual in recent works, the author has drawn freely on the common stock of current knowledge, and gives credit to a score of contemporary geologists. W J M.

GEOGRAPHIC SERIALS

In "The Journal of School Geography" we welcome a new periodical in the field of geographic literature. This journal, which is addressed particularly to teachers, is edited by Mr R. E. Dodge, Associate Professor of Natural Science in the Teachers College, New York, with, as associates, Prof. W. M. Davis, of Harvard; C. W. Hayes, of the U. S. Geological

Survey; H. B. Kummel, of the Lewis Institute, Chicago; F. M. McMurry, Dean of the School of Pedagogy, University of Buffalo, Buffalo, N. Y., and R. DeC. Ward, of Harvard. Ten numbers will be published a year, price $1.00, or 15 cents a number.

Two numbers have thus far been issued, the leading contents of which are as follows: In the January number, "Home Geography," by W. M. Davis; "Some Things About Africa," by Cyrus C. Adams; "Geographic Instruction in Germany," by W. S. Monroe; "Some Suggestions Regarding Geography in Grade Schools," by R. E. Dodge. The February number contains the following articles: "The Influence of the Appalachian Barrier upon Colonial History," by Ellen C. Semple. It appears to us that Miss Semple exaggerates the influence of this geographic feature in delaying the settlement of the interior of the country. "Meteorological Observations in Schools," by Robert DeC. Ward; "The Causal Notion in Geography," by F. M. McMurry; "Geographic Aids," by R. E. Dodge.

This is a much-needed publication, and we welcome it with the prediction that it will be successful.

Another periodical of somewhat similar character which has just been added to our list of exchanges is "The Inland Educator," edited by Francis M. Stalker and Charles M. Curry, and published at Terre Haute, Indiana, price $1.00 a year, monthly. The opening article of the February number, which lies before us, is entitled "The New Geography," written by Prof. Charles R. Dryer.

From time immemorial the teaching of geography in the schools has consisted in memorizing isolated facts regarding the earth, its products and inhabitants, with little attempt to show relations. It is only in recent years that educators have become dissatisfied with this condition of things, and it is only in recent years, moreover, that geography has advanced from what might be termed an art to the dignity of a science—*i. e.*, that it has become recognized that the class of facts grouped under the name of geography have causal relations among themselves. The unrest among educators regarding the teaching of geography, which at first was merely aimless dissatisfaction with existing methods, is gradually leading toward definite lines of improvement. Gradually teachers are learning that geography is a logical science, and must be taught as such, and the text-books are beginning to adapt themselves to this view. The introduction of physiography into text-books is but one step in this direction. Physiography explains the origin of relief and drainage forms, and when to this are added the relations between the earth's surface and its climate, on the one hand, and the distribution of life and of man's industries and products, on the other, in our text-books, the improvement will be a well-rounded one. Then geography in its broad sense can be taught as a science. These are some of the ideas which are brought out in Professor Dryer's admirable article. Other articles in "The Inland Educator" relate especially to other branches of education and require no special mention here.

"The Geographical Journal" for February seems to be especially devoted to African exploration. It opens with "A Journey in the Marotse and Mashikolumbwe Countries," by Capt. A. St H. Gibbons. Other articles are "A Journey up the Machili," by Percy C. Reid, "From the Machili to Lialui," by Capt. Alfred Bertrand; "Notes on a Journey Around Mount Masawa," by C. W. Hobley. Concerning Asia, there are "Explorations in Mysia," by J. A. R. Munro and H. M. Anthony; "Journey of Captain Wellby and Lieutenant Malcolm Across Tibet," and "Captain Deasy's Journey in Western Tibet." Mr J. Bartalhareis contributes an article entitled "The Supposed Discovery of South America Before 1448 and the Critical Methods of the Historians of Geographical Discovery."

"The Scottish Geographical Magazine" for February contains an account of "Recent Explorations in the Patagonian Andes South of 41° South Latitude," by Dr Hans Steffen, and "Notes upon the Geography of the Argentine Republic," by H. D. Hoskold, Director-General of the National Department of Mines and Geology, Buenos Aires.

H. G.

PROCEEDINGS OF THE NATIONAL GEOGRAPHIC SOCIETY, SESSION 1896-'97

Regular Meeting, February 19, 1897.—President Hubbard in the chair. Mr J. E. Spurr read a paper, with lantern-slide illustrations, on the Forty-Mile Creek Gold-Mining District, Alaska.

Special Meeting, February 20, 1897.—President Hubbard in the chair. Mr George Kennan lectured on Vagabond Life in Eastern Europe, with lantern-slide illustrations.

Special Meeting, February 26, 1897.—President Hubbard in the chair. Mr Frank Hamilton Cushing addressed the Society on the Ancient Sea-Dwellers and Key-Builders of Florida, illustrating his subject with lantern slides.

Special Meeting, March 1, 1897.—First lecture of the course of Monday afternoon illustrated lectures and annual address of the President of the National Geographic Society, under the auspices of the Joint Commission of the Scientific Societies of Washington. Surgeon-General George M. Sternberg, U. S. Army, Vice-President of the Joint Commission, in the chair. The subject of President Hubbard's address was the Effects of Geographic Environment in the Development of Civilization in Prehistoric Man.

Regular Meeting, March 5, 1897.—Secretary Hayden in the chair. Mr F. H. Newell delivered an address, illustrated by lantern slides, on the Distribution and Mining of Petroleum.

Special Meeting, March 8, 1897.—Second Monday afternoon illustrated lecture. President Hubbard in the chair. Rev. W. Hayes Ward, D. D., LL. D., of the New York *Independent*, lectured on Babylonia.

Special Meeting, March 12, 1897.—Vice-President Greely in the chair. Miss Annie S. Peck lectured on Mountaineering in the Tyrol and Switzerland, including an Ascent of the Matterhorn, with lantern-slide illustrations.

ELECTIONS.—New members have been elected as follows:

February 26.—Miss H. J. Baird-Huey, Judge George S. Batcheller, Mrs Diaz-Albertini, Alex. Everett Frye, George B. Hollister, Mark S. W. Jefferson, Albert M. Lewers, Robert H. Paxson, Mrs Altha Gibbs Powell, Miss Mattie Scott, Mrs George Westinghouse, Rev. R. P. Williams.

DEATHS.—The Society has recently lost by death the following-named members:

Mr J. M. Cunningham, of San Francisco; Mr Joseph Macfarland, of the U. S. Geological Survey; Hon. J. Randolph Tucker, of Lexington, Va.; General Alfred Pleasanton, U. S. A.; Mr Lewis Clephane, of Washington, D. C., and Mr L. P. Smith, of the U. S. Department of Agriculture.

GEOGRAPHIC NOTES

CENTRAL AMERICA

NICARAGUA. Concessions have been granted to United States citizens for a street railway to be operated by steam between the town of Bluefields and the Bluefields custom-house, situated at the mouth of the harbor, and also for a railway between Rama and San Ubaldo. The United States consul, however, makes the significant statement that "so little has ever been done in Nicaragua under any government concessions, big or little, that it seems a waste of time to enter into the details of any concession without positive proof that it is to be pushed."

A contract has been let for the construction of a canal to connect Pearl and Bluefields lagoons, which will afford an inside channel with a depth of 4.5 feet for a distance of 55 miles north of Bluefields.

EUROPE

RUSSIA. On September 13 the total length of railways in operation in Russia was 36,861 versts, or about 24,400 miles. Of these lines, 21,158 versts were operated by the government.

The development of the mineral and manufacturing industries of Russia is progressing with astonishing rapidity. The production of coal has trebled in the last 15 years and the progress in the textile industries is marvelous. The empire, however, is still largely dependent upon other countries for its machinery and upon foreigners for the more responsible positions in its factories and ironworks.

There has been an enormous increase in the shipping industry of the Caspian sea, owing to the development of the oil wells of Baku, one of which recently discharged 300,000 tons of oil, valued at $750,000, within a period of two months. Several of the Russian railways and most of the steamship companies on the Volga, as well as the manufacturing centers along that great waterway, are using oil for fuel.

ASIA

SIBERIA. By consent of the Russian authorities the peninsula discovered by Dr Nansen is to be named for King Oscar of Sweden.

Over 200,000 Russian peasants migrated to Siberia in 1896, but some 25,000 were forced to tramp back to their miserable homes, owing to the land set apart for colonization being insufficient to meet the demand.

Syria. A steamer is now making regular trips from Jericho to Tiberias—*i. e.*, from the Dead Sea to the Sea of Galilee—in five hours. Several Jewish families recently settled in Jericho and are preparing to irrigate extensive fruit farms.

Japan. The Russo-Japanese convention has been published in St Petersburg. It provides that Korea shall retain full liberty of action as regards both domestic and foreign policy. Russia and Japan will each keep a small force of troops in Korea until such time as the government can maintain order.

India. It is estimated that the present famine in India would have reduced the population of that country by 10,000,000 if it had been allowed to run its course unchecked. Over 3,000,000 persons are employed on government relief works, and hundreds of thousands more are being succored out of the fund (now amounting to the equivalent of nearly $3,000,000) contributed in the British Islands.

AFRICA

Transvaal. The total output of gold for November was 201,113 ounces, as compared with an output of 195,218 ounces in November, 1895.

Madagascar. The French Colonial Minister has announced the intention of the government to maintain the equality of all religions in the island of Madagascar. He has forbidden, by telegraph, the proposed confiscation of Protestant churches.

Algeria. According to the recent census, the city of Algiers contains 96,000 inhabitants, 46,000 being French by birth or naturalization, 9,600 Jews, 25,000 Arabs or belonging to other native races, 9,800 Spaniards, 3,500 Italians, 1,100 Maltese, and 235 English.

Central Africa. Mr Poulett Weatherley, an Englishman, who recently visited Old Chitambo, where Livingstone's heart is buried, calls attention to the decay of the tree that marks the spot, and suggests the necessity of the immediate erection of a more enduring monument.

Egypt. During the recent Sudan expedition the number of all ranks of the Egyptian army killed in action was 47; the wounded numbered 122; 235 of all ranks died of cholera, and 126 died of other diseases. The Egyptian troops are said to have displayed great powers of endurance and a remarkable capacity for hard and continuous work.

West Africa. Wherever British influence predominates, railroad building is in progress. A line is in operation from Dakar, the chief port of Senegal, to St Louis, 175 miles north. Another line runs from Kayes up the valley of the Senegal toward Timbuctu, which it will soon reach. A line from Conakry to the Niger is also in contemplation. Dr Karl Peters recently stated in London that the whole African question was one of communication.

"FROM FROST TO FLOWERS."

"The Chariot . . .
. . . of the Sun"

SUNSET LIMITED is the Southern Pacific's great train, running through solid from New Orleans to the Pacific Coast.

SUNSET LIMITED leaves New Orleans every Monday and Thursday, at 10 o'clock in the morning.

SUNSET LIMITED covers the 2006 miles to Los Angeles in 58 hours, and the 2489 to San Francisco in 75 hours.

SUNSET LIMITED is vestibuled throughout, steam heated and gas lighted.

SUNSET LIMITED has a ladies' parlor the full width and a third the length of a car, equipped with fine library, escritoire and writing materials, large easy chairs, etc.

SUNSET LIMITED has an equally commodious smoking and reading room for gentlemen, supplied in a similar manner.

SUNSET LIMITED has bath room, barber shop and buffet—luxuries the tourist will appreciate.

SUNSET LIMITED has a car containing seven drawing rooms, which can be used separately or *en suite*, each having private lavatory and toilet facilities.

SUNSET LIMITED has a sumptuous diner, which goes through with it and in which meals are served *à la carte*.

SUNSET LIMITED is accompanied by a maid whose services are at the disposition of lady passengers.

SUNSET LIMITED traverses a road where snow never falls and blockades and blizzards are unknown, and through a region of marvelous interest.

SUNSET LIMITED is at your service, and any Southern Pacific Agent will be glad to tell you all about it, or if you want to know more, send 10 cents in stamps to the General Passenger Agent, and a beautiful book of 205 pages, that will tell you all about the route, will be sent you.

S. F. B. MORSE,

General Passenger and Ticket Agent,

NEW ORLEANS.

Among the Contents of Forthcoming Numbers of

THE NATIONAL GEOGRAPHIC MAGAZINE

WILL BE THE FOLLOWING:

A Winter Voyage through the Straits of Magellan,

By ADMIRAL R. W. MEADE, U. S. N.;

The Deserts and Forests of Arizona,

By PROF. B. E. FERNOW, Ph. D.,

Chief of the Division of Forestry, U. S. Department of Agriculture;

A Summer Voyage to the Arctic,

By G. R. PUTNAM,

U. S. Coast and Geodetic Survey;

The Siberian Transcontinental Railroad,

By GENERAL A. W. GREELY,

Chief Signal Officer, U. S. Army,

—— AND ——

Down the Volga, from Nijni Novgorod to Kazan,

By PROF. FREDERIC W. TAYLOR.

JUDD & DETWEILER, PRINTERS, WASHINGTON, D. C.

The National Geographic Magazine

AN ILLUSTRATED MONTHLY

Honorary Editor: JOHN HYDE

Honorary Associate Editors

A. W. GREELY W J McGEE HENRY GANNETT
C. HART MERRIAM ELIZA RUHAMAH SCIDMORE

CONTENTS

WASHINGTON

PUBLISHED BY THE NATIONAL GEOGRAPHIC SOCIETY

AGENTS IN THE UNITED STATES AND CANADA

THE AMERICAN NEWS COMPANY, 39 AND 41 CHAMBERS STREET, NEW YORK
PARIS: BRENTANO'S, 37 AVENUE DE L'OPERA

Price 25 Cents $2.50 a Year

Entered at the Post-office in Washington, D. C., as Second-class Mail Matter

THE

National Geographic Society

ORGANIZED, JANUARY, 1888

PRESIDENT

GARDINER G. HUBBARD

VICE-PRESIDENTS

MARCUS BAKER
WILLIAM H. DALL
G. K. GILBERT
A. W. GREELY
C. HART MERRIAM
HERBERT G. OGDEN

TREASURER

CHARLES J. BELL

RECORDING SECRETARY

EVERETT HAYDEN

CORRESPONDING SECRETARY

HENRY GANNETT

MANAGERS

H. F. BLOUNT
C. W. DABNEY, JR.
DAVID T. DAY
JOHN HYDE
W J McGEE
F. H. NEWELL
W. B. POWELL
J. B. WIGHT

SECRETARY'S OFFICE, 1517 H STREET N. W., WASHINGTON

The National Geographic Society, the object of which is the increase and diffusion of geographic knowledge, has a paying membership of 1,400. Its membership is not restricted to practical geographers, but is open to any person in good standing who may be sufficiently interested in its work to seek admission. The annual subscription is: for active members, $5.00 per annum; for corresponding members, $2.00 per annum. Active members pay also an entrance fee of $2.00 on election. THE NATIONAL GEOGRAPHIC MAGAZINE is sent regularly to all members, both active and corresponding.

Donations for the founding of Prize Medals and Scholarships are respectfully solicited.

MAP OF THE KOOTENAI

THE most complete map of the rich mining region of the **Kootenai** and adjacent territory in **Washington and British Columbia** has just been published by the

NORTHERN PACIFIC RAILWAY.

It is just what is needed by those going to that country or who desire to study and know about it.

The map is made in relief, is **25** by **18** inches in size between borders, and has in connection with it—on the same page—smaller maps that show the relation of the region to the world at large.

SMELTER, TRAIL, B. C.

The principal drainage of the country is laid down in blue, the trails and roads are shown, the railways plainly indicated, the names of important towns printed in large black letters, and the topography is represented in brown. As far as the ore deposits are known, they are indicated in a general way by red lettering.

The country shown upon the map includes particularly the **Slocan, Kootenai Lake, Cariboo Creek, Deer Park, Nelson, Salmon River, Trail** or **Rossland**, and the **Boundary Creek regions.** It also shows the **Arrow Lakes** and **Lardeau country** and some portion of the **Okanogan** and **Fort Steele regions.**

The map is compiled from reliable and official data and shows the **Mining District Subdivisions** and the elevations of the mountains and lakes.

The opposite side of the sheet contains an accurate statement and description of the country, showing its discovery and development to the present time. The folder will be sent to any address, together with a copy of

WONDERLAND '97,

our new tourist book, upon receipt of **six cents in stamps.**

CHAS. S. FEE,

General Passenger Agent, St. Paul, Minn.

SOUTHERN RAILWAY

GREATEST

SOUTHERN SYSTEM.

Penetrates with its main line or branches eight States South of the Ohio and Mississippi Rivers, and in conjunction with its friendly allied connections reaches all the commercial centers of the South and Southwest . . .

DOUBLE DAILY VESTIBULED LIMITED TRAINS

. . . BETWEEN . . .

Washington and Nashville via Salisbury, Asheville, Knoxville and Chattanooga.
Washington and Tampa via Columbia, Savannah and Jacksonville.
Washington and Memphis via Atlanta, Birmingham and K. C. M. & B.
Washington and New Orleans via Atlanta, Montgomery and Mobile.
Norfolk and Chattanooga via Salisbury, Asheville and Knoxville.

Pullman Sleeping Cars—Dining Cars—Day Coaches.
Additional Trains for local travelers . . . .

The direct line to the Winter Resorts of { FLORIDA, GULF COAST and TEXAS, ... MEXICO and CALIFORNIA,

—AND THE BEST—

Through Car Line to and from Asheville and Hot Springs—"The Land of the Sky."

Write for Map Folders.

R. D. CARPENTER, General Agent, 271 Broadway, New York City.
L. S. BROWN, General Agent Passenger Department, Washington, D. C.
J. H. WINGFIELD, Passenger Agent, Norfolk, Va.

S. H. HARDWICK, Assistant General Passenger Agent, Atlanta, Ga.
C. A. BENSCOTER, Assistant General Passenger Agent, Chattanooga, Tenn.
W. H. TAYLOE, Assistant General Passenger Agent, Louisville, Ky.

J. M. CULP, Traffic Manager. W. A. TURK, General Passenger Agent.

FLORIDA

THE SHORTEST, QUICKEST, MOST ATTRACTIVE ROUTE

IS BY THE LINES OPERATED OVER THE

Florida Central & Peninsular R. R.

THE FLORIDA CENTRAL AND PENINSULAR RAILROAD begins on the north at Columbia, runs through Savannah, Jacksonville, Ocala, Tampa, Fernandina, Gainesville, Orlando, and Tallahassee.

It is the direct route to take for St. Augustine, Lake Worth, and all East Coast points; for Miami, Key West, and Nassau; also for points on the Gulf of Mexico and Havana and for all the principal interior points in Florida. Three trains daily from New York during the tourist season, passing through Philadelphia, Baltimore, and Washington.

One of the finest trains in the country is the **NEW YORK AND FLORIDA LIMITED**, with Compartment Cars, Pullman Sleepers, Observation Cars, Dining Cars, and Passenger Coaches. This train leaves New York at 12.10 noon and arrives at Jacksonville at 3.30 p. m. next day, St. Augustine at 4.30 p. m.

The **CINCINNATI AND FLORIDA LIMITED**, another very elegant vestibuled train, makes the run in about 24 hours between Cincinnati and Jacksonville, via Chattanooga, Atlanta, Macon, and Everett.

The **ASHEVILLE ROUTE** is the scenic route (over the Carolina mountains) between Cincinnati and Jacksonville, via Knoxville, the Mountain Resorts, Columbia, and Savannah.

The **KANSAS CITY** through car route is by this road, via Fort Scott, Memphis, Holly Springs, Birmingham, Atlanta and Everett.

The **NEW ORLEANS** through sleeper route runs from New Orleans by Pensacola on this route and via the beautiful Middle Florida Country.

Remember that the **FLORIDA CENTRAL AND PENINSULAR** does not only go to Jacksonville, but distributes passengers by close connections all over the State.

Get **THE BEST INDEXED MAP OF FLORIDA** from any of our agents or from the General Passenger Agent.

J. L. ADAMS, Genl. Eastern Agt., 353 Broadway, New York.
W. B. PENNINGTON, Genl. Western Agt., 417 Walnut Street, Cincinnati, O.
WALTER G. COLEMAN, Genl. Trav. Agt., 353 Broadway, New York.
N. S. PENNINGTON, Traffic Manager, **A. O. MacDONELL**, Genl. Pass. Agt., Jacksonville, Fla.

FLORIDA

The Great Hotels OF THE

East Coast

AT

ST. AUGUSTINE,
ORMOND,
PALM BEACH
AND
MIAMI.

Railway.

KEY WEST AND MIAMI . . . STEAMSHIP CO.

THE BEAUTIFUL ROUTE TO

KEY WEST.

Ten Hours from Miami along the Florida Keys in daylight.

See local time card for sailing dates.

MIAMI AND NASSAU

STEAMSHIP SERVICE

BETWEEN

Miami and Nassau, N. P.

(Bahama Islands),

Will be inaugurated about **JANUARY 15th** for the WINTER TOURIST SEASON OF 1897.

See advertisements for sailing dates.

For map of Florida and book Florida East Coast, address—

J. R. PARROTT, *Vice-President.*
J. P. BECKWITH, *Traffic Manager.*
J. D. RAHNER, *Ass't General Pass'r Agent. St. Augustine, Fla.*

CHESAPEAKE & OHIO RY.

THE F. F. V. LIMITED is one of the finest trains hauled over any railway track in America. It runs solid between Cincinnati and New York, the route from Washington being over the Pennsylvania system. It has every modern convenience and appliance, and the dining-car service has no superior if it has an equal. The road-bed is literally hewed out of the eternal rocks; it is ballasted with stone from one end to the other; the greater portion is laid with one-hundred-pound steel rails, and although curves are numerous in the mountain section, the ride is as smooth as over a Western prairie.

One of the most delightful rides in all the route is that through the New River valley. The mountains are just low enough to be clad with verdure to the very top, and in the early spring every variety of green known to the mixer of colors can be seen, while the tones in autumn take on all the range from brown to scarlet.

These facts should be borne in mind by the traveler between the East and the West.

H. W. FULLER, *Genl. Pass. Agent, Washington, D. C.*

The Mutual Life Insurance Company

OF NEW YORK,

RICHARD A. McCURDY, President,

—IS—

The Largest and Best Life Insurance Company in the World.

Assets over $220,000,000.

The Mutual Life has Paid since Organization . . . . Over $388,440,897 to Policy-holders.

The New Instalment Policy issued by this Company is admirably adapted to the wants of the Insuring Public.

EVERY DESIRABLE FORM OF POLICY IS ISSUED BY

THE MUTUAL LIFE INSURANCE COMPANY OF NEW YORK.

Burlington Route

TO

ST. PAUL

BEST LINE

CHICAGO OR ST. LOUIS

MINNEAPOLIS

Ripans Tabules cure headache.

The Fastest and Finest Train in the West . . . .

IS

UNION PACIFIC

THE OVERLAND ROUTE

WORLD'S PICTORIAL LINE

The Overland Limited

......TO......

UTAH and CALIFORNIA.

FROM 16 TO 20 HOURS
SAVED BY USING

"THE OVERLAND ROUTE."

Double Drawing-Room Pullman Sleepers.
Free Reclining Chair Cars.
Pullman Dining Cars.
Buffet Smoking and Library Cars.

Send for Descriptive Pamphlet "49-96,"
Folders and other Advertising Matter.
(Mention this publication.)

E. L. LOMAX,
General Passenger and Ticket Agent.
OMAHA, NEB.

National Geographic Monographs

On the PHYSICAL FEATURES OF THE EARTH'S SURFACE, designed especially to supply to teachers and students of geography fresh and interesting material with which to supplement the regular text-book.

LIST OF MONOGRAPHS COMPRISING VOLUME I:

GENERAL PHYSIOGRAPHIC PROCESSES	J. W. Powell
GENERAL PHYSIOGRAPHIC FEATURES	J. W. Powell
PHYSIOGRAPHIC REGIONS OF THE UNITED STATES	J. W. Powell
BEACHES AND TIDAL MARSHES OF THE ATLANTIC COAST	Prof. N. S. Shaler
PRESENT AND EXTINCT LAKES OF NEVADA	Prof. I. C. Russell
APPALACHIAN MOUNTAINS—NORTHERN SECTION	Bailey Willis
APPALACHIAN MOUNTAINS—SOUTHERN SECTION	C. Willard Hayes
MT. SHASTA—A TYPICAL EXTINCT VOLCANO	J. S. Diller
THE NEW ENGLAND PLATEAU	Prof. W. M. Davis
NIAGARA FALLS AND ITS HISTORY	G. K. Gilbert

Price for one set of ten monographs, **$1.50.** Five sets to one address, **$6.00.** Single monographs, **20c.**

Remit with order to AMERICAN BOOK COMPANY,

New York - Cincinnati - Chicago

Ripans Tabules assist digestion.

WHENEVER YOU VISIT WASHINGTON . . .

YOU ARE INVITED TO INSPECT THE

MAMMOTH DRY GOODS ESTABLISHMENT

OF

WOODWARD & LOTHROP

Where the **LATEST PARIS NOVELTIES** are always on Exhibition.
The attention of those who anticipate purchasing . . . .

BRIDAL TROUSSEAUX

Is invited especially to extreme PARIS NOVELTIES in matched sets of French Hand-made Lingerie, including Gowns, Skirts, Chemises, Drawers, Corset Covers, &c. These can be furnished in any number of pieces desired. . . . .

HAND-MADE BRIDAL TROUSSEAUX, personally selected in Paris and exclusive in style and design: Three or more pieces . . . . **$10 to $250.**

CORRESPONDENCE SOLICITED. MAIL ORDERS RECEIVE PROMPT AND CAREFUL ATTENTION.

TENTH, ELEVENTH, AND F STREETS N. W. . . . . . WASHINGTON, D. C.

THE CHICAGO, MILWAUKEE AND ST. PAUL RAILWAY

. . RUNS . .

Electric Lighted and Steam Heated Vestibuled Trains between **Chicago, Milwaukee, St. Paul and Minneapolis** daily.

Through Parlor Cars on day trains between **Chicago, St. Paul and Minneapolis.**

Electric Lighted and Steam Heated Vestibuled Trains between **Chicago** and **Omaha and Sioux City** daily.

Through Sleeping Cars, Free Reclining Chair Cars and Coaches between **Chicago and Kansas City, Mo.**

Only two hours from Chicago to Milwaukee. Seven fast trains each way, daily, with Parlor Car Service.

Solid trains between **Chicago** and principal points in **Northern Wisconsin** and the **Peninsula of Michigan.**

Through Trains with Palace Sleeping Cars, Free Reclining Chair Cars and Coaches between **Chicago** and points in **Iowa, Minnesota, Southern and Central Dakota.**

The **finest Dining Cars** in the World.

The **best Sleeping Cars. Electric Reading Lamps in Berths.**

The best and latest type of **private Compartment Cars, Free Reclining Chair Cars, and buffet Library Smoking Cars.**

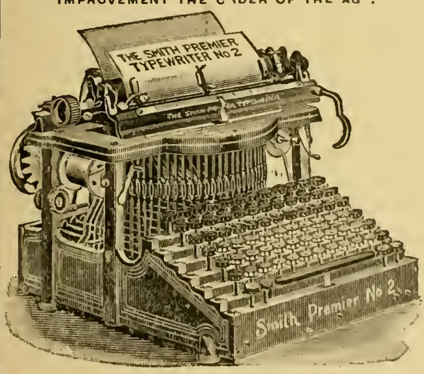
Everything First-class. First-class People patronize First-class Lines.

Ticket Agents everywhere sell tickets over the Chicago, Milwaukee and St. Paul Ry.

GEO. H. HEAFFORD,
General Passenger Agent, Chicago, Ill.

A VITAL POINT

"IMPROVEMENT THE ORDER OF THE AGE."



A TYPEWRITER'S PRINTING MECHANISM

MUST BE SCIENTIFICALLY CONSTRUCTED. THIS POINT IS OF UTMOST IMPORT FOR

EASY OPERATION AND PERFECT EXECUTION.

The Smith.. Premier Typewriters

Superior on This Pcint as Well as on All Others.

ONLY CORRECT PRINCIPLES EMPLOYED.

The Smith Premier Typewriter Co.,
SYRACUSE, N. Y., U. S. A.

Catalogues and Information at Washington Office, No. 1416 F Street.

AN IMPROVED METHOD OF KEEPING THE SCORE IN

DUPLICATE WHIST, COMPASS WHIST, STRAIGHT WHIST AND EUCHRE.

Since Duplicate and Compass Whist have come into fashion there has been an unprecedented revival of interest in the game, due to the fact that mere *luck* is to a large extent eliminated by a comparison of the scores made in the play of the same hands by different players.

The one thing needed to perfect the new method has been a convenient device by means of which the score made on the first round can be concealed until after the replay of the hands, as a knowledge of the first score often enables a good player to make a decisive gain, and matches are lost and won on just such little chances.

A Washington player has at length invented and put upon the market at a very low price a little device which admirably answers the purpose, and at the same time serves as a pretty and useful table ornament, marker, and pencil rest. It is called the "Cosmos Counter," and consists of a little polished wood tablet with a metal keyboard that can be clamped down on the score in such a way as to bring 24 little metal plates over the 24 spaces in the "score" column of the card, for use in concealing each first score as soon as recorded and until the hand is replayed (in duplicate whist) or the entire series finished (in compass whist).

Whist players will at once see the advantage of this new method of keeping the score, as it effectually prevents their opponents at the same or another table from taking advantage, either by accident or design, of a knowledge of what the hand is capable. The trouble with duplicate whist, especially, is that the replay is liable to be influenced by memory of the cards and score, and anything that helps to confuse such recollection is a great gain to fair play.

The "Cosmos Score Card," prepared for use with the counter, shows several new features, such as a heading for both Duplicate and Compass Whist and (on the reverse) for Straight Whist, Euchre, &c., thus enabling the same counter and score to be used for any game of cards.

Cosmos Counters, with tablet of quartered oak, maple, or birch, and metal in either gold or silver finish, 50 cts. apiece; 6 for $2.75; 12 for $5; by mail, 4 cts. apiece extra. Cosmos Score Cards, 25 cts. per package of 50; 12 packages for $2.50; by mail free of postage.

Ask to see samples at any stationer's, or order direct from the General Agents.

Cosmos Duplicate Whist Score

N .... E ....

S .... W ....

HAND	COMPASS WHIST: SCORE	TOTALS	TRUMP	OPPONENTS		HAND
	DUPLICATE WHIST: SCORE	GAIN	TRUMP	GAIN	SCORE	
1						1
2						2
3						3
4						4
5						5
6						6
7						7
8						8
9						9
10						10
11						11
12						12
13						13
14						14
15						15
16						16
17						17
18						18
19						19
20						20
21						21
22						22
23						23
24						24
TOTALS						TOTALS

Copyright, 1895, by Everett Hayden, Washington, D. C. For use with the Cosmos Duplicate Whist Counter, patented July 7, 1896.

................................, 189......

E. MORRISON PAPER CO., 1009 Penna. Avenue, Washington, D. C.

THE

National Geographic Magazine

Vol. VIII APRIL, 1897 No. 4

A SUMMER VOYAGE TO THE ARCTIC

By G. R. Putnam,

United States Coast and Geodetic Survey

Among the scientific parties that assembled at Sydney, Cape Breton, in July last, for the purpose of paying a brief visit to the Arctic under the leadership of Lieutenant Robert E. Peary, U. S. N., was one organized by Professor A. E. Burton, of the Massachusetts Institute of Technology. Of this party I became a member, having been granted leave of absence by the Superintendent of the Coast and Geodetic Survey, with the use of the necessary instruments to carry on magnetic and pendulum observations. The destination of our party was Umanak fiord, in the northern part of Danish Greenland and several hundred miles within the Arctic circle. This fiord, although of considerable interest, has seldom been visited by exploring expeditions. It is one of the largest on the Greenland coast and contains some of the finest mountain scenery, being the outlet of a group of glaciers of unusual magnitude. It is also the home of the most prosperous of the Greenland Eskimo communities.

Our voyage was but a summer trip to moderate latitudes, devoid of the conventional Arctic hardships; and yet such a trip to Greenland has the peculiar advantage that many of the most striking of Arctic phenomena are either actually encountered or are easily accessible. We sailed from Sydney on July 16 on the steamer *Hope*, under the command of Captain John Bartlett, an experienced Arctic navigator. The *Hope* is one of the best of the Newfoundland sealing and whaling fleet, which is composed of strongly built ships, heavily timbered and sheathed for work in the ice, and manned by hardy Newfoundland sailors. Our course lay north along the east coast of Cape Breton and the west coast of Newfoundland, and then through the straits of Belle Isle, where on the third day out we saw the first icebergs. From this time on for over two months these Arctic wanderers formed a part of every scene. At first they were a constant source of interest, because of their enormous bulk, their varied outlines, and their beautiful coloring, changing from a marble white to a sky blue or a delicate pink, with an emerald green just below the surface of the water. We amused ourselves by idealizing them, turreted castles, vast amphitheaters, triumphal arches, obelisks, ships, and animals being all represented in the magnificent procession of bergs which we passed. Some which I measured had a height of 160 feet above the water and a length of 800 feet.

Soon after leaving the straits we began to encounter floe-ice, through which we continued to steam for about 700 miles, along the Labrador coast, which we closely followed. This was a great stream of ice brought south by the Labrador current, and consisted of "pans" from a few feet to several hundred feet in diameter, but generally so separated that the steamer could push her way through without difficulty. In places, however, the effect of the wind had been to drive the pans close together, and then our progress was extremely slow, and indeed sometimes the ship was entirely stopped until a change in wind or tide caused the ice to loosen. To break through barriers across our way it was sometimes necessary to back the ship and then go ahead at full speed, using the prow as a ram. The sensation of a ship striking and pushing these ice pans was a little startling at first, but we soon saw what the vessel could stand, so that only an unusual bump, that would rattle the dishes on the table and perhaps throw us off our feet, would cause remark. It took us a long time, however, to become used to the grinding of the ice against the sides of the vessel as we lay in our bunks at night.

While in this ice we had some extremely beautiful effects of the mirage. One day when steaming along with only loose cakes about us we appeared to be surrounded by a perpendicular ice-wall, apparently cutting off all hope of progress, but as we proceeded this phantom ice-wall ever kept at the same distance from us. Near sunset the coloring on this mirage made an especially beautiful sight. We sometimes saw three and even four perfect images of distant icebergs and islands, one suspended above another. Some of these effects were fantastic beyond

ROUTE OF THE "HOPE" AS FAR AS UMANAK, SHOWING MAGNETIC STATIONS

description, frequently changing even while we were gazing on them. Although the ice impeded the progress of the ship, it proved a blessing in disguise to those who were not good sailors, as it had the effect of destroying the ocean swell. Thousands of Newfoundlanders gather on the Labrador coast each summer to fish. Many of their vessels we saw, and at Turnavik, one of their little settlements, we stopped a few hours.

It was while in the ice off Cape Chudleigh that we first saw polar bears in their native habitat. A large white bear and two cubs were one day seen running over the pans not far distant from the ship, and their curiosity caused them to come nearer and gaze at us. They were nearly the color of the ice and, running nimbly over the pans or swimming rapidly across the water spaces, were a pretty sight. A number of rifles were brought out, and the large bear was killed after a desperate effort to escape. A long chase followed for the cubs, the injunction being to take them alive. They were followed by boats and on foot over the ice and finally were taken. The one captured first was left in charge of one of the Cornell party to hold until the return of the boat. As the cub, although but a few weeks old, would not have been a pleasant companion for one man on a small ice-cake, our comrade, holding to the line about the bear's neck, kept him in the water and at a safe distance with a boat-hook, and the struggles of the bear to get on the ice and of the man to keep him off furnished considerable amusement to those members of the party who remained on the ship. The cubs were finally caged on the deck of the *Hope* and remained our companions during the remainder of the voyage, growing greatly in size but not the least in affection either for their captors or for each other. They may now be seen in the National Zoological Park at Washington.

The scenery along the Labrador coast became more striking as we proceeded northward. It is mostly a rocky, bleak-looking shore, treeless and barren, indented with deep bays and fringed with islands. In the southern portion the topography is low and its rounded outlines give every indication of the smoothing effect of glacial action. Just south of Cape Chudleigh, however, the mountains fringing the shore attain a height of 6,000 feet, and in many cases have sharp, rugged outlines.

Passing into Hudson strait, the *Hope* was soon clear of the ice. After steaming over 200 miles along the north shore, we reached Ashe inlet on July 24. Here and on the mainland opposite two days were spent in exploration and investigation. At Ashe inlet there was located some ten years ago one of a number of meteorological stations established by the Canadian government for the study of the Hudson bay and strait climate in connection with the practicability of regular navigation in this region. A portion of the frame house was found standing, and it was the only sign of human habitation, with the exception of a few traces of Eskimo encampments. A more bleak and desolate-looking region it would be difficult to imagine; where the rock was not bare, the scanty vegetation was not over a few inches high. In this vicinity one of the ship's anchors was lost, the chain being parted by a moving pan of ice, and a whale-boat was injured by a southeasterly gale driving it on the rocks. There is a tremendous tidal action in Hudson strait, the rise and fall at Ashe inlet being some 30 feet. On this account the strait does not freeze solid in winter, but becomes filled with an enormous ice-pack, which moves back and forth and forms an impenetrable barrier to navigation the greater part of the year.

On the way out of Hudson strait we had our first good view of the Eskimo, although we had seen a few of the race at Turnavik, in Labrador. Our first warning of their approach was a peculiar shrill call, which travels over the water long distances. It was some minutes before the uninitiated could discern the distant specks on the water, which we were told were the Eskimo men in their kayaks. They rapidly approached and were taken on board—boats and all. The kayakers were soon followed by an umiak, or large skin boat, filled with the remainder of the settlement, including women, children, and dogs, as well as nearly all their earthly possessions. Although their wealth seemed very meager, they appeared to be among the happiest of peoples; their round, fat faces simply beamed with good nature. They were very anxious to trade, the objects most highly prized being plugs of tobacco, knives, guns, and copper coins. The last mentioned they took in preference to silver, their only use for either apparently being to sew on to the women's blouses as ornaments. They were dressed in furs, the men and women much alike, except that the women's blouses had a long tail behind and a large hood or sack on the back, in which the baby was carried. Their peculiar appetite was shown by the relish with which they drank the contents of some cans of bear oil which the boys had been saving to grease their shoes with.

After passing out of Hudson strait, an attempt was made to enter Cumberland sound, but the entrance was completely blocked with ice, and our course was shaped for Greenland. In crossing Davis strait we also crossed the Arctic Circle. This event was celebrated by the firing of cannon and the hoisting of flags. Neptune came aboard in the person of one of the sailors, who attempted to shave the uninitiated, using a lather of engine grease, and a ship's scraping iron for a razor.

Our first view of the Greenland coast was obtained near midnight on August 1, the high, ice-capped mountains in the vicinity of Holstenborg forming a beautiful scene in the Arctic twilight.

The following day we landed at Godhavn, the capital of the Danish inspectorate of North Greenland, and were cordially received by the government officials. The interior of the island of Disko, on which Godhavn is situated, is an elevated plateau averaging three or four thousand feet in height and covered with an ice-cap. The passage through the remarkable channel east of Disko, called the Vaigat, was a continual panorama of fine scenery. High mountains rose directly from the water on either side, with glaciers coming down between them and glimpses of the interior ice-cap presenting themselves at intervals. The Vaigat itself was so filled with enormous bergs that the ship had to wind its course among them. Entering Umanak fiord on the night of August 4, a most beautiful Arctic midnight scene was spread out before us. The sun dipped only about two degrees below the horizon at midnight, so that after about an hour of glowing sunset there was bright sunshine again. Lying along the northern border of the fiord were the highest mountains in this part of Greenland, sharp, cragged peaks of over 6,000 feet. To the eastward were groups of mountainous islands, and between them could be seen the smooth, white swell of the great interior ice-cap of Greenland. To the south were the mountains, glaciers, and green foothills of Nugsuak peninsula, and to the

A SETTLEMENT ON UMANAK FIORD

west stretched the open water of Baffin bay, while all around were the stately icebergs proceeding from the great glaciers at the head of the fiord.

The *Hope* left our party at Umanak, the principal settlement of the district, which was to be our headquarters for several weeks, and where the vessel was again to return for us after its trip further north. The village is situated on an island, which though only about three miles in length, has in its center a mountain nearly 4,000 feet in height, a most remarkable shaft of rock, from which the name Umanak, being the Eskimo for "heart-shaped," is derived. The village consists of about 150 Eskimos and three Danish families. We found these Danish officials and their families most intelligent and hospitable people. They are almost entirely cut off from the rest of the world, only receiving news from Europe two or three times during the short summer. During ten months they are completely isolated, and for two months they do not see the sun.

In the management of their possessions in Greenland and of the native races, the Danes have followed a plan unique in the world's history. Between Cape Farewell and Upernivik, said to be the most northern civilized settlement in the world, there live about 10,000 Eskimos, scattered in villages along the coast. They are divided into twelve districts, of which Umanak is commercially the most important. In each district there are usually a governor, an assistant governor, having charge of commercial affairs, and a Lutheran pastor, in care of religious and educational matters, but beyond these and a few minor officials in charge of sub-settlements, no Danes or other foreigners are allowed to settle in Greenland. The whole is under the direction of the Royal Greenland Board of Trade, a government bureau in Copenhagen which has a monopoly of the trade of Greenland. Supplies are sent out annually in nine ships, which bring back the products of the region to Denmark. European goods are furnished to the Eskimos at but a slight advance over cost price, and they are paid amounts fixed in advance, once in five years, for the furs, oil, ivory, etc., which they bring in. All other trade along this coast is prohibited, and vessels are not allowed to even enter the Greenland ports, except by special permission or in distress. The idea has been to protect the natives in their rights and pursuits as well as in their morals. The arrangement is not a profitable one to the Danish government, the loss on the Greenland trade during recent years being said to have been as much as

$100,000 annually. Almost every village is provided with a church and a school, and the language taught is not the Danish, but that spoken by the natives themselves. The great majority of the Eskimos can read and write and are nominally, if not actually, christianized. Such a policy could hardly have been carried out in any region less isolated than Greenland. Whether or not their contact with civilization has been beneficial to the Greenlanders, it is probable that the continuance of the Danish system is their only salvation, for if the Danes were to withdraw, the wealth of this region in fisheries and hunting would soon attract a population that would so far interfere with the life and pursuits of the Eskimos as to cause their early extinction.

These Greenland Eskimos, although they have been in contact with civilization for 250 years and are largely intermixed with foreign blood, have retained many of their original modes of life. The more pure-blooded are an intelligent-looking people, with smooth, round features and frank, open countenances; they are short in stature and have straight, black hair. They ordinarily live in flat-roofed houses, built of rocks and turf, often containing but a single room, with a sleeping-bench at one end and a long, low entrance for keeping out the cold in winter. In summer they often live in tents, moving from place to place. They

A GREENLAND FAMILY

KAYAKER IN UMANAK FIORD

hunt the seal, walrus, narwhal, reindeer, bear, and smaller game—birds and fish—with which the region is stocked. By far the most important of these, to them, is the hair-seal, called by them "puisse," many varieties of which are found on this coast. The skin is used for clothing, boat covering, and tents, the blubber for fuel and illuminating oil, and the flesh for food. The highest ambition of a young Eskimo is to become a successful seal-catcher. For this pursuit they have developed some of the most ingenious appliances ever invented by a primitive people. In the summer they use the kayak, a skin boat which is a model of ingenuity, lightness, and gracefulness. With these small, frail boats, sometimes not over 18 inches wide, they do not hesitate to go out into open water and to attack large animals, such as the seal or walrus. The more expert can perform remarkable feats, the most astonishing of which is for the kayaker to turn completely over, boat and all, and right himself again without getting out of the kayak, and without getting a drop of water into it. He wears a waterproof shirt tied closely about the small opening in the deck in which he sits, and rights himself with a dexterous use of his double-bladed paddle. In addition to the rifle, which is now generally used, his main weapon is a harpoon having a detachable point which remains in the seal after it is struck. Attached to this point by a long line is an air-bag, which floats on the surface, and enables the kayaker to follow the seal in its struggles. In winter the northern Greenlander depends on his dogs and sled for transportation. The Eskimo dogs are his only domestic animals, and every village is filled with them. On smooth ice great distances can be traversed in a single day, speeds of 16 miles an hour being attained. In Umanak fiord the sledging lasts more than half the year, the season in 1896 not ending until July.

The Eskimos are a childlike, gentle race. They are honest and remarkably free from brawls and disputes. Jails and constables are entirely lacking in Danish Greenland. The very simple local affairs are regulated by district councils, composed of the leading natives and the Danish officials, who meet twice a year. The language is most peculiar and difficult for a stranger to master. It is composed almost entirely of nouns and verbs, and by suffixes and affixes to these the other parts of speech are formed. It is possible to express the meaning of a long English sentence in a single word, but some of these are forty letters in length. The investigations of Rink have shown that the more familiar words are common to all the Eskimo peoples, thus proving their common origin. He estimates that there are about 30,000 Eskimos, of whom one-third live in Danish Greenland, one-third in Alaska, and the remainder in northeastern Siberia, the northern portions of North America, and a few in Greenland beyond the Danish dominions.

From Umanak several trips were made in small boats to the great glaciers at the head of the fiord. The largest of these is the Karajak. The face of this glacier, from which the bergs break off into salt water, has a width of about four miles, a height above the water of over 250 feet, and in the center moves with a velocity of from 20 to 35 feet per day. A single iceberg breaking off from this glacier has been estimated to contain 24 million cubic yards of ice. At the price usually paid for ice for domestic purposes in the United States, the ice in such a berg as this would be worth over $100,000,000. At another glacier, the Itivdliarsuk, we saw a great mass, 300 feet long, break from the face; the crashing and thundering noise that resulted, the surging of the berg until it found its equilibrium in the water, and the dashing of the waves on the beach, with spray in places 100 feet high or more, made an impressive scene. In the narrower fiords the calving of a large berg will sometimes cause a tidal swell that will raise the water 20 feet. The surface of a glacier near its front is usually a mass of jagged pinnacles with deep crevasses between. Looking up the slope of the great ice-river the surface becomes smoother, and finally back on the distant horizon one sees the apparently smooth white plain of the ice cap. A climb to the summit of a 3,000-foot mountain near the Itivdliarsuk glacier gave us some idea of this great ice-cap and the glacial

FACE OF ITIVDLIARSUK GLACIER

work along its edge. As far as the eye could reach to the north, south, and east extended this smooth, white field of ice sloping up from the seacoast and with an horizon line as level as that of the ocean. At regular intervals along its edge could be seen the crevassing at the heads of the glaciers, which were themselves cut off from view by the intervening mountains. At our feet the course of the ice-river was spread out before us, winding through the mountain valleys and around the nunataks or peaks projecting through the ice, from each of which it drew out a long moraine of rock debris. The interior ice-sheet covers the whole of Greenland with the exception of a narrow fringe along the coast. It rises to elevations of from 8,000 to 10,000 feet in the center, and the enormous pressure of the accumulating snow presses out the glaciers through every opening in the bordering mountains. That this ice-sheet was once more extensive than it is now is proved by the rounded outlines and glacial scratches found on nearly all the coast mountains. On the other hand, the climate of Greenland must at one time have been very much warmer. In the vicinity of Umanak fiord coal deposits are found and fossils of such semi-tropical trees as the fig and magnolia.

Notwithstanding the nearness of the ice-cap, the present climate of Greenland is much milder than that of the opposite side of Davis strait. In the fiords the summer climate is moderate and

THE "HOPE" IN THE ICE OFF CAPE MERCY

pleasant; we found light winter clothing comfortable, but nothing more was needed. Wherever there is soil, there is an abundance of wild flowers and grasses, but we found no trees. A curious meteorological fact is that the Föhn wind, which blows directly off the ice-cap, always brings the warmest weather; the usual explanation being that this heating of the wind is due to its sudden descent from the elevated interior to the low coast.

The *Hope* called for us at Umanak on September 9, and our homeward voyage followed much the same course as our outward one. The only severe storm we encountered was in crossing Davis strait. Off Cape Mercy the *Hope* was caught in an ice-pack, in which she was held for three days. With a change of wind the ice loosened and the ship was slowly extricated, reaching open water in Cumberland sound. Two days were spent in the vicinity of Blacklead island. This is a Scotch whaling station, and the settlement consists of three or four Europeans and a large number of Eskimos. The system obtaining here is a sort of feudal one, without government control. The natives work for the management, in return for which they receive European supplies, no money being used. From this point two passengers were brought back to America, one an English missionary, who had been working among the Eskimos, and the other a Dane, who had charge of an American whaling station farther south. The latter brought with him the whalebone taken from a single whale, the whalebone weighing something over a ton and being valued at more than $10,000. Both of these men, who had spent years in this bleak, cold country, expressed regret at leaving it and the hope of soon returning.

The voyage from Cumberland sound was without incident, save some beautiful auroral displays at night, and we landed at

CUMBERLAND SOUND ESKIMOS

Sydney on September 26, all the 48 persons constituting the passengers and crew returning well and without accident.

Some investigations in two lines of terrestrial physics were carried out by the writer in connection with the work of Professor Burton's party. At each of the stopping places where time permitted, magnetic observations were made, determining the deviation of the compass needle from true north, the dip of the dipping needle, and the force of the earth's magnetism. Two of the stations were near enough to the magnetic North Pole of the earth to cause the dipping needle to stand within six degrees of the vertical. The Greenland stations were so well to the east of the magnetic pole that the compass needle pointed more nearly west than north. The horizontal magnetic force in these regions is very weak on account of the great dip, so that magnetic disturbances caused considerable changes in the needle, a change of over four degrees being noted in a single day at one point. For the same reason the ship's compasses were irregular. A comparison of these results with earlier magnetic observations made in these regions clearly indicates the direction of change at present going on. At all the stations from Halifax, Nova Scotia. to Umanak, Greenland, the westerly declination, the dip, and the total magnetic force are all diminishing. At several points also pendulum observations for the measurement of the force of gravity were made. This force increases from the equator to the poles, and, following the theorem of the French mathematician, Clairaut, the amount of flattening at the poles of the earth may be computed by comparing the force of gravity at different latitudes. By a well-known law, the time of oscillation of a pendulum will be proportional to the square root of the force of gravity; so that by comparing the time of oscillation of the same pendulum at different places the relation of the force of gravity may be obtained. Comparatively few such observations have been made in high latitudes, where they have great weight in the problem of the figure of the earth.

[The illustrations accompanying the foregoing article are from photographs by Professor A. E. Burton and other members of the party.]

AREA AND DRAINAGE BASIN OF LAKE SUPERIOR

By Dr Mark W. Harrington,

President of the University of the State of Washington

Lake Superior is the largest and one of the deepest, not only of the Great Lakes of the St Lawrence basin, but of all the bodies of fresh water on the earth, and it possesses some other remarkable characteristics of its own; yet, though it has been so long known that it was roughly mapped 250 years ago under its present name, and charted several times with fair accuracy in details for the time before the end of the 17th century, and though it was charted with minute accuracy by the United States engineers 30 years ago, there has even yet been but little discussion of its more interesting and peculiar features. This is all the more remarkable because its extraordinary wealth in minerals and fish has been recognized from the beginning and has for half a century formed an important item of our national wealth and commerce, and more recent developments have shown agricultural possibilities which are by no means contemptible. It is the purpose of this paper to call attention to some of the peculiar and noteworthy features of the lake, more especially those which relate to its climate and weather and have a bearing on its commerce and agriculture.

The statistics of Lake Superior, as to coast line and area, vary so much in geographic publications that I have had new measurements made with a planimeter by Mr R. F. De Grain, of the Weather Bureau, the coast line being carefully meandered. The following are the results:

Coast Line

On American side	880 miles.
On Canadian side	992 "
Total coast line	1,872 miles.

Areas of Lake Superior

Total, including all bays and islands		32,166 square miles.
Deduct islands:		
Isle Royal	223 square miles.	
St Ignace	112 "	
Michipicoten	83 "	
Simpson	36 "	
Grand	26 "	
Pie	22 "	
Slate	14 "	
Copper	12 "	
Apostle islands	82 "	
Total		* 660 square miles.
Total water surface		31,506 square miles.

It is customary on the lake to look on certain nearly inclosed bays as distinct from the lake. Deducting these:

Whitefish bay	353 square miles.	
Nipigon bay	310 "	
Black bay	213 "	
Thunder bay	165 "	
Total area of bays		1,041 square miles.
Resulting open-lake water surface		30,465 square miles.

Of the 32,166 square miles of the total surface of the lake, there are on the American side 23,359 square miles and on the Canadian side 8,807 square miles.

The boundary line across the lake between the Dominion and the United States is 289 miles long.

With a surface area of 32,166 square miles, Lake Superior is the largest lake in the world. Next comes probably Victoria Nyanza or Ukerewe, in equatorial Africa, with an estimated area of 25,000 to 30,000 square miles. Lake Superior is a half larger than Lake Michigan (22,000 square miles) or Lake Huron (24,000 square miles) and nearly twice as large as Lake Erie (10,000 square miles) and Lake Ontario (7,000 square miles) combined. The combined area of the Great Lakes of the St Lawrence as given by Schermerhorn† is 95,275 square miles, and a third of this is formed by Lake Superior.

*Including 50 square miles for smaller islands not enumerated.

†L. Y. Schermerhorn: Am. Jour. of Science, 3d series, vol. xxxiii, 1887, p. 278.

Of the islands the largest and most remarkable is the one to which the early Jesuit visitors gave the name of Isle Royale, or Regal island. As seen from the north shore, it appeared to the natives like a sleeping Manitou lying prone, but for some reason unknown they chose to consider it an evil spirit and called it *Windigo*. The natives never ventured on the island, and I was told in the summer of 1894 that they are still very loth to do so. Judging by the amount of money which has been expended on it within the last half century, with no adequate return, it has proved a "hoodoo" island to the whites also. Copper indications abound, and so, also, do the deserted shafts and drifts where somebody has tried following a vein or reaching it from one side. Probably a million and a half or two million dollars have been expended in mining on Isle Royal with inappreciable return. The chlorastrolites or greenstones of Isle Royal have probably given and may continue to give more income than the copper. The island consists of a series of ridges running parallel to its length, reaching at times a height of 400 or 500 feet above the lake, generally smoothed and rounded on top, terminating to the northeast in the most interesting illustration of fiord structures to be found on the continent. Finger-shaped alternations of slender bays and equally slender peninsulas, the latter extending or breaking up into parallel lines of islands, afford a complex of land and water, the former steep and rocky, but generally covered with a dense growth of dark green spruce and fir trees, the latter very deep, very blue, and very clear, the whole very picturesque in bright weather, but extremely confusing when the weather is smoky or foggy. The population of the island is generally small and never permanent. It belongs to Michigan and brings the western point of this state only 12 miles from the eastern point of Minnesota. It was at one time a county by itself, but there were not enough permanent residents to fill the offices, and it was attached to Houghton county of the mainland. It has no post-office. There is abundant water, the soil is excellent, though small in quantity, and the usual vegetables and cereals can be raised. The native animals on the island included nothing larger than the lynx or wild-cat until a few years ago, when a small drove of caribou came over on the ice from the north shore. The passage between Isle Royal and the north shore, though only 12 to 18 miles broad, has so deep water and so strong currents that it does not long remain frozen, and the caribou still remain on the island, where, not being hunted, they had become in 1894 a drove of a score or more and were quite tame. They are said to be sometimes found standing and looking with longing eyes toward the north shore, as if anxious to return to their fellows, with the expanse of the continent before them. The very deep soundings which can be made on all sides of Isle Royal and almost off its banks and the form and surface of the island show that it is an isolated and nearly submerged mountain ridge, rising from 1,000 to 1,500 feet from the bottom of the lake. It is the only island of this sort in the Great Lakes, and for its parallel we must look to the isolated and volcanic islands of the great oceans.

The island next in size is St Ignace, or, with Anglo-Saxon love of brevity, simply Ignace. It is one of the series of islands which close the three great bays (Thunder, Black, and Nipigon) of the extreme north of the lake, and with the projecting ends of the two peninsulas between these bays they form a remarkable series of escarpments extending from Pigeon river on the west nearly to Slate islands on the east, all belonging to Ontario. Beginning at the west, the first great island, and the "stopper" to Thunder bay, is Pie island, so named from its resemblance to a British pie—a structure which has a much greater altitude than its American namesake. This island has an area of 22 square miles, and consists of two tabled hills or mountains separated by a large space so low as to make the tables appear to be separate islands. The western or smaller table is 850 feet above sea-level. Its escarpments are very abrupt on all sides, and the top is nearly inaccessible. On it, however, is a large pond or small lake without outlet, but stocked with brook-trout. The other table, the "pie" proper, is much larger, but only 700 feet high and relatively accessible. Next, going eastward, is Thunder cape, the extreme point of the peninsula between Thunder bay and Black bay, precipitous and rising directly from the lake to an elevation of 1,250 feet from its surface. It is the highest point immediately on Lake Superior, and is of tabular form. The precipitous sides are carved into curious forms, especially on the west side, and are bare of trees. The assumed daily thunder about this point in summer is the alleged origin of the name of the cape as well as of the bay over which it stands sentinel. The "stopper" for Black bay is Edward island (6 square miles), and Nipigon bay is closed by St Ignace, Simpson (or Sampson), and Copper islands in their order from west to east. These islands are very similar in general characteristics, and a description of St Ignace will apply to all. It is of a general quadrangular form and is separated from the peninsula to the west and Simpson to the east by narrow rivers or fiord-like straits only a mile or so broad, though many miles long, and several to many fathoms deep. Like the preceding, it is of basaltic character, but the tabular formation so abundantly represented about Thunder bay is here modified by lower altitudes and by rounded hills, which replace the flat surface. On St Ignace island the highest hill attains an elevation of about 850 feet.

In Lake Superior there is but one archipelago proper—that is, a cluster of islands in which no one greatly surpasses all the others. This is the archipelago of the Apostle islands, or, more briefly, "The Apostles," so called by the early Jesuit Fathers, because there were twelve principal islands. The individual islands, however, have received anything but apostolic names, being, in order of size, Madeline (23 square miles), Stockton (16 square miles), Outer (12), Oak (8), Sand (4), Bear, Basswood, and Michigan (each 3 square miles), Rocky, Otter, Manitou, and Cat (each 2 square miles). Then comes the thirteenth apostle, or Devil's island; then the south and north Twins. The total area of the archipelago is eighty-two square miles. The larger of these islands are somewhat hilly and are covered with spruce trees of some size. The smaller are sandy and level. They were settled early in the history of the colonization of the lake, but the population has since dwindled until it is almost *nil*. There is no post-office on the islands.

The drainage basin of Lake Superior is relatively small. Its outlines have not been so definitely mapped that it can be measured with the same accuracy as that of the lake surface, but the total area may be put at 82,800 square miles.* Of this the area of the lake itself makes 39 per cent, and of the land 39 per cent is Canadian and 22 per cent American. The margin of the watershed is low in all directions, and it is in general ill-defined. Along it, throughout almost its entire length, are found innumerable small bodies of water, isolated and without drainage, except at seasons of high water, showing that this watershed is indefinite. The lowest points of the watershed are on the southeast, near the St Marys river, where it reaches but a few score feet above the lake. It gradually rises toward the west, and at a point about fifty miles southeast of Marquette first reaches an altitude of 400 feet above the lake surface. South of Keweenaw

* Schermerhorn, l. c.

point it reaches 900 or 1,000 feet and continues at this elevation to the mountains of northeast Minnesota with so slight fall in either direction that it forms a distinct area of independent lakes, generally small in size, but extremely numerous, both in northern Wisconsin and northern Minnesota. The separation of the waters of the St Louis and the Mississippi where they come closest together is but a few feet. The highest known point of the watershed is in the Mesabi mountains in northeastern Minnesota, where it reaches 1,500 feet above the lake, and isolated points are higher. To the north of the lake the watershed is more distant from the lake and not so well known. The topographic features on the south side are low-rolling and well rounded. On the northwest they are sharper, but still preserve the ordinary mountain form, though sharply serrated. This is especially true of the regular indentations of the "Sawtooth mountains," which follow the northwest shore of the lake and in some places form the watershed. As soon as the Canadian border is passed in the west, the escarpment structure becomes marked—that is, an elevated plateau, relatively flat. Through this the streams have cut down 500 or even 1,000 feet, forming a broad, level valley or narrow ravine, but leaving generally nearly vertical walls. This structure is very characteristic of the Thunder bay region and extends eastward to the Nipigon valley, but farther eastward it appears to run out, until to the east of Lake Superior the basin is similar in topography and vegetation to that about the river St Mary. The drainage area on the south shore is narrow, often not more than 20 miles wide, and seldom more than twice that. The tributaries to the lake are here very numerous but small. There are about fourscore that are 20 miles or more long, but few of them exceed 50 miles. They usually descend rapidly from their source to the lake. In some cases, as in that of the streams at the Pictured Rocks, they have a considerable fall at or near the shore, and the streams that enter at the same level as the lake are usually barred by the combined action of their sediment and the waves. The longest stream on the south shore is the Ontonagon, which enters at Ontonagon, and has a length of 100 miles, with a basin of 250 square miles.

At the extreme western angle of the lake enters the St Louis river, considered the mother-stream of the lake and the source of the St Lawrence. It is 200 miles long and has a basin containing 4,370 square miles. The basin adjoins the remarkable lacustrine region of Rainy lake, from which it is separated toward the east by the Iron or Mesabi range. Elsewhere its separation from this region, and in the west and south from the basin of the upper Mississippi, is low and ill-defined, characterized by the presence of lakes, ponds, and swamps. Its source is in Otter lake, 30 miles from the northwest shore of Lake Superior and 1,650 feet above sea-level, or 1,050 feet above the lake surface. It flows southwest until about 25 miles from the Mississippi river, when it turns sharply southeast, soon descends nearly all its 1,050 feet of fall, and enters Lake Superior through a long estuary. Its minimum flow of water is *nil*, for it is sometimes frozen solid. Its average contribution to the lake is estimated by Greenleaf* at 1,242 cubic feet per second, but it is probably considerably larger. The rapids are at the Dalles, below the mouth of its tributary, the Cloquet, and but a few miles above Duluth. The presence of a considerable stream with a large fall within a short distance of two such prosperous towns as Superior and Duluth, has suggested to enterprisng engineers the scheme of damming the St Louis above the Dalles and bringing its waters to these cities under a head of 650 feet, as an enormous source of cheap power. Ex-Representative M. R. Baldwin, of that Congressional district, makes the following report on this plan:

"This company has discovered that by putting a dam just above Cloquet it can make a reservoir which will not only be the largest in the world, but will lie entirely within the bluffs of the natural streams; that from the level to which the river will be raised by the proposed dam the water can be taken in a straight line through a canal or pipe, only twelve miles long, to the bluffs back of Duluth, at an elevation of 650 feet above Lake Superior, and that by the storage in this great reservoir of the flood waters, which now go to waste, a supply of water will be available for use under that head, which will create the greatest water-power in the world."

One curious difficulty is found in the fact that if the dam is made too high the reservoir will empty into the Mississippi river and thus contribute to the water-power of Minneapolis instead of to that of Duluth.

Reference has been made to the estuary at the mouth of the St Louis. This has so many features of interest that it deserves a fuller treatment than space will here permit. Suffice it to say, that Lake Superior has been robbed of the extremity of her horn by the combined action of the water of the river and the waves of the

* Report on the Water-Power of the Northwest; Census of 1880, vol. xvii, p. 73.

lake. Formerly the lake extended up to Fond du Lac, so named because the fact of the termination of the lake here was recognized when the settlement was first established. From here to Duluth is eight miles and to Superior City seven miles. From Duluth to Superior is five miles. The triangle thus inclosed by sides of seven, eight, and five miles is the area of which the lake has been robbed. All this has been done within times geologically recent, but before settlements were made, and the later stages of the operation are still in progress.

Lake Superior has not submitted tamely to this highway robbery. She has resisted it continually, and at several points the topography shows that her resistance was successful in staying for a time the progress of the encroachment. The operation is this: Along the line where the motion of the current is stayed by the contact with the lake water a sandbar is formed and the waves soon develop this into a bar rising above the surface, stretching in an easy curve from one side of the bay to the other, thus making an inner bay separate from the lake. The sediment of the river then proceeds to fill up this bay until it is dry land, with possibly a little lake or two left behind. When this is completed the current is again directed into the lake, another sandbar is formed, the whole process is repeated, and the river has encroached another step. Three such steps are easily recognized by the topography, and the fourth is made probable. The fourth is the earliest, and the remnant is found in Spirit lake. The next in order of time is represented by Grassy point, the next by Rices point, and the latest by Minnesota point.

It will be interesting to go into detail for the last, now in progress of development. The bar in this case is called Minnesota point; it is about five miles long, is from 200 to 1,200 feet wide, and sweeps in a free curve from the Minnesota to the Wisconsin shore. It is interrupted for the passage of the river close to the Wisconsin shore. Its average height is 12 to 15 feet, but toward the Wisconsin side the wind has built up a pyramid of from 20 to 25 feet above the surface of the water. It is made of sand and gravel, is covered with small trees and brush, and is a favorite picnic ground for the citizens of Duluth. Behind it is Superior bay, about five miles long and one mile wide, and this is the bay which the river is now filling up. To keep it available for commerce requires the constant efforts of the engineers.

In order to make accessible to commerce the several interior bays of Duluth, a canal 300 feet wide was cut through Minnesota point at the Duluth end. The port of Superior is entered by the natural outlet—the passage maintained by the river. When the canal was cut by Duluth, in order that this city might not obtain too great an advantage over its rival, Superior had a dyke erected across Superior bay, on the Duluth side of the mouth of the river. It was expected that the river would not waste its energies on the interests of Duluth, but proceed to scour out the channel for Superior. With that freakiness so characteristic of rivers (perhaps the occasion of our personifying them as "she"), the stream did what was unexpected and proceeded to fill up the Superior channel. Shortly thereafter the dyke disappeared on a dark night by the aid of explosives.

The northwest shore, from the St Louis to Thunder bay, is very abrupt and rocky, backed for about half its length by the "Sawtooth" or "Devil's Tracks" mountains. Along this coast, a distance of 200 miles, there are only a dozen streams that deserve any better name than creek. These drain a strip along the coast only a few miles wide, while behind them comes the basin of the St Louis or that of the Rainy lake district. These streams are all so small that the heavy surf of the coast succeeds in damming their mouths with lofty beaches through which the water seeps. Into Thunder bay enters the beautiful Kaministiquia, 150 miles long, with a basin of 750 square miles. It is a picturesque stream, well known to the French voyageurs, for whom it was the usual route from Lake Superior to Winnipeg in the good old times of the undisputed sway of the fur companies. In its lower course about Fort William, its deep brown waters flow lazily through a broad, flat, low delta which is still growing and which is bounded by distant escarpments of flat-topped mountains. Higher up it has numerous rapids, and few streams along which it was the fate of the hardy voyageur to labor are marked by more numerous portages. The sources are in Lac des Isles and Muskeg lake, from the latter of which it passes as the unpretentious Dog river until Dog lake is reached. It is only below this lake that it receives the harmonious name of Kaministiquia, meaning "that which goes far around."

At the head of Nipigon bay and at the extreme northernmost point of Lake Superior enters the Nipigon river, for which the claim is sometimes seriously made that it is the mother stream of the St Lawrence system. The claim is based on the fact that this stream is the outlet of Nipigon lake, just as the St Marys is of Lake Superior, and that the Great Lakes consist not of five or of six (when St Clair is included), but of seven, and Nipigon is the seventh and most distant. Nipigon lake is about 40 miles north of Lake Superior and is 850 feet above sea-level. Nipigon river, about 50 miles long, has therefore a fall of 250 feet. It is a picturesque stream, full of rapids and full of fish. The bay, stream, and lake which bear the name of Nipigon (meaning "dirty water") are said to furnish the best fishing in the Lake Superior basin. Lake Nipigon is oval in form, about 60 miles long, north and south, and 50 miles broad, with a surface area of 2,900 square miles. Its coasts are very much indented, and it contains several hundred islands and islets. The greatest depth so far reported is 540 feet, which would bring its bottom below that of Lake Erie, and only 310 feet above sea-level. The erosion at the outlet is strong, and the fall is reported to be wearing away at the rate of 10 feet per century, in which case Lake Nipigon will at no very distant day dwindle to more modest proportions. The lake occupies a small drainage basin, the land area of which hardly surpasses the water area. Its principal feeder is the Ombalika river, which rises in Summit lake, 40 or 50 miles to the north of Lake Nipigon. This lake is said to lie on the "Height of Land" or watershed between Hudson bay and the St Lawrence basin, and its waters are reputed to flow both ways, part into Nipigon and part, by way of the Albany river, into James bay.

There are several other streams on the north shore which are 100 miles or more long, namely, the Pic, the White, and the Magpie, while the Michipicoten does not fall far below this length. The last mentioned was well known to the voyageurs, as it was a part of the regular route from Lake Superior to James bay. At its mouth was the Michipicoten house, which, with Fort William, on Thunder bay, formed trading centers on the north shore a century or more ago, when the western states were an almost unbroken wilderness. Indeed, the north shore of Lake Superior echoed to the busy hum of a considerable commerce a century before the south shore began to attract attention. The history of these two old stations of the Hudson's Bay Company goes back to a time so distant that Agassiz's visit to Lake Superior in 1848 is relatively a recent event.

THE SIBERIAN TRANSCONTINENTAL RAILROAD

By General A. W. Greely,
Chief Signal Officer, United States Army

Recent advices from the East point to the early completion of the great Siberian railroad, which will be the next strong link to bind indissolubly together the commercial interests of the world. It therefore seems an opportune moment to present to the readers of The National Geographic Magazine a résumé of the advices lately forwarded to the Department of State by our consular officials, Messrs Karel, Monaghan, and Stephan.

The Russian budget for 1897 assigns 65,000,000 rubles to the continuation of the Trans-Siberian railway, and its opening will be an event scarcely less important than the completion of the Suez canal. Five thousand miles of steel rails have been laid already at a cost of 350,000,000 rubles, and in 1898 trains are to run to the Amur river. Passengers, post parcels, and freight will be pushed on by fast steamer to Chaborowka, and thence over the South Russian section of the Siberian road to Vladivostok, making the distance from London to the Japan sea in 17½ days. After the first few years, when high rates of speed across Siberia are attainable, the trip will be made in nine days.

Travelers to and from the East will prefer to make the journey in eleven days overland to making it, as now, over seas in thirty days. Tickets from Warsaw to Vladivostok are to cost only 120 rubles, first class; from London to Warsaw costs now 150 marks ($35.70). The ticket from London to Vladivostok is to cost about 500 marks ($119), first class; second class is to cost considerably less. A ticket to Japan today via Brindisi and Suez costs 1,800 marks ($428).

That the world is so soon to enjoy trans-Asiatic travel is due to the energetic and successful negotiations of Russian diplomats with the Chinese government. At the beginning of the work the Trans-Baikal and Amur section was planned to extend from Chita, through Sretensk, to Pokrovskaia; thence along the river Amur to Khabarovsk to join the Ussuri railroad, running south to Vladivostok. The construction of this line involved such technical difficulties as would greatly increase the cost of the undertaking. On investigation it was found that building through Manchuria would not only cheapen and shorten the construction of the road, but would present other advantages. Negotiations were begun, and the Chinese government granted a concession. The Eastern Chinese Railway Company was formed to construct and operate the railway. The articles of association were sanctioned by the Czar, and an imperial ordinance was issued in December, 1896.

The association organized under the convention of August 27, 1896, by the Chinese government ,with the Russo-Chinese Government Bank, is to construct and operate a railroad from the western frontier of the province of Heilung Chang to the eastern frontier of Kirin, which is to connect with the Trans-Siberian railway. The company may, with the permission of the Chinese government, engage in coal and other mining, industrial, and commercial enterprises in China. The Russo-Chinese Bank takes upon itself the duty of organizing this company, which acquires the rights and duties granted by the above-mentioned convention. Shares can be held only by Russian and Chinese subjects, and the company will own the Chinese Eastern Railway during eighty years after the opening of the whole line.

The Russian government guarantees the resources of the company to the extent of making obligatory the payment of shares. The company takes upon itself on the part of the Russian government the following obligations: (1) The Chinese Eastern Railway must be always kept in full order to satisfy all the requirements in relation to safety, convenience, and movement of passengers and freights; (2) the traffic on the Chinese Eastern Railway to be kept up in conformity with the traffic on the connecting Russian railroads; (3) all trains of the Russian Trans-Baikal and Ussuri railroads are to be met and forwarded without delay ; (4) the company must transmit, with speed not less than that used on the Siberian railway, all passenger and freight trains in direct communication ; (5) the company binds itself to construct along its road a telegraph line connecting with the telegraph lines of the Russian railroads, and to promptly receive and send through dispatches to and from Russia and China; (6) if its technical arrangements shall not insure uninterrupted traffic of passengers and freights, then, as the Russian railways require, the Chinese Eastern Railway must take suitable measures to improve its technical arrangements. In case of misunderstandings the Chinese Eastern Railway agrees to submit to the decision of the Russian Minister of Finance. If the means of the Chinese Eastern Railway shall not be sufficient to carry out the necessary improvements, the road can apply for pecuniary assistance to the Russian Minister of Finance; (7) maximum passenger, freight, and telegraph tariffs shall be established by agreement between the company and the Russian government, which cannot be raised during the whole period of the concession without the consent of the Russian government; (8) Russian mail packages and officials accompanying the same are to be carried free of charge. For this purpose the company assigns to each passenger train a part of one car. The Russian post-office department may furnish post-cars constructed at its own expense, but the repairing, keeping, and switching of them must be done by the railway company free of charge. After the eighty years' concession has expired the road will pass free to the Chinese government. A sale of the railway does not in any way change the obligations.

The following rights are given by the Chinese government to the railroad company: (1) The passenger baggage and merchandise in transit from one Russian station to another are exempt from all Chinese customs duties, interior taxes, and revenues; (2) the tariffs for passengers, freights, telegraphs, etc., are to be free from all Chinese dues and taxes; (3) merchandise imported and exported to and from China and Russia will pay one-third less than the regular export and import Chinese duty paid at Chinese sea custom-houses; (4) goods imported by rail for the interior shall pay transit duty to the amount of one-half of the import duty, and are free from additional duties.

The company is at liberty to buy its construction materials wherever it sees fit, and materials not purchased in Russia will be free from Russian customs duties. The stock capital is fixed at 5,000,000 paper rubles ($2,570,000), and is divided into 1,000 shares, issued at par. The Russian government does not guarantee these shares. Bonds will be issued in proportion to requirements, subject to the approval of the Russian Minister of Finance. The income and liquidation of these bonds will be guaranteed by the Russian government.

The company is to begin work in August, 1897, and the line is to be completed in six years. The new line will begin at Onon, on the Trans-Baikal Railroad, cross the frontier near Staro-

Zurukhait, run in Manchuria toward the towns of Cicikar (Tsitsikar), Khu-lan-Chen, and Ning-tu, and connect with the Nikolsk station of the South Ussuri Railroad. The total length of the Manchuria railway will be 1,920 versts (1,273 miles), of which 1,425 versts (945 miles) will be in Chinese territory. According to the original survey of the Siberian line, the course through Manchuria will shorten the Siberian railroad 514 versts (341 miles). The Manchuria line traverses a country of better climate and more productive soil. The fruitful valley of the Sungari supplies the Amur region with bread, and northern Manchuria possesses natural wealth, to some extent already worked.

In a recent number of *Jahrbücher für Nationalökonamic und Statistik* there appeared an article by Dr Ballod "Concerning the importance of the husbandry of Siberia." He arrives at the conclusion that the Siberian railway will at first only open up the country for the export of the more valuable classes of goods and facilitate wholesale immigration. It will be of enormous importance as a transit route for goods of high value from China and Japan, and also for passenger traffic from and to these countries, but it will be serviceable to the development of grain export only in a very limited degree. Careful estimates of production and freights convince him that an increased output of grain cannot be expected so long as low prices rule. It would be necessary for the Siberian peasant to export at a lower price than has hitherto been paid for his grain in the home markets. Should prices rise materially, profitable cultivation of wheat in middle Siberia would become a possibility, and this would probably bring about an important increase in exports.

GEOGRAPHIC LITERATURE

Glaciers of North America: A Reading Lesson for Students of Geography and Geology. By Israel C. Russell, Professor of Geology in the University of Michigan. Pp. x + 210, with maps and illustrations. Boston: Ginn & Company. 1897. $1.90.

Professor Russell's prefatory "To the Reader" is a stalwart message. "Strange as it may appear," he says, "in the face of the overshadowing popular interest that centers in the glaciers of the Alps, North America offers more favorable conditions for the study of existing glaciers and of the records of ancient ice sheets than any other continent," for in North America the three great types of glacier—alpine, piedmont, and continental—are magnificently exemplified, while the glaciers of other continents (save little-known Antarctica) are limited to the poor little alpine type. The type specimen of the piedmont glacier is the Malaspina ice sheet of Alaska, while the type for the vast continental glaciers of the ice age is found in Greenland. "The magnificence of the field for glacial study in North America has only been appreciated within recent years, and is still unrecognized outside of a limited circle of special students," but the recognition must extend under this forcible presentation.

A student of the European Alps and the Southern Alps of New Zealand, both famed for glaciers; the explorer of several glaciers of the high Sierra; the discoverer of Malaspina glacier and the sole student of the ice-fields high on the slopes of Mount St Elias; an experienced investigator of the glacial deposits and glacial history of United States from Atlantic to Pacific, Professor Russell is well qualified to prepare a reading lesson on glaciers, and his experience crops out between the lines on every page. Perhaps half of his admirable pictures are from photographs of his own making, and although the pronoun in the first person seldom appears, a third or a half of the descriptive paragraphs—and these make up most of the book—represent personal work. Thus the chapters have an attractive air of freshness and realness. This strong personal element, which gives the treatise its greatest value, has apparently affected the arrangement of contents, giving the work the form of a narrative rather than the symmetry of a monograph. The first chapter is an introduction, in which definitions and general features are set forth. After enumerating the "leading characteristics of glaciers," the author proceeds thus to answer the question, "What is a glacier?" "As a provisional definition, it may be said that a glacier is an ice body originating from the consolidation of snow in regions where secular accumulation exceeds melting and evaporation, *i. e.*, above the snow line, and flowing to regions where waste exceeds supply, *i. e.*, below the snow line" (page 16). He then describes glacial abrasion, smoothed and striated surfaces not produced by glaciers, special features of glaciated surfaces, glacial deposits, glacial sediments, and changes in topography produced by glaciers, all with less repetition in treatment than in titles. The second chapter relates to the general distribution of the glaciers of North America, and then follow five chapters devoted respectively to the glaciers of the Sierra Nevada, the glaciers of northern California and the Cascade mountains, the glaciers of Canada, the glaciers of Alaska, and the glaciers in the Greenland region, these chapters containing more than half the volume and most of the value of the book. There is a chapter on the climatic changes indicated by the glaciers of the Ice Age and another on the movement of glaciers, while the tenth and last chapter is a suggestive and attractive discussion of the life history of a glacier, in which the extended observations and reflections of the author are summarized.

The strong points of the work are its vividness and trustworthiness; the arrangement might have been improved, a few trifling errors in the orthography of names might have been corrected, and the general scientific discussion might have been strengthened, but teachers and others are to be congratulated on having at last—and for the first—a thoroughly reliable popular account of the glaciers of North America.

W J M.

A Treatise on Rocks, Rock-Weathering, and Soils. By George P. Merrill, Curator of Geology in the National Museum, etc. Pp. xx + 411, with numerous illustrations. New York: The Macmillan Company. 1897. $4.00, net.

During the present generation a score of students in this and other countries have turned attention to the soil; and, while it may be questioned whether they have yet succeeded in organizing a science of the soil, it may be affirmed that they have made substantial contributions toward such a science. Hitherto most of the publications pertaining to the subject have been technical or at least special, and confined to official documents; but now comes Professor Merrill, already favorably known through professorial work and general writing, with a popular work on soils adapted to both class work and general reading. His apology for the publication—"It is believed that no apology is necessary even in this day of many books for bringing out the present work"—emphasizes the importance of the subject: Human life and the ancillary animal and vegetal life of the land depends on the soil; the fullness of the earth is its wealth in soil; and the worthiest science—albeit in very infancy yet—is that pertaining to this richest of all natural resources. Every student, every teacher, every citizen, every statesman, ought to welcome such a contribution to human progress as this useful treatise.

The work is arranged in five parts, each divided into several chapterlets. In the first part rocks are discussed as to their constituents, their physical and chemical properties, and their modes of occurrence, and in the second they are classified as (1) igneous, (2) aqueous, (3) æolian, and (4) metamorphic; thus this part of the work deals with rock-making, and sets forth the laws involved in the development of the fundamental constituents of the external earth. The next two parts are devoted, respectively, to the weathering of rocks and to the transportation and redeposition of rock debris, and in them the unmaking and remaking of rocks are admirably though briefly expounded. Part V, in which the originality of the work is concentrated, is entitled "The Regolith;" under this new term (derived from Greek words for *blanket* and *stone*) the unconsolidated material mantling the hard rocks is discussed in detail. The warrant for introducing a new word for the soils, subsoils, and other superficial materials of the earth arises in daily need; several terms have already been employed—"soil," "earth," etc., in general, "drift," "diluvium," "alluvium," etc., for transported material, and "residua," "terra rossa," "gruss," "geest," "saprodite," etc., for the products of rock decay—among laymen and scholars, but none has thus far proved satisfactory. Merrill's suggestion is better than any that has gone before, but it remains to be seen whether his term will survive or fall into the ever-yawning grave of desuetude. The author proceeds to classify the regolith as (1) sedentary and (2) transported; the former is subclassed as (*a*) residual deposits and (*b*) cumulose deposits, while the latter is divided into (*a*) colluvial deposits, (*b*) alluvial deposits, (*c*) æolian deposits, and (*d*) glacial deposits. In addition, the soil proper is described, as a product rather than a deposit, with respect to chemical composition, mineral constitution, and physical condition, as well as with respect to weight, color, and age. The great complexity of the soil is adequately recognized, and the multifarious interactions between the chemical, physical, and vital, by which the soil is produced and modified, are set forth appreciatively.

In treatment as in subject, Professor Merrill's work is notable. It is strictly up-to-date, embracing the results of the latest researches, and duly recognizing the work of contemporary investigators; also it is made admirable mechanically by clear typography, good paper, excellent illustrations (many of them photomechanical reproductions), and a full index.

W J M.

GEOGRAPHIC SERIALS

The Geographical Journal for March opens with the minutes of the Nansen meeting in London. Messrs Munro and Anthony continue the narrative of their explorations in Mysia. Dr Dawson summarizes the progress of the geographical work of the Geological Survey of Canada for the past year. Mr Vaughan Cornish furnishes an exhaustive article on the Formation of Sand-dunes, and Professor Leo Reinisch an article on Egypt and Abyssinia.

The Scottish Geographical Magazine for March opens with an article entitled "Cape Juby," by Mr Fred S. Zaytoun, which contains a quite full description of the northwestern part of the Sahara. Mr John Murray has an article on the Balfour Shoal, a submarine formation in the Coral sea, in the southwestern Pacific. This is accompanied by a chart and profile showing temperatures of the sea water. The Nansen expedition receives further notice in the form of a review of Dr Nansen's book.

The Royal Colonial Institute, of London, is an organization for the increase and diffusion of knowledge relating to Great Britain and her dependencies. Its purpose, as stated in its by-laws, is "to provide a place of meeting for all gentlemen connected with the Colonies and British India, and others taking an interest in Colonial and Indian affairs; to establish a reading-room and library, in which recent and authentic intelligence upon Colonial and Indian subjects may be constantly available, and a museum for the collection and exhibition of Colonial and Indian productions; to facilitate interchange of experiences among persons representing all the dependencies of Great Britain; to afford opportunity for the reading of papers and for holding discussions upon Colonial and Indian subjects generally, and to undertake scientific, literary, and statistical investigations in connection with the British empire."

The Institute publishes a journal, which has already reached its twenty-eighth volume, the first four numbers of which have been issued. The character of its work may perhaps be illustrated by an enumeration of the principal papers contained in these recent numbers of the journal. Part I contains "Inter-British Trade," by Mr John Lowles, and "The Colony of Victoria; Some of its Industries," by E. Gerome Dyer. Part II contains an article by Sir Henry H. Johnston, entitled "England's Work in Central Africa," in which the recent progress of civilization in Great Britain's share of that continent is admirably summarized. Mr

E. Burney Young has an article entitled "The Colonial Producer." Part III contains an article by Sir Sidney Shippard on the Administration of Justice in South Africa, and one entitled "Cyprus and Its Possibilities," by Charles Christian. Part IV pictures the economic condition of Australia at the present time, under the title "Studies in Australia in 1896," by Hon. T. A. Brassey. H. G.

PROCEEDINGS OF THE NATIONAL GEOGRAPHIC SOCIETY, SESSION 1896-'97

Special Meeting, March 15, 1897.—Third Monday afternoon illustrated lecture. Vice-President Greely in the chair. Rev. Thomas J. Shahan, LL. D., Professor in the Catholic University of America, lectured on Syria.

Regular Meeting, March 19, 1897.—Vice-President Merriam in the chair. Mr Arthur P. Davis, of the U. S. Geological Survey, read a paper on "The Deserts of Southern Arizona and How They Are Redeemed by Irrigation," illustrating his subject with lantern slides.

Special Meeting, March 22, 1897.—Fourth Monday afternoon illustrated lecture. President Hubbard in the chair. Prof. Thomas Davidson, M. A., of Aberdeen, Scotland, lectured on Tyre and Sidon.

Annual Reception, March 25, 1897.—The Annual Reception of the Society was held at the Arlington Hotel, from 9 to 12 o'clock p. m. President Hubbard, with the ladies of the Reception Committee, received the members and guests of the Society, to the number of 300. The Society was honored with the presence of the President of the United States and several members of the Cabinet.

Special Meeting, March 26, 1897.—President Hubbard in the chair. Hon. John W. Foster read a paper on the Hawaiian islands. A number of maps were shown on the screen at the commencement of the lecture, and at its close Mr E. D. Preston, of the U. S. Coast and Geodetic Survey, exhibited a series of lantern-slide views of scenery in the islands.

ELECTIONS.—New members have been elected as follows:

March 19.—D. Q. Abbot, Mrs Emily E. Briggs, Paul Brockett, Rev. S. Bayard Dod, Prof. L. M. Drake, A. F. Dunnington, Miss C. L. Freethey, Prof. H. G. Hipp, S. B. Laird, Col. J. R. Lewis, U. S. A., George B. Magrath, V. F. Marsters, Miss Hester McNully, Miss Annie S. Peck, Dr Fred L. Ransome, Miss Olive R. Seward, J. C. Stanton, C. E.

At a meeting of the Royal Geographical Society held in London on March 22 Dr Nansen expressed his conviction that a properly equipped expedition could now reach the Pole in a single summer. He stated, however, that from a scientific point of view the results of such an expedition would be of far less value than those of some other explorations that might be undertaken in the less known parts of the Arctic regions.

"FROM FROST TO FLOWERS."

"The Chariot . . .

. . . of the Sun"

SUNSET LIMITED is the Southern Pacific's great train, running through solid from New Orleans to the Pacific Coast.

SUNSET LIMITED leaves New Orleans every Monday and Thursday, at 10 o'clock in the morning.

SUNSET LIMITED covers the 2006 miles to Los Angeles in 58 hours, and the 2489 to San Francisco in 75 hours.

SUNSET LIMITED is vestibuled throughout, steam heated and gas lighted.

SUNSET LIMITED has a ladies' parlor the full width and a third the length of a car, equipped with fine library, escritoire and writing materials, large easy chairs, etc.

SUNSET LIMITED has an equally commodious smoking and reading room for gentlemen, supplied in a similar manner.

SUNSET LIMITED has bath room, barber shop and buffet - luxuries the tourist will appreciate.

SUNSET LIMITED has a car containing seven drawing rooms, which can be used separately or *en suite*, each having private lavatory and toilet facilities.

SUNSET LIMITED has a sumptuous diner, which goes through with it and in which meals are served *à la carte.*

SUNSET LIMITED is accompanied by a maid whose services are at the disposition of lady passengers.

SUNSET LIMITED traverses a road where snow never falls and blockades and blizzards are unknown, and through a region of marvelous interest.

SUNSET LIMITED is at your service, and any Southern Pacific Agent will be glad to tell you all about it, or if you want to know more, send 10 cents in stamps to the General Passenger Agent, and a beautiful book of 205 pages, that will tell you all about the route, will be sent you.

S. F. B. MORSE,

General Passenger and Ticket Agent,

NEW ORLEANS.

Among the Contents of Forthcoming Numbers of

THE NATIONAL GEOGRAPHIC MAGAZINE

WILL BE THE FOLLOWING:

A Winter Voyage through the Straits of Magellan,

BY ADMIRAL R. W. MEADE, U. S. N.;

The Deserts and Forests of Arizona,

BY PROF. B. E. FERNOW, PH. D.,

CHIEF OF THE DIVISION OF FORESTRY, U. S. DEPARTMENT OF AGRICULTURE;

Costa Rica,

BY GENERAL RICHARD VILLAFRANCA,

CONSUL-GENERAL OF COSTA RICA AT SAN JOSE, GUATEMALA, EX-COMMISSIONER TO THE WORLD'S COLUMBIAN EXPOSITION;

Prehistoric Man the Product of Geographic Environment,

BY HON. GARDINER G. HUBBARD, LL. D.,

PRESIDENT OF THE NATIONAL GEOGRAPHIC SOCIETY,

—— AND ——

Down the Volga, from Nijni Novgorod to Kazan,

BY PROF. FREDERIC W. TAYLOR.

JUDD & DETWEILER, PRINTERS, WASHINGTON, D. C.

The National Geographic Magazine

AN ILLUSTRATED MONTHLY

Editor: JOHN HYDE

Associate Editors

A. W. GREELY W J McGEE HENRY GANNETT
C. HART MERRIAM ELIZA RUHAMAH SCIDMORE

CONTENTS

WASHINGTON

PUBLISHED BY THE NATIONAL GEOGRAPHIC SOCIETY

AGENTS IN THE UNITED STATES AND CANADA

THE AMERICAN NEWS COMPANY, 39 AND 41 CHAMBERS STREET, NEW YORK

PARIS: BRENTANOS, 37 AVENUE DE L'OPERA

Price 25 Cents $2.50 a Year

Entered at the Post-office in Washington, D. C., as Second-class Mail Matter

THE

National Geographic Society

ORGANIZED, JANUARY, 1888

PRESIDENT

GARDINER G. HUBBARD

VICE-PRESIDENTS

MARCUS BAKER
WILLIAM H. DALL
G. K. GILBERT
A. W. GREELY
C. HART MERRIAM
HERBERT G. OGDEN

TREASURER

CHARLES J. BELL

RECORDING SECRETARY

EVERETT HAYDEN

CORRESPONDING SECRETARY

HENRY GANNETT

MANAGERS

H. F. BLOUNT
C. W. DABNEY, JR.
DAVID T. DAY
JOHN HYDE
W J McGEE
F. H. NEWELL
W. B. POWELL
J. B. WIGHT

SECRETARY'S OFFICE, 1517 H STREET N. W., WASHINGTON

The National Geographic Society, the object of which is the increase and diffusion of geographic knowledge, has a paying membership of 1,400. Its membership is not restricted to practical geographers, but is open to any person in good standing who may be sufficiently interested in its work to seek admission. The annual subscription is: for active members, $5.00 per annum; for corresponding members, $2.00 per annum. Active members pay also an entrance fee of $2.00 on election. THE NATIONAL GEOGRAPHIC MAGAZINE is sent regularly to all members, both active and corresponding.

Donations for the founding of Prize Medals and Scholarships are respectfully solicited.

Richard Worsam Meade
Rear Admiral U.S. Navy.

Photo-engraved by Electro-Tint Eng. Co.,

THE

National Geographic Magazine

Vol. VIII | MAY, 1897 | No. 5

A WINTER VOYAGE THROUGH THE STRAITS OF MAGELLAN*

By the late Admiral R. W. Meade, U. S. N.

Some twenty-six years ago I received peremptory orders to assume command of the *Narragansett* and sail forthwith to the Pacific station. We left Sandy Hook on the first blast of a nor'wester which followed on the heels of a March equinoctial, being the first steamer of the navy to leave the port of New York with stunsails set alow and aloft and no steam up. Whether it was this tribute to Boreas that brought us good fortune I do not know, but we made a famous run to the Line, where, Neptune having come on board and duly shaved and ducked several score greenhorns, our luck for the time deserted us, and for the next two or three weeks the ship fanned along with light airs and tedious calms, until the fortieth day out saw us safely in the beautiful harbor of Rio de Janeiro, tinkering away at a wretched old pair of engines which had broken down when we tried to use them to steam into harbor.

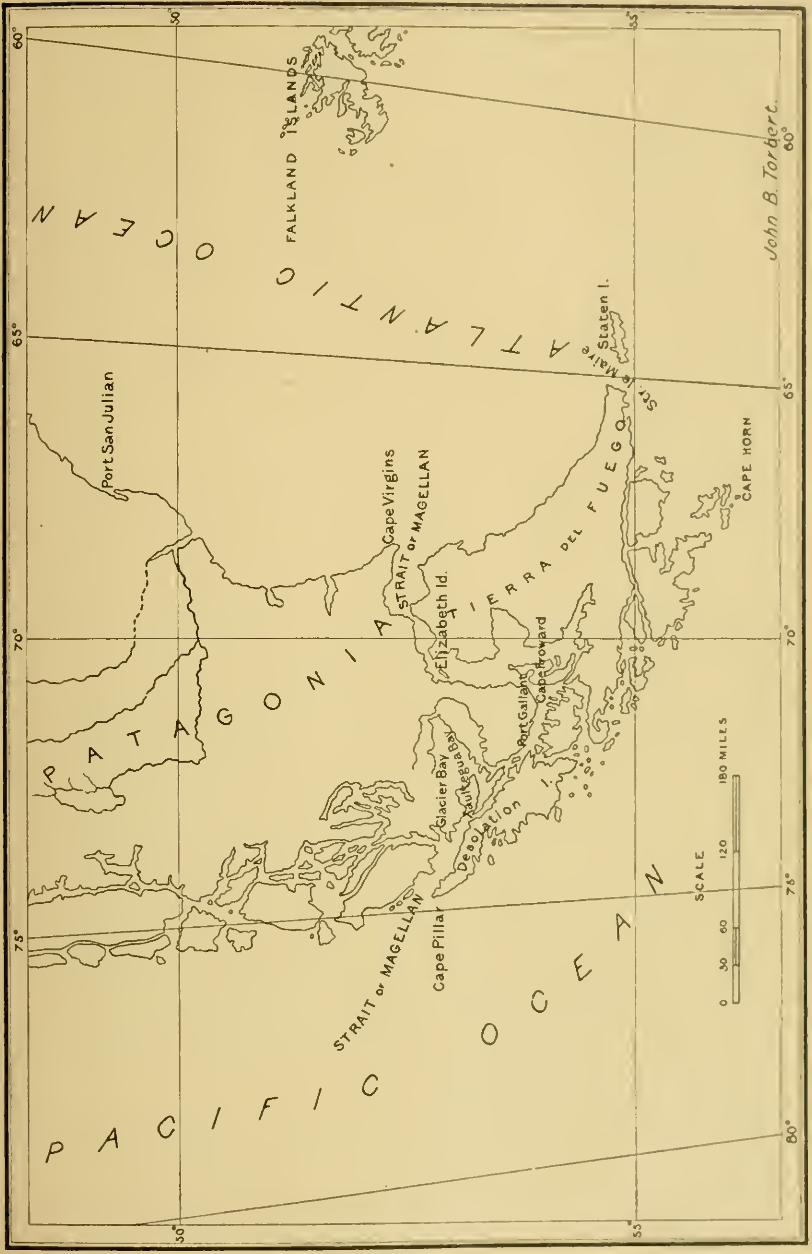
Resuming our cruise, we were favored by a sea as smooth as glass and with the most charming weather imaginable. But there is a cry of "Land ho!" from aloft, and what we see proves to be Mount Wood, a solitary peak of moderate elevation on the coast of Patagonia, and in the vicinity of the very Port San Julian where Magellan wintered his ships, about 200 miles north of the straits. As we approach the land it seems a pleasanter-looking coast than many I have seen; and though, no doubt, we

*Abstract of a lecture delivered before the National Geographic Society, December 4, 1896.

see it under most favorable circumstances of wind and weather, I incline to the belief that the popular idea in regard to the dreariness and forbidding character of the shores of Patagonia is a delusion which the commerce of the future will dispel. The day after we made Mount Wood the weather became thick and the wind squally, and, not being able to see the land, we ran by the lead. When near Cape Virgins by our reckoning the barometer commenced to rise. Now a rise in the glass in this latitude (50° south), the barometer having previously stood low, is an almost certain indication of a change of wind, if not bad weather; so all hands were called to reef topsails. Scarcely had the second reef been taken in when the wind shifted in a moment from the north landward (N.N.E. to W.S.W.) and blew in furious gusts, the horizon suddenly cleared, the mists were dispelled, the air became cold and raw, and by the rays of the setting sun (it was now 3 o'clock of a June day) we saw in the distance Cape Virgins, with its abrupt. cliff-like shore, 16 miles dead to windward of us. Thus far we had made the voyage from New York entirely under sail, ships of war not being expected to steam unless necessary. We managed, with the aid of fore-and-aft canvas, to crawl slowly to windward, and, there being a bright, full moon, crossed the great Sarmiento bank, south of Cape Virgins, where the rise of the tide is 43 feet, and by 11 o'clock that night were safely at anchor in the straits, some four miles west of Magellan's landfall.

To make our voyage intelligible it will here be necessary to describe the general character of the strait. It is safe to say that there is no other part of the world where, as a rule, the weather is so tempestuous and dangerous as it is off Cape Horn. There old Ocean exerts his full sovereignty, and the winds and the waves are almost ceaselessly raging and surging in wild tumult against a bleak, forbidding, iron-bound coast. The climate of Cape Horn is the most wretched on earth. Fierce storms of rain, hail, and snow drift in from the Atlantic, Antarctic, and Pacific oceans in everlasting succession, broken only by the furious williwaws or Cape Horn squalls.

The real difficulties of the voyage commence at Cape Froward, the southern extremity of our continent, which is 175 miles from Cape Virgins. Here the weather undergoes an entire change, and no matter how pleasant it has been before, the mariner may expect to don his "sou'wester" the moment he doubles this precipitous headland, worthy of terminating so grand a continent.



OUTLINE MAP SHOWING, THE PRINCIPAL POINTS IN THE STRAITS OF MAGELLAN

For steamers and smart sailing schooners the voyage through is merely one of ordinary care and prudence, but for square-rigged sailing craft the difficulties are almost insuperable; yet one large sailing ship, the frigate *Fisgard*, went through in the astonishing time of 17 days!

From Cape Virgins to Cape Pillar the distance by the usual route is 315 nautical miles, and to traverse this from the eastward every course between W.N.W. and S.S.E. must, at one time or other, be steered, and as the wind is persistently west or southwest (or always dead ahead), the difficulties to the sailing ship are readily seen. Moreover, the character of the strait changes materially as the voyager goes west, for to the eastward of Cape Froward, as a rule, the weather is better, the sun shines brighter, anchorages are more convenient, and the dangers of navigation fewer in number.

The strait may be geographically divided as follows: (1) From Cape Virgins to Elizabeth island, the termination of the second narrows, 95 miles, where the tides are very strong, the rise and fall extraordinary (43 feet), the land comparatively low and entirely destitute of timber, the weather generally good, and anchorages safe and convenient. (2) From Elizabeth island, where trees first make their appearance and the land commences to rise, to Cape Froward, 80 miles. Here anchorages are frequent and safe, timber is plentiful, the tides are weak (not exceeding 5 feet), and the weather is comparatively pleasant. (3) From Cape Froward to Cape Quod, 50 miles, with anchorages few and far between, currents strong and in places dangerous, weather almost constantly tempestuous, mountains of great height and bare of vegetation, their peaks covered with snow or ice, natives savage and dangerous, and voyaging even in steamers attended with risk. Lastly, from Cape Quod to the Pacific, 90 miles, where there are few anchorages, and some of these, as Port Mercy, dangerous in the extreme, there is very little tide, the weather is stormy nearly all the year, and the high mountains are covered with eternal snow—the land aptly termed by Sir John Narborough "Ye Land of Desolation."

When daylight came on the morning after our arrival we found ourselves anchored off a long, low spit of shingle called by the English navigators "Dungeness," from some fancied resemblance to the headland of that name in the English channel. To the eastward was Cape Virgins, not unlike the chalk cliffs of England. To the westward loomed Cape Possession, a bold, dark-looking headland, while to the south, dimly visible in the gray of the morning, was Magellan's Land of Fire—a low, indented coast just rising above the distant horizon. The straits are 16 miles wide at this point. Following the usual rule of the mariner in these parts, we had prepared beforehand our tables for tides, sunrise, and sunset, the light yards and topgallant masts were struck, all stunsails and booms sent on deck, and everything made snug aloft for steaming against the strong westerly winds we expected to encounter. But our apprehensions of bad weather proved groundless. The southwester had died out, and the day broke calm and comparatively clear. The sun shone out of a leaden-hued sky with just warmth enough to be pleasant, and, weighing our anchor, with a favorable flood-tide we were soon passing the land at the rate of 13 knots an hour, though the engineer would have gone wild if anyone had suggested to him the possibility of the *Narragansett's* engines driving her over 8 knots. The rise and fall of the tide in this part of the strait is very great. It is no less than 43 feet, and a singular circumstance attends the changes of the tidal stream. The flood, which runs with great velocity to the westward, commences about three hours before it is low water by the beach, and so here we were rapidly going west with the flood-tide while apparently the water was everywhere ebbing by the shore. Another feature in the tides east of Cape Froward is that the time of high water grows later as the ship proceeds to the westward, so that it is possible in a fast steamer, starting from Cape Virgins with a favorable flood, to reach the Chilean settlement at Sandy Point (110 miles) in a daylight run in June, which corresponds to our December.

As we pass Cape Possession the wind draws in fresh gusts from the northward and westward, and we set the fore-and-aft sails, which increases the vessel's speed to 14 knots. We rapidly approach the first narrows, for the low, cliff-like shores on each side are now plainly visible, and all hands are on deck to witness the terrific tide race we have heard so much about. By 10 o'clock we are fairly in the narrow pass, which is a perfectly straight "reach" of perpendicular wall-like shore, 9 miles long by 2 miles broad, with very deep water, precipitous beach at low tide, and a straight, rapid current of 8 knots an hour. We are fairly flying along the land, and by noon have made over 60 nautical miles since we started. We are clear of the narrows, dimly visible astern, and skirting the southern shore of Philip bay. By 2 o'clock we are nearly up with the second narrows, but now the flood-tide is done, and it would be the merest folly to attempt to force the *Narragansett* through against the ebb, so we give up all hope of reaching Sandy Point this evening, and steam slowly in for the anchorage under Gregory Summit.

On the cliff abreast of the ship we observe a native camp and see some animals grazing on the downs. Soon there are other signs of life, and a dozen Indians come sweeping along on horseback. They are splendidly mounted and seem a fine, athletic race. Now they are on the edge of the bluff making signals to us, but it is too late to communicate with the shore, and, moreover, the character of "ye native" hereabouts is open to suspicion, though to do the Indians simple justice they have been rendered hostile to all white men by two centuries of brutality at the hands of the Spaniards and their descendants. As a people these Patagonians are less savage and intractable than the Fuegians or natives of the southern and western shores. There are in truth some very striking differences between these two races, and it may be well to allude to them here. In the first place, the term Patagonian, unless explained, is apt to mislead, for the whole of the continent south of the parallel of 40 degrees is known as Patagonia, and is geographically divided by the mountains into Eastern and Western Patagonia, inhabited, as far as we know, by two very different races, though Dr Darwin in his narrative of the *Beagle's* voyage in 1831 declares his conviction that they are the same race and that the present difference is caused by environment. This is probable, as food, climate, and environment are doubtless responsible for most racial differences; but, strictly speaking, the Patagonians are the natives of Eastern Patagonia, for the inhabitants of the islands along the Smyth channel (north of Magellan straits) and Western Patagonia as far as the Gulf of Peñas are of the same family as the natives of Tierra del Fuego, and are invariably designated as Fuegians. The Patagonians then inhabit the northern side of the strait east of Cape Froward and the chain of mountains known as the Southern Andes, and are probably of the same family as the Araucanians, so justly celebrated for their prowess in their encounters with the steel-clad warriors of Spain in the sixteenth century. Of these Patagonians, one explorer who passed some time with them says:

"They are very tall, finely formed, and athletic, with jet black eyes, black, coarse hair, thick lips, and a skin of reddish-brown color. They often paint themselves in a hideous manner and then grease themselves all over. They approve the early fashions (Garden of Eden, and so on), with occasionally a mantle of skin thrown over their shoulders. They worship a god of good and a god of evil, and all that happens is considered as directly sent by one or the other of these deities. They do not believe in the final salvation of the wicked. They are averse to Christianity, uncontrollable in a state of anger, and passionately fond of strong drink. Their favorite food is horse-flesh and the blood of animals, and though they have cooking utensils they prefer to eat their meat raw. They subsist by hunting the guanaco, an animal never seen in Patagonia to the westward of Cape Froward, but very numerous on the plains of Eastern Patagonia. These people live either in camp or on horseback and do not seem to be fishermen—at least they are not known to have canoes. Their bows and arrows betoken that they live by hunting, as their arrow-heads are both poisoned and unpoisoned, and it is not at all likely they would waste the latter on their enemies. Even so late as 1871 it was said they possessed few firearms. They are a bold, warlike, and fearless race; possessing certain magnanimous traits, and in this they differ widely from the natives of the southern and western shores of Magellan straits."

The same explorer says of the Fuegians:

"They are an ugly, savage race, who in hard times become cannibals, and their most splendid feasts are characterized by dirt, filth, and misery. Christianity seems to have had no power among them."

Every one who has voyaged in these waters regards the Fuegians as treacherous and dangerous. They are short in stature and of a dirty copper-color, their only clothing, even in the coldest weather, being a sealskin or deerskin worn with the hair outward, and this solitary garment, vermin included, they will readily exchange for a little biscuit or tobacco. Darwin admits their cannibalism, which he excuses on the plea of necessity. When pressed by hunger they kill first their old women and then their dogs, because, said one of them, "Doggy, he catch otter; old woman, she no catchee otter." But usually they live by fishing and what they can gather from the rocks, as, for instance, snails and mussels, but they will eagerly devour putrid seal's flesh and the most disgusting offal.

They live in huts constructed in a very primitive way of the branches of trees, and have no articles of traffic except their weapons and implements, which are sometimes bought as curiosities. They are thievish, cunning, and greedy, and great caution is requisite in dealing with them. Attempts have been made by English missionaries to lessen their barbarism, but with no success, a fact which is the more singular, as even the

Fiji Islanders have been rendered subject to the civilizing influences of Christianity.

Captain Mayne, who recently resurveyed these waters in H. B. M. ship *Nassau*, states that "these people pass most of their time in canoes and make voyages from the straits to the Gulf of Peñas, a distance of many miles. Though usually but few canoes are seen in passing through, it is extraordinary how rapidly a hundred or more will gather together if they see an opportunity for attacking boats, small vessels, or a wreck. How the rendezvous is known is a mystery," says Captain Mayne, "but fires are seen smoking all along the coast for miles, and out of every creek a canoe will be seen shooting toward the rallying point; but there is no romance whatever about their appearance, for instead of the graceful shape of the Indian canoe, these miserable craft are simply planks tied together with thongs or fibers of trees, without the slightest regard to form, and instead of being urged along by paddles they are rowed by oars rudely made of pieces of board tied to the end of a short pole. On the bottom of the boat, in the middle, is a small fire, and on each side of it are crouched six or eight men, women, or children, according to the size of the craft. These are generally, as we have said, almost entirely naked, the women appearing to care less about clothing than the men."

A very striking difference between these people and the Patagonians was noticed by Captain Fitzroy in 1830, and subsequently by Captain Mayne in 1867. This is that while the Patagonian will generally drink all the rum he can get and is always more or less drunk when near a settlement, the Fuegian cannot be persuaded to drink at all, and if he is enticed into tasting strong liquor of any kind will always put it away with a wry face. In fact, this is the solitary redeeming trait in these savages, who are indeed to be dreaded, for they have frequently attacked and overcome the crews of passing vessels.

The next morning we were under way with the first of the flood, and steamed around Cape Gregory into the second narrows. Up to Elizabeth island the scenery was as tame and uninteresting as possible, but now for the first time we caught sight of the distant mountains to the southward, with their snowy peaks and glaciers. Passing the island, we descried the clearing above the settlement at Punta Arenas, and soon after the village was in full view, showing to much advantage its white houses and fences dotting the hillsides. It is now a colony of Chile, originally founded as a penal settlement in 1849, when the government removed its post from Port Famine, 28 miles to the southward. A dreadful tragedy took place in 1851, the convicts rising upon the garrison, seizing several vessels, and murdering the governor and his subordinates with circumstances of atrocious cruelty, since which time the practice of sending felons here has been abandoned. The village consists of about one hundred houses built upon ground which slopes gradually back from the water. The governor was very enthusiastic about the success of the colony and showed some gold nuggets found in the little stream east of the village. The attractions of Sandy Point were insufficient to detain us long, and on the next evening we left by moonlight, steaming slowly for that magnificent headland, Cape Froward.

The morning sun shone bright and beautiful over the lofty snow-capped hills, while in the valleys, which were entirely free from snow, a flood of golden light upon the dark green foliage of the forest rendered the landscape very charming. The shore, after passing Cape San Isidro, is dotted with numerous little bays, in one of which, known as Jack harbor, the celebrated Bougainville in 1764 moored his ships and cut timber for the French colony on the Malouines, now the Falkland islands. The cove, which is hardly larger than an ordinary wet dock, is a romantic-looking nook, sheltered completely, and to add to its beauty a sparkling mountain rivulet tumbles noisily into the sea at its head.

At noon we had reached our extreme southern limit and were off Cape Froward. Though up to this time the weather had been beautifully clear and pleasant, the moment we rounded this magnificent terminus of our continent we felt a change. The bright sky gave place to an overcast leaden hued one, the air grew colder, and for the first time since entering the strait we felt the williwaw. These winds are peculiar to this region, the name being corrupted from the term "whirl 'awas" of the old navigators and seal hunters. They are rotary squalls, which blow at times with indescribable fury, seeming apparently to come from every point of the compass. There is one peculiarity about these squalls which seems to have escaped notice hitherto. This is the singularly mournful whistling sound, like the sighing of an Æolian harp, which invariably precedes and follows them.

Cape Froward, 53° 54′ S., 71° 18′ W., is the southern extremity of the continent of America. It is one of the grandest headlands in the world, and I say this after a lengthened experience at sea. Let those who have seen the sea face of Gibraltar imagine a thousand feet added to the rock and they will have an idea of the grandeur of Cape Froward. But we are now on the home-stretch for San Francisco as the ship doubles the pitch of the cape and edges closer and closer to the eastern shore to avoid the fury of the west wind, of the force of which the white caps and heavy sea in the middle of Froward reach give indications.

It was quite dark when the ship reached Fortescue bay and anchored. This is the most secure anchorage in the strait, and may eventually become the principal stopping-point of mail steamers. There is an outer and an inner harbor, the latter, known as Port Gallant, being accessible for ordinary steam vessels. The view from the anchorage is very fine. There are several prettily wooded islets separating Fortescue bay from Port Gallant, while Mount Cross, covered with snow, rises gradually to a height of 3,000 feet and completely overlooks the anchorage.

A few weeks before our arrival off Port Gallant it had been the scene of a tragical occurrence, the captain and three men of an English vessel, the *Propontis*, having been murdered by the Fuegians while obtaining water. On our arrival the Fuegians had apparently deserted that part of the strait. The governor had evidently deemed it impossible to apprehend the wretches concerned in these frightful murders. The fate of these unfortunate men should be a warning to small merchant vessels.

The next day was mostly consumed in making the run from Port Gallant to Borja bay, the wind being adverse and the tide strongly against us, but the beautiful scenery compensated for the tediousness of the trip; it was by far the finest that we had yet seen. The serrated ranges of mountains on Cordoba peninsula, covered with snow and glaciers sparkling in the sunlight, are very grand. The character of the strait seems to change entirely when abreast of Jerome channel, at the entrance to which Cordoba peninsula apparently blocks up the strait, which now assumes all the grandeur and beauty of an Alpine lake. The ship anchored in the deep waters of Byron's Island bay, under the shadow of Borja mountain, towering grandly 3,000 feet above our heads. A landing party soon woke the echoes of the mountain with the sharp crack of the rifle, the sound reverberating in prolonged echoes. The scenery on the mountain side is very picturesque, but the ascent is made under difficulties. The deep bay is thoroughly sheltered, and to add to its beauty three sparkling rivulets fall into it at different points. A peculiar feature of the place (which is a favorite post-office) is the great number of boards, nailed to the trees, which serve as a rough log of the numerous vessels that in the last fifty years have touched here. A very conspicuous one drew our attention. It read: "U. S. sloop of war *Decatur*, Dec'r 11th, 1854. All well." This ship had then been 80 days in the strait, and was finally towed through by the United States steamer *Massachusetts*, Captain R. W. Meade, father of the writer. Before leaving, the *Narragansett's* board, "5 days in the straits; all well," was nailed above the *Decatur's*.

The trees at Borja bay differ from those at some other points, being of great girth and gnarled and stunted in their growth. As soon as the moon was up, the ship steamed westward past the bold cliff of El Morion (the Helmet), and was at last fairly pointed for the great long reach to the Pacific.

The lights and shadows reflected by the moon upon the dark waters of the strait—here almost unfathomable—the dark spots under the overhanging cliffs of the lofty mountains, and the flood of silver moonlight beyond rendered the scene one of surpassing beauty. The night was calm and quiet, the stars overhead shone with the peculiar brilliancy of the high latitude, and everything promised fair for a quick run to the Pacific. At 10 next morning we had passed Glacier bay and the chill, dreary coast between it and the Spanish gulf with the unpronounceable name (Xaultegua), when a change in the weather became apparent. At 2 o'clock in the afternoon the Pacific ocean was only 35 miles off, but the long swell we now encountered and the stormy appearance of the weather compelled us to choose between a port of refuge or a stormy night in the open strait. Port Churruca, on Desolation island, seemed the best harbor, and the ship bore up for the narrow entrance. There being no bridge on the *Narragansett*, the captain took his place on the forecastle as pilot, the navigating lieutenant* held the chart, and an old sailor held a tarpaulin over it to keep it from getting wet. Careful hands were in the chains and at the engine-room bell, and all hands were called to "bring ship to anchor." The steamer was heading for two small rocky islets, about 50 yards apart, dimly visible through the sleet and mist of a driving squall. The surf broke furiously all along the rocky shore. "Slow down!" says the captain from his lookout on the forecastle, and slow it is. No soundings! In truth none could be found here with 200 fathoms of line. In a few minutes a narrow

* Now Commander Z. L. Tanner, U. S. N.

channel is descried leading apparently into the very bowels of the mountain, which towers thousands of feet above us. "Port!" from the forecastle. "Port it is, sir!" from the quartermaster at the wheel, and the ship's head flies to starboard, obedient to the helm. All hands are at their stations, both anchors ready, and the silence fore and aft is profound. We enter the passage, and the helm is alternately hard-up and hard-down as we thread our way through the narrow pass, scarce 200 yards wide, bordered by rocks and islets, upon which the sea roars and surges dismally. Now we emerge into an inland sea which in the thick weather seems almost illimitable, the shores being perpendicular walls of rock two and three thousand feet in height. The vessel turns short round to port and shoots ahead toward a little cove under the shadow of an immense mountain. "By the mark, seventeen!" comes from the chains, and the anchor is let go. Hawsers are run from the ship to one of the few stunted trees to keep the vessel clear of the rocks, and the *Narragansett* is safely sheltered for the night.

Sir John Narborough spoke soberly and truly when he named this the "Isle of Desolation." Nothing can be more grandly or profoundly desolate than the scenery in the neighborhood of Oldfield anchorage, Port Churruca. The term port is an entire misnomer, for beyond two small coves, where anchorage may be obtained in from 15 to 40 fathoms of water, there is no bottom to be found with less than 50 or 100 fathoms of line; in many places there are no soundings at all. The deep inlets of this inland sea are bordered by awful precipices, broken by frightful chasms and ravines. There are a few stunted trees along the beach, but on the mountain side not even the usual moss or lichen—nothing but bare, slate-colored, savage-looking rocks, covered with ice and snow. The place is fully sheltered, and all that night the ship lay profoundly quiet, not a breath of air stirring, though the roar of the sea and the whistling of the furious west wind outside could be distinctly heard. A party left the ship before dark to explore the head of the little cove. They found some signs of vegetation in the gully at the base of the cliff, under which the ship was moored, and one of the explorers collected a bouquet of Fuegian flowers. The sailors, however, looking rather toward the practical than the beautiful, found a bed of fine mussels, upon which we all regaled ourselves that evening.

The next morning the weather, though overcast with rain squalls at intervals, was sufficiently favorable to admit of an attempt to leave. Some of the officers seemed dubious of the *Narragansett's* ability to clear the strait, but the captain concluded to take the chances, and at noon Cape Pillar was in sight on the port bow.

With a full head of steam and the fore-and-aft canvas the ship made good way, and at 2 o'clock passed out of the strait and steered directly west for an offing. But both the wind and sea were now rapidly rising. At dark it was blowing a furious gale from the W.S.W., with one of the most tremendous rolling seas I ever saw. No chance to run back or find an anchorage in such weather as this. At times the squalls of wind, sleet, and rain were so thick that we could not see a ship's length. There was nothing to do now but to "claw off" shore under every inch of storm canvas the vessel could carry, and trust to the engines to help us to gain an offing. At 8 o'clock that night the hatches fore and aft were securely battened down, and the lee rail of the ship was under water as she struggled under sail and steam against the storm and sea. Dimly visible astern, through the furious driving squalls, was Cape Pillar, eight miles distant. On the lee beam were the black rocks of Los Apostoles, the ship drifting slowly southward in dangerous proximity to them. The wind veered constantly from point to point, and the squalls came with blinding and terrific force; but everything held well, and the Providence which watches over "poor Jack" sent us a slant of wind which enabled us to make an offing during that dark, dismal, and anxious night.

For eight long days and nights this state of things continued, the ship vainly struggling to get to the westward, the squalls of sleet and snow never continuing long enough from southwest to enable the vessel to get north at all. On the eighth day the vessel was nearly as far south as the parallel of Cape Horn, with a fair prospect of being driven round the cape altogether. There were but a few tons of coal left, and the ship was still 1,200 miles from Valparaiso. Affairs looked blue. Many of the men were worn out, exhausted by cold and fatigue; several of the officers were in the same condition.

But all ill fortune, as all good fortune, must at some period come to an end, and so it happened that the next day the wind shifted to the south, and with strong and favoring gales the old ship went rapidly north under a press of canvas, and in ten days was safely anchored in the harbor of Valparaiso. And so ended the *Narragansett's* winter voyage through the Straits of Magellan.

ADMIRAL R. W. MEADE, U. S. N.

When the principal contents of this number of The National Geographic Magazine were sent to the printer there was no indication that the gallant and accomplished author of the article "A Winter Voyage through the Straits of Magellan" would have completed the long and eventful voyage of life before his stirring narrative of one of the most interesting portions of his famous cruise in the *Narragansett* could be placed in the hands of our readers. On the first of May, however, he succumbed to the effects of a surgical operation, from which he had been supposed by his friends to have permanently rallied. It is impossible, on the eve of going to press, to present more than the briefest outline of Admiral Meade's distinguished career or to render adequate tribute to his memory. It must suffice to remind our readers of his brilliant career at college; of his becoming navigating officer of the *Cumberland* before he was 19 years of age; of his command of a naval division, engaged with the enemy, before he was 25; of the dauntless courage, good judgment, and unfailing skill that won for him, time and again, the commendations of his superior officers; of his historic cruise of 60,000 miles, mainly under canvas, in the *Narragansett;* of his success as a professor of seamanship and naval tactics; of his numerous contributions to periodical literature, and of his ever-welcome appearances before the National Geographic Society, of which he was an active member. The accompanying article contains an allusion, which we cannot regard as without significance, to "the Providence which watches over poor Jack." Himself handsome, courageous, true-hearted, and patriotic, we can say of Admiral Meade, in the words of Dibdin's grand old sea-song:

"His form was of the manliest beauty,
His heart was kind and soft;
Faithful below he did his duty,
And now he's gone aloft."

J. H.

COSTA RICA

By Señor Ricardo Villafranca,

Consul-General of the Republic of Costa Rica at San José, Guatemala

It is impossible to give within the space allotted to me a complete idea of Costa Rica, or to describe explicitly its varied resources and industries. I can but dwell briefly on the more important features of the land, the characteristics of the people, and the natural resources of the country.

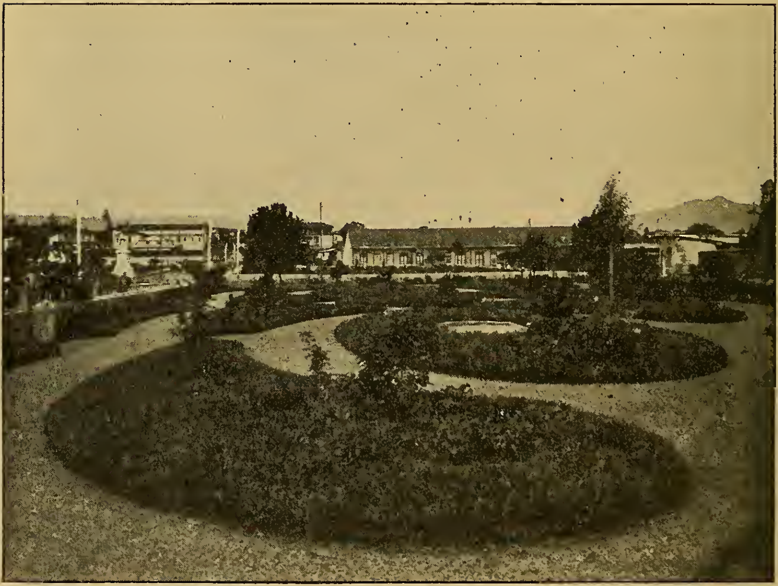
The peculiarly favorable situation of Costa Rica might well be the envy of all nations, for it lies between the continents of the new world and between the earth's greatest seas; it enjoys a temperate climate, with the advantages of a tropical sun; it is one of the smallest of small nations—the true gem of American republics; its people are peaceful and law-abiding; its republican form of government, copied from the United States, is very popular; its climate is moderate, without extremes of heat or cold, and is remarkably healthful. The dreaded fevers are found only along the swampy coastal fringe and other low-lying land, of which there is little in Costa Rica. Against visionary dangers we have a land of prolonged spring and autumnal splendor—a soil upon which the flowers smile with perennial bloom.

Costa Rica is feeble for want of sufficient population, but she possesses a rich store of undeveloped resources in her widely disseminated minerals and the endless productions of her fertile soil. Her forests are an incalculable natural wealth. Throughout the country the land is thickly covered with gigantic trees, among the finest in the world, and all are of a rare quality, such as mahogany, cedar, rosewood, lignum-vitæ, and a number of dye-woods, such as anatto and indigo. Little attention has been given to the forest wealth. Along the seashore, where transportation is easy, some woods have been marketed, but in the interior the trees stand as they did a hundred years ago.

In the Matina valley the Matina Banana Company is working an extensive plantation and paying large dividends. The extent of this industry cannot be appreciated except at the shipping stations. Hundreds of cars are loaded every day, and the number of boats loaded with bananas far surpasses those carrying any other freight. The harvest never ends. From January to December there is a continuous cutting and marketing. One sees at the same time the budding blossoms, the young fruit, and the fully developed bananas.

Those who have seen cotton plants elsewhere, rarely attaining the height of a man, are ill prepared to see cotton trees growing to the height of 12 feet, with numberless branches, which are tipped by the snowy down. There is nothing that more clearly proves the fertility of Costa Rican soil. The bread-fruit tree is also a wonder to northern visitors. The tree is tall and massive; its branches are innumerable; its leaves large, resembling fig leaves, and the characteristic bread-fruit, of a greenish yellow color, is the size and shape of a cantaloupe. The fruit—fried, boiled, and baked, very much like potatoes—forms one of the staple foods of the working people.

The Costa Rica-Nicaraguan and Panama canals are such important projects that the nations of the earth must sooner or later complete them. Costa Rica, occupying almost entirely the territory between the two proposed canals, will ere long reap the benefit of such an unparalleled position. The Nicaraguan canal



LIMON, COSTA RICA, FROM THE PARK

will be the final event which shall make Costa Rica the true gem of American republics.

Only a few years ago a few shanties marked the present site of Limon, which today is one of the most important cities fanned by the Caribbean breezes. Rare tropical trees in the distance overshadow the most elaborate buildings, which are as a rule low; the regular streets are well kept, and the churches neat and well attended. In Central American cities great prominence is given to churches, but at Limon they are not as elegant as in more typical cities. Here foreigners are numerous, and the native population is neither wealthy nor important, but the places of worship and many of the buildings are of foreign design and foreign material. Limon has a distinctive appearance, not unlike southern settlements in the United States. English is the prevailing language, and English-speaking people conduct most of the business.

Nearly one-third of the population of the country is in the province of San José, a broad expanse containing the main coffee plantations, at short distances from the principal cities, where the owners generally live. The wealthiest, most prosperous, and most conservative of the towns are Heredia and Alajuela, which are connected with the capital by a railroad. What we shall say about San José applies more or less to all Costa Rican cities. In this magnificent neighborhood the country is studded with fruitful plantations. Here the true population of Costa Rica dwells, since here are found the hardy, simple toilers, who wrest from the earth its agricultural products—the true wealth of the soil. An air of ease combined with antique simplicity characterizes the majority of these villages. The city of San José at once gives the impression of thrift, not unlike the cities of the United States. The traveler sees two-story houses, wide sidewalks, and electric lights. In the center of Walker's park has recently been placed a handsome monument to commemorate the defeat of the filibuster Walker. Educational facilities are excellent: there are high schools, a school of law, several colleges, public libraries, etc. It is safe to say that the number of teachers in Costa Rica far exceeds the number of soldiers. The well-kept hotels, like most private residences, are built around a beautiful courtyard, from which every room in the house receives moist, cool air charged with natural perfumes of carefully cultivated flowers. Costa Ricans mingle work and play in the most delightful way; in the cities amusement is often considered more important than business, and means of recreation are abundant. San José has a modern theater not equaled in Central America.

The Roman Catholic churches in San José, Heredia, and Alajuela are excellent indications of the wealth of the country. These churches, and particularly the Cathedral of San José, are of a design and finish that are rarely surpassed in Spanish America. The people may at times go barefoot and hungry, but the priests never lack enthusiastic support.

The home of the Costa Rican is the true pivot of life and the center of all pleasure. The houses are built around the ever-present courtyard, a garden spot which is carefully cultivated.

THE CATHEDRAL AT SAN JOSE, COSTA RICA

In it one finds flowering plants in full bloom throughout the year, and from it every room of the house has a never-ceasing current of air charged with a delightful odor.

Everybody in Costa Rica who has money and some ambition is either directly or indirectly interested in farms. The gentleman farmers are the rulers of the land. Coffee farming is the primary industry, since Costa Rican coffee has become famous and commands very high prices. Almost anywhere within a radius

A STREET IN SAN JOSE, COSTA RICA

of fifty miles one can find coffee farms, either in their infancy or in full development, with shade trees to protect the young plants. Coffee plants in bloom are among the most beautiful sights in nature. Three years after the planting of the young coffee bush it bears its first fruit. The crop increases until the eighth year; after that, for fifteen years, the crops are more or less even. In the first weeks of December the berry is of a bright red color, which indicates that the coffee is fully ripe. Every man, woman, and child is pressed into the service of picking coffee, and with a basket swung from the waist, picks from sunrise to sunset. This operation is a delicate one, and is watched very closely to prevent the leaves from being broken, as the next crop starts from the angle formed by the leaf and branch. The fresh coffee is transported by ox carts, passes through a machine that breaks the outer skin, and is then placed for twenty-four hours in water, until the syrup-like substance that has adhered to the grains is washed away. After it has been washed, the coffee is spread out on a cemented court into smooth beds. Here it remains during the sunshine, but at night and during cloudy days it is gathered into heaps and covered with canvas. The process of spreading and gathering together is continued until the coffee is thoroughly dry. During this operation no planter neglects to place sentinels around the coffee court, since coffee even in Costa Rica is worth 40 cents a pound, and a single individual might carry away several hundred dollars' worth of it in a few hours. When dry the coffee is sacked and transported to the factory, where an elaborate process by modern machinery prepares it for the market. The final work is the separation of the black, small, and imperfect berries and classifying them. They are called first, second, third, and fourth classes, and the well-known caracolillo or peaberry. This is done by a machine having a long center cylinder, with openings of various sizes that correspond with the different classes of coffee. From this machine the berries are transferred to large tables, where girls pick out by hand any impurities not removed by the machines. The coffee is then sacked and marked; each bag weighs 132 pounds. Now that the coffee is ready for export and marked "Hamburg," "Liverpool," etc., a question naturally arises, Is there any marked "New York," "New Orleans," or "Baltimore"? I have to answer with deep regret that very little is marked that way, the bulk of the crop being bought by European firms, who send their agents several months in advance of harvest time, either to buy outright or to furnish funds, with liberal conditions, to farmers who agree to consign their crops. American merchants make very little effort to secure the products of Costa Rica or to furnish its markets with the manufactured articles which are produced in the United States.

Time does not permit me to speak of other agricultural productions. Costa Rica is capable of producing not only coffee, bananas, cocoa, and sugar-cane, but northern fruits and vegetables. There we find peaches, apples, quinces, strawberries, and grapes, as well as tomatoes, cabbages, potatoes, corn, wheat, and other cereals. Costa Rica heretofore has not produced enough meat for home consumption, but this is not because cattle will not thrive there; it is because few intelligent attempts have been made. There is abundance of water, a perpetual verdure, and no winter necessitating feeding. Cattle of every kind and variety thrive beautifully, and that without any attention or care. Although stock farming is new and people are ill prepared to raise cattle, yet the results are excellent. Even sheep, the last animal in the world that one would expect to do well under a tropical sun, thrive and multiply with remarkable success.

Not far from these farms are several peculiar natural springs. The most popular and interesting thermal springs today are those of Agua Caliente, which are frequented by the wealthy citizens of Costa Rica and by foreign visitors. These springs, like most natural waters, are said to be good for nearly all human ailments, but it is certain that they cure rheumatism and skin diseases. One finds among them waters hot enough to boil an egg and of a strong sulphurous odor, while, on the other hand, there are others extremely cold.

One of the unique primitive structures of the country, which portrays the characteristic ingenuity of early settlers, is the bridge made of *bejuco*, a native vine-like growth, noted for its great strength, to be noticed hanging from large trees. This strange substance is made into a rope which is hung from convenient trees near the banks of the river. The peculiar sensation experienced while crossing is far from a feeling of safety: with every step the dry, woody ropes crack and the bridge moves not only up and down, but sidewise, forward, and backward.

Entering the Indian reservation of Talamanca, fine views greet the eye of the traveler. Here are the farm-houses of half-breeds; there, colossal cocoanut trees, with large leaves, of which the roofs and sides of huts are made. The true Indian house is built on the bee-hive plan, and its framework of vine rope is thatched by palm and cocoanut leaves. Its external appearance is artistic, and the people are comfortable within. The Indians are completely isolated from civilization, are peaceful, and never give the government trouble. The men are usually well built and the women are patient and gentle. They are very thinly clad, as the climate is such that clothing is the least of their wants and is worn only with an idea of adornment. Most clothing is of the local cotton, colored by home dye-roots and certain kinds of shells. Their beds are placed on platforms well up under the roof. The floor is the naked earth. Hammocks are strung about, always occupied, for Costa Rican Indians are not fond of work. The most interesting character in Talamanca is Antonio Sandano, the king, to whom the government accords the absolute sovereignty of the Talamanca Indians.

The rainfall of Costa Rica is somewhat greater than that of the United States. There is a dry season and a wet season every year, but the rains are never constant, nor are they ever entirely

IN TALAMANCA, COSTA RICA

absent; indeed, the atmospheric moisture is reliable and droughts never affect plants. It is well to become acquainted with a fact that seems rather curious in reference to rain; it is the one that attracts the attention of foreigners, who in visiting Central America expect to see rain pouring down constantly. The rain begins at about 2 o'clock in the afternoon, continuing from a half hour to three hours. But what rain! It seems as though the dikes of the heavenly reservoirs had been torn asunder. Another peculiarity still, when it rains on the eastern slope it is clear on the western, and *vice versa*.

To visit the successful mining camps in Costa Rica one has to ride over rough roads, crossing bridgeless rivers, and traversing thick forests, where mahogany, cedar, rubber, and other tropical trees cover the earth and screen the skies. The journey is long and at times tiresome, but to see gold at the end of the journey mingling with the best of mother earth more than repays for the discomfort of travel. Here is a region of incomparable mineral richness, but up to the present the mines have been worked in a most primitive way, necessitating great labor and expense. With the importation of new labor-saving machines and improved mining methods there is no doubt that we shall soon see golden streams flowing from the depths of Costa Rica.

Throughout the Republic transportation is largely conducted by caravans, with ox teams as the motive power. The carts are heavy, primitive vehicles made by the peasants, the wheels being solid circular disks cut from the stems of large trees. The oxen are always objects of regard, as their drivers and owners have an almost supernatural love for them, and often prize them more than they do their own wives.

The railroad from San José to the Pacific coast is partially completed and passes through a fertile agricultural country and several towns, among them Alajuela, with its extensive market. At Alajuela we leave behind us the train and reach Esparta, twelve miles away from Puntarenas, by mules. From Esparta, one of the oldest towns in Costa Rica, we again take the train to Puntarenas. This is the principal seaport on the Pacific and is connected by steamer with San Francisco.

It must be plain that Costa Rica offers industrious immigrants exceptional advantages. Men who can begin life on a plantation or in one of the many industries with a few hundred dollars can in a few years accumulate a reasonable property, secure a permanent home in a region surpassed nowhere in the world for healthfulness, and lay the foundation for an estate which is certain to increase rapidly in value. Costa Rica is indeed a land of promise to all interested in securing for themselves a future prosperity; it is a land upon which greater nations will ere long be casting their ambitious eyes.

[The illustrations accompanying the foregoing article are from photographs kindly placed at the disposal of the editor by Señor Don Joaquin B. Calvo, Costa Rican Minister Resident at Washington.]

APPLIED PHYSIOGRAPHY IN SOUTH CAROLINA

By L. C. Glenn

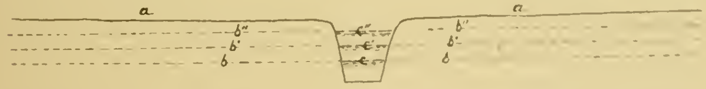
An interesting physiographic change is now going on in much of the Piedmont section of South Carolina and other cotton-growing states, the consequences of which are becoming grave to the owners of the soil and are threatening soon to result, unless checked by a proper observance of physiographic laws, in the destruction of much of the most fertile land of the region—a destruction already wrought in many cases. The change referred to is the exceedingly rapid aggradation by the streams as a result of a system of farming that has recently come into vogue in that region.

This Piedmont section is an old peneplain that has been uplifted and is now well dissected by the many streams that have cut their way down into the plateau from fifty to a hundred and fifty or more feet below the general level. In some places rapids and falls still occur, but for the most part the streams are at grade and rapid down-cutting has ceased, while lateral swinging has widened the valleys and bordered the banks with large tracts of rich alluvial "bottom land." On these bottoms chiefly the corn of the country has heretofore been raised, while the hill-sides and interstream upland are devoted to the culture of cotton.

Before the first settlement of the country the forest-clad slopes furnished waste to the streams very slowly and they were able to erode for themselves deep channels and keep their valley floors well drained. Although the country has been settled over a hundred years, the system of farming common before the war did not so materially increase the amount of waste furnished to the streams from the hill slopes as to overload them and endanger the fertility of the bottoms. When a field became too poor for profitable cultivation it was turned out to grow up in old-field sedge and fresh land was cleared. In this way either much of each stream basin was in original forest or vegetation covered old fields, both of which fed the rainfall to the streams slowly and furnished only a moderate amount of waste.

Since the war the use of commercial fertilizers has become general in this region. By their application these worn-out old fields have again become capable of producing paying crops and have been plowed and planted in cotton. The successful growing of this crop requires such clean culture that, in the almost total neglect of crop rotation, the soil is soon deprived of nearly all its vegetable matter, while the cotton plant furnishes far too few root fibers to hold the soil together and prevent it from washing down into the valleys. When to this is added the fact that terrace plowing is almost unknown, it is readily seen that the rain falling on these slopes rapidly gathers into hillside gullies and quickly finds its way down to the effluent stream, carrying with it an immense amount of detritus. The stream is now overloaded, and does the only thing possible under the circumstances—it drops the portion of its load that it is unable to carry. Thus the channel that of old was often five to ten feet deep is soon filled until it is scarcely more than twice so many inches in depth. With every heavy rain the stream now overflows its banks, covers the rich flood-plain soil with barren sand, and spreads desolation over almost its entire area. In the case of small streams the waste has been showered down from the valley sides during heavy rains in such quantities as, in many instances, to completely fill the stream's channel and leave it to wander as an outcast hither and thither over the surface which it formerly drained and rendered fertile, but on which it now aids in producing marshes and malaria—in just retribution, as it were, for its owner's neglect of physiographic laws.

It might be well to note more fully the regular cycle of change through which the flood-plain passes before assuming the completely wasted state. As the stream bed begins aggrading, overflows become easier and hence more frequent; the mouths of the artificial drainage ditches leading from the flood-plain into the stream channel soon silt up; the drainage becomes poor, and as a consequence the land is longer after overflows in becoming sufficiently dry for cultivation. As the aggradation



gradually raises the stream surface nearer the surface of the flood-plain (c, c', c''), the water level in the land on either side of the stream rises, *pari passu*, nearer the land surface (b, b', b'') and thus constantly decreases the distance through which capillary attraction must act in raising water to the plant roots, and hence makes the land wetter and wetter until finally the culture of corn must be abandoned. Though now too wet for cultivation, the land may yet for a short time furnish a rather poor meadow, since comparatively little of the rich alluvial surface has yet been covered by the sand, most of which has been disposed of in filling the stream channel. It is as though the stream realized its inability to directly attack the surface at first and so turned its attention to preparations for a more effective attack a little later by filling its channel with sand and thus placing itself in a position to rapidly complete the work of destruction when it has once actively begun. When it has built up its bed almost even with the flood-plain surface level this work of preparation ends and the work of direct destruction begins. Every overflow now cuts channels that lead away from the main stream, and spread sand far and wide over the plain, burying the fertile soil. As the depth of the sand increases, the flood-plain becomes more barren, until it is finally a waste of sand thinly overgrown with nettles and other sand-loving plants, while willows fringe the branching channels of the wandering stream, and here and there along the margins of the wasted plain and in other chance low places water collects and forms marshes that are soon overgrown with reeds and rushes. The cycle of destruction is now complete.

Thus in some sections much of the formerly fertile "bottom land" has already been abandoned as worthless, much more can scarcely be cultivated profitably, while but little is so favorably situated as to escape entirely the ruinous effect of the continual clean cultivation of the hill slopes.

The remedy for this destruction is so simple and self-evident to the student as hardly to require statement; the cotton crop must be rotated with some crop that will furnish an abundance of root fibers to hold the soil together and prevent it from washing, and the hill slopes must be terrace-plowed. If this is done the degradation of the hill fields and the aggradation on the bottom fields will be checked; if this is not done all the most fertile land will soon become but barren wastes.

Mention may be made of a lake of aggradation of the Red river (Louisiana) family, to be found in the northwestern part of Fairfield county, S. C., since it is due to the same general cause. From a broad open valley there runs back into the upland a broad side valley that contained a weak stream draining but a small area. When the master stream began aggrading, it set a pace with which the side stream could not keep up. Its mouth was sealed up, and it was forced to lake itself before gaining an exit, thus covering to a depth of eight or ten feet a considerable area that before the war had been planted in corn.

SHEIK SAID

The Société de Geographie, of this city, has just published a fine map of Africa. On looking over it I noticed that Sheik Said, on the south coast of Arabia, was given as French territory. This surprised me, as Philip's map of the Nile valley gives it as an English possession, making Aden the center of a large territory, extending to and including Sheik Said. On consulting a German map I found it given neither as English nor French, but as a part of the province of the Yemen, and therefore Turkish. I then called on M. Gauthiot, general secretary of the Commercial Geographic Society, who informed me that it was positively French territory, although wrongfully occupied by a Turkish garrison. M. Gauthiot having suggested certain authentic sources of information, I proceeded to make further investigations, and in view of the growing interest in eastern affairs I venture to submit the result to the readers of The National Geographic Magazine.

The territory of Bab-el-Mandeb was well known in antiquity. On its southern side was the important port of Okelis. The fall of the Roman power in Egypt and the Red sea brought also that of Okelis, whose ruins are still visible, and trade with India went by way of the Persian gulf. When, under the Sultan Selim the First, the Red sea regained its importance, it was Aden that was selected as the chief port. Since the downfall of the Kalifate the territory of Bab-el-Mandeb has been left to govern itself. It is inhabited by the tribe of the Akemi-ed-Dourein, who have always held their independence against the Turks. This independence was indirectly recognized both by Turkey and by England. It was of the sheik of the Akemi-ed-Dourein that the governor of Aden asked permission to dig wells on the territory of Bab-el-Mandeb to obtain water for the garrison of Perim. A Turkish vessel having been wrecked on the Arabian coast south of Mokha, it was to this same sheik that her owner applied for help. In 1863 an English vessel was wrecked on the coast of Bab-el-Mandeb and looted by the natives. The English governor of Aden applied to the kaimakam of Mokha for redress, but the kaimakam said he could do nothing, as the Turkish authority did not extend south of Mokha

In October, 1868, the firm of Raband & Bazin, of Marseilles, entered into negotiations with the sheik of the Akemi-ed-Dourein, Ali Tabatt, and purchased from him a part of the territory of Bab-el-Mandeb, including the bay of Sheik Said and about 400,000 acres of land adjoining. Naturally England did not like to see France take possession of so important a strategic point, but, not wishing to openly oppose France, she is said to have stirred up Turkey to claim it as included in her dominion. Accordingly a small Turkish garrison landed in Turks' bay to take possession of Sheik Said, but, warned by the French consul at Aden, the French ship *Bruat* was immediately dispatched to protect the small colony of Sheik Said. Early in 1870 the firm of Raband & Bazin erected a two-story building and began to lay in coal supplies. A few weeks later the

Franco-Prussian war broke out, and England, having declared her neutrality, refused to allow French ships to coal at Aden. The French government then officially took possession of Sheik Said by making it a coaling station and a refuge for French warships. After the treaty of Frankfort Sheik Said was abandoned. Raband & Bazin continued to occupy it for some time, but finally withdrew, after lodging a declaration as to their rights and ownership with the Turkish authorities. In 1884 the French press again took up the subject, and the government sent out some surveyors and engineers, who found the place occupied by a Turkish garrison. In 1885 the Turkish government officially announced its occupation by a notice published in a newspaper of Sana, the capital of the Yemen.

It is very evident that the occupation—I mean a thorough military occupation—of Sheik Said would be of the highest importance to France in view of the enormous development of her colonial empire, and especially of England's continued occupation of Egypt. The way to the Indian ocean and the far East has become almost as important to France as it is to England, and it is hardly fair that one nation should possess all the keys to the gates of the famous waterway to the exclusion of all other nations. France's present occupation of the territory of Obok, on the west side of the Straits of Bab-el-Mandeb, with the port of Djibouti, is very good as a commercial position, but as a strategic point it can only acquire importance by the addition of Sheik Said on the east side.

This incident of Sheik Said furnishes an example of inaccurate map-making by men who are apparently more zealous and patriotic than learned and accurate. Whatever may be said of the claims of France to the territory in question, it does not appear that England has ever had the shadow of a claim to it, and Mr Philip ought to know that the use of a brush and some color to make a territory appear to be either English, French, or Turkish, according to one's patriotic ambitions, does not make it so. Geographers ought certainly to stick to official facts and not mislead by marking on their maps unofficial and inaccurate boundaries.*

Ernest de Sasseville.

Paris, *April 12, 1897.*

GEOGRAPHIC LITERATURE

Bulletin of the Department of Labor. No. 9. Edited by Carroll D. Wright, Commissioner; Oren W. Weaver, Chief Clerk. Pp. 109–236.

Rand, McNally & Co.'s Road Maps and Cycling Guide to Westchester County, New York. Chicago and New York: Rand, McNally & Co. 50 cents.

Magnetic Declination in the United States. By Henry Gannett. From the Seventeenth Annual Report of the U. S. Geological Survey. Washington, 1896. Pp. 203–440, with map and diagrams.

Statistical Abstract of the United States. 1896. Nineteenth number. Prepared by the Bureau of Statistics, under the direction of the Secretary of the Treasury. Pp. XII + 400. Washington, 1897.

*In the Times Atlas, London, 1896, Sheik Said is distinctly marked as a French possession. J. H.

The Foreign Commerce and Navigation of the United States for the year ending June 30, 1896. Prepared in the Bureau of Statistics, U. S. Treasury Department. Worthington C. Ford, Chief of Bureau. Vol. I, pp. I–CXLVII + 1–760; vol. II, pp. 761–1432.

It is rarely that the bimonthly Bulletin of the Department of Labor fails to present some useful contribution to the literature of economic geography. Two articles in the March number are worthy of note in this connection: The Padrone System and Padrone Banks, by John Koren, and The Dutch Society for General Welfare, by Prof. J. Howard Gore, Ph. D., of the Columbian University.

Nothing could better illustrate the extraordinary popularity of cycling than the publication for the express use of wheelmen of the attractive handbook and large-scale road maps of Westchester county, New York, recently issued by Rand, McNally & Co. While the easy accessibility to an immense population of the interesting and delightful region described will no doubt fully justify the publishers in their venture, the publication is none the less a notable one and worthy of high commendation.

Henry Gannett, whose versatility of mind as a geographer, statistician, and diligent investigator in many other lines of scientific inquiry is continually enriching our technical literature, has compiled for the Annual Report of the Geological Survey an elaborate series of tables and diagrams relative to the variation of the compass. While the chief aim of the author has been to show the approximate declination for the year 1900 at 22,000 different points in the United States, he gives us an interesting historical review of the secular variation and briefly notices the various other changes to which the magnetic declination is subject.

The high standard of excellence that has characterized the publications of the Bureau of Statistics of the Treasury Department under Mr Worthington C. Ford is fully maintained in the Report on the Foreign Commerce and Navigation of the United States for the fiscal year 1895–'96 and in the new number of the Statistical Abstract. The latter is more comprehensive and correspondingly more valuable than ever before. In a country whose official statistical publications are as voluminous as those of the United States, such an abstract is indispensable, and the provision made by Congress for its publication should be such as to admit of a careful analysis of such statistical data as may from time to time become available and of an absolutely accurate presentation of them in a summarized form.

J. H.

GEOGRAPHIC SERIALS

The Journal of the Royal Colonial Institute for April contains a valuable paper on "The Dairy Industry in the Colonies," by Mr Samuel Lowe.

The Scottish Geographical Magazine for April contains an excellent physical and political description of Ceylon by Mr L. B. Clarence and an historical article treating of "The British in South America" by Colonel Howard Vincent.

The Geographical Journal for April contains several articles of interest, including "The First Crossing of Spitzbergen," by Sir W. Martin Conway; "Two Years' Travel in Uganda, Unyoro, and on the Upper Nile," by Lieutenant C. F. S. Vandeleur; "The Southern Borderlands of Afghanistan," by Captain A. H. McMahon; "The Perso-Baluch Boundary," by Colonel Holdich, and "The River Oder." The last article of the volume is by Professor A. W. Andrews on "The Teaching of Geography in Relation to History." This article has a special interest to members of the National Geographic Society, inasmuch as it is in line with the course of afternoon lectures recently completed.

The Journal of the Manchester Geographical Society, January–March, opens with an article entitled "The Mendi Country and Some of the Customs and Characteristics of its People," by Rev. William Vivian. This is a little known region between Sierra Leone and Liberia. Sir W. Maxwell contributes an article on the Results of the Ashanti Expedition in 1895–'96, which is supplemented by a description of the Niger River and Territories, by Major Hampden Jackson. The work of the Hausa Association is summarized by Rev. W. Robinson, in a paper read at the Liverpool meeting of the British Association and published here. The Botany and Zoölogy of Uganda and other parts of Equatorial Africa are the subject of papers by Rev. F. C. Smith, and the number concludes with an excellent article on Queensland, by General Sir Henry W. Norman.

The *Transactions of the Liverpool Geographical Society* for the year 1896 include several interesting and valuable papers. The first, entitled "Railways in Africa," by Major Darwin, describes not only the existing lines of railway, but the lines of water communication and the railway routes needed in the future. Miss M. H. Kingsley writes on the "Ascent of Cameroons Peak and Travels in French Congo," the narrative of an interesting journey. Mr Gray Hill writes the narrative of "A Journey to Petra," and Mr W. A. L. Fletcher of "A Journey Toward Llassa." Mr J. C. Ernest Parkes gives a short description of "The Man-Eating People of the Imperri," and Mr James Irvine furnishes a "Description of the Kingdom of Benin," written about the year 1630 and abridged from the folio edition of John Ogilby, published in 1670. The volume closes with a summary of the scientific results of Dr Nansen's North Polar Expedition, by Professor Mohn.

The April *Bulletin of the American Geographical Society* is an exceptionally interesting number. Mr Cosmos Mindeleff writes on "The Influence of Geographic Environment," discussing its application to the Pueblo Indians of New Mexico and Arizona. Dr George M. Dawson summarizes, in two and one-half pages, the "Geographical Work in Canada" in the year 1896. Professor R. S. Tarr continues his series of papers on "The Physical Geography of New York State." Mr James Douglas furnishes an historical article entitled "The Consolidation of the Iroquois Confederacy," and Mr Francis C. Nicholas contributes a paper upon the "Economic Importance of Geological and Physical Conditions in Tropical America." The Washington letter of Mr F. H. Newell contains an admirable summary of the situation regarding forest reserves. The "Record of Geographical Progress" is exceptionally full, and this, with Map and Book Notices, closes the number.

Among the recent publications in the Johns Hopkins University Studies is one entitled "The Street Railway System of Philadelphia, its History and Present Condition," by Dr Frederic W. Speirs. The street railway system in that city commenced in 1858, when the first line was opened. The history of the development of the system was probably very similar to that of other American cities, extensions being sought by railway companies and promoters and strenuously opposed by the majority of the people living upon the threatened streets. In 1876 the system had grown until it comprised 289 miles, operated by 17 separate companies, which were associated in a pool, under the control of a board of railway presidents. In 1880 the current began to set strongly toward monopoly, and the movement went on, until in 1895 all the mileage of the city, amounting to 430 miles, was in the hands of four companies, and in 1896 the Union Traction Company, a new company formed for the purpose, obtained control of all the lines of Philadelphia, with the exception of one short line, 24 miles in length, the Hestonville, Mantua and Fairmount road. Besides giving a history of the lines, the paper treats *in extenso* of the financial aspect of the system, the price of franchise privileges, the principal item of which is the paving of the streets, estimated by the Bureau of Highways at $9,000,000. It contains a chapter on the public control of the railway system and upon municipal ownership and corporate influence in the city government. "The Relations of the Railways to their Employés" is treated in a separate chapter.

H. G.

PROCEEDINGS OF THE NATIONAL GEOGRAPHIC SOCIETY, SESSION 1896-'97

Special Meeting, March 29, 1897.—Fifth Monday afternoon illustrated lecture. President Hubbard in the chair. Prof. Benj. Ide Wheeler, of Cornell University, lectured on Greece.

Regular Meeting, April 2, 1897.—Vice-President Gilbert in the chair. Mr H. M. Wilson and Mr Isaac Winston described instruments and methods used in spirit-leveling by the U. S. Geological Survey and the U. S. Coast and Geodetic Survey respectively. Illustration by instruments, maps, and diagrams.

Special Meeting, April 5, 1897.—Sixth Monday afternoon illustrated lecture. President Hubbard in the chair. Rev. Dr Alex. Mackay-Smith lectured on Rome.

Special Meeting, April 9, 1897.—President Hubbard in the chair. Vice-President Merriam read a paper, with lantern illustrations, on the Effects of Geographic Environment on Animal Life.

Special Meeting, April 12, 1897.—Seventh Monday afternoon illustrated lecture. President Hubbard in the chair. Prof. Edwin A. Grosvenor, of Amherst College, lectured on Constantinople.

Regular Meeting, April 16, 1897.—Secretary Gannett in the chair. The paper for the evening was on the Secular Variation of the Magnetic Declination in the United States, by the chairman, with maps and diagrams, followed by an address by Mr G. W. Littlehales on the Magnetic Compass in Modern Navigation.

Special Meeting, April 19, 1897.—Eighth Monday afternoon illustrated lecture. President Hubbard in the chair. Prof. Wm. H. Goodyear, of the Brooklyn Institute of Arts and Sciences, lectured on Venice and Genoa.

Special Meeting, April 23, 1897.—President Hubbard in the chair. Dr T. C. Mendenhall, President of the Worcester Polytechnic Institute, lectured, with lantern illustrations, on Weighing the Earth.

Special Meeting, April 26, 1897.—Ninth, and last, Monday afternoon illustrated lecture. President Hubbard in the chair. Dr David J. Hill lectured on America. After the lecture a number of lantern illustrations of American scenery were thrown on the screen by Mr B. P. Murray.

Regular Meeting, April 30, 1897.—President Hubbard in the chair. Hon. Martin A. Knapp, Commissioner of Interstate Commerce, read a paper, with lantern illustrations, on Some Geographic Effects of Modern Methods of Transportation.

Elections.—*March 26.*—J. M. Boutwell, Pay-Inspector A. Burtis, U. S. N., Col. R. M. Calhoun, Lieut. G. B. Harber, U. S. N., E. T. Parsons, Louis R. Peak, Powhatan Robertson, Hon. N. D. Sperry, Wallace Streator.

April 9.—Capt. John Callahan, Rev. Asa S. Fiske, Miss L. N. Forrest, Lieut. F. M. Kemp, U. S. A., Mrs Porter King, W. A. McFarland, Wm. A. McKenney, Dr Grace Roberts, Miss Grace C. Sheldon, Miss Mary A. Spencer, Julius Ulke, Jr.

Deaths.—Major Charles E. Bendire, U. S. A.; Rear-Admiral Richard W. Meade, U. S. N.

MISCELLANEA

The map of the United States published by the General Land Office in 1896 represented in broad lines the original territory of the United States and the several accessions made to it by purchase or otherwise. Among the mistakes perpetuated by this map is that of representing "Oregon," *i. e.*, the present states of Oregon, Washington, Idaho, and part of Montana, as a portion of the Louisiana purchase. This mistake is taken as a text by Colonel James O. Broadhead for a critical review entitled "The Louisiana Purchase; Extent of Territory Acquired by the Purchase," published by the Missouri Historical Society. Colonel Broadhead shows most conclusively that Louisiana extended on the northwest only to the limits of the Mississippi drainage basin. The conclusion is not a new one, but we are obliged to Colonel Broadhead for many new items of evidence. If anything were needed to settle the matter beyond peradventure, the proofs which he brings forward should be conclusive.

H. G.

CHESAPEAKE & OHIO RY.

THE F. F. V. LIMITED is one of the finest trains hauled over any railway track in America. It runs solid between Cincinnati and New York, the route from Washington being over the Pennsylvania system. It has every modern convenience and appliance, and the dining-car service has no superior if it has an equal. The road-bed is literally hewed out of the eternal rocks; it is ballasted with stone from one end to the other; the greater portion is laid with one-hundred-pound steel rails, and although curves are numerous in the mountain section, the ride is as smooth as over a Western prairie.

One of the most delightful rides in all the route is that through the New River valley. The mountains are just low enough to be clad with verdure to the very top, and in the early spring every variety of green known to the mixer of colors can be seen, while the tones in autumn take on all the range from brown to scarlet.

These facts should be borne in mind by the traveler between the East and the West.

H. W. FULLER, *Genl. Pass. Agent, Washington, D. C.*

NORTHERN PACIFIC

LAKE CRESCENT

TROUT FISHING EXTRAORDINARY.

NEW species of trout in a new region. If you care for fine TROUT FISHING, by all means visit LAKE CRESCENT.

Go and tussle with the famous BLUE BACKS that weigh eleven pounds and more, and are thirty inches in length.

The Lake is easily reached from PORT ANGELES, Washington.

Send **Six Cents** for our new WONDERLAND '97 and read about the spot.

CHAS. S. FEE, Gen. Pass. Agent, St. Paul, Minn.

OLYMPIC RANGE

SOUTHERN RAILWAY

GREATEST SOUTHERN SYSTEM.

Penetrates with its main line or branches eight States South of the Ohio and Mississippi Rivers, and in conjunction with its friendly allied connections reaches all the commercial centers of the South and Southwest . . .

DOUBLE DAILY VESTIBULED LIMITED TRAINS

. . . BETWEEN . . .

Washington and Nashville via Salisbury, Asheville, Knoxville and Chattanooga.
Washington and Tampa via Columbia, Savannah and Jacksonville.
Washington and Memphis via Atlanta, Birmingham and K. C. M. & B.
Washington and New Orleans via Atlanta, Montgomery and Mobile.
Norfolk and Chattanooga via Salisbury, Asheville and Knoxville.

Pullman Sleeping Cars—Dining Cars—Day Coaches.
Additional Trains for local travelers . . . .

The direct line to the Winter Resorts of { FLORIDA, GULF COAST and TEXAS, ... MEXICO and CALIFORNIA,

—AND THE BEST—

Through Car Line to and from Asheville and Hot Springs—"The Land of the Sky."

Write for Map Folders.

R. D. CARPENTER, General Agent, 271 Broadway, New York City.
L. S. BROWN, General Agent Passenger Department, Washington, D. C.
J. H. WINGFIELD, Passenger Agent, Norfolk, Va.
S. H. HARDWICK, Assistant General Passenger Agent, Atlanta, Ga.
C. A. BENSCOTER, Assistant General Passenger Agent, Chattanooga, Tenn.
W. H. TAYLOE, Assistant General Passenger Agent, Louisville, Ky.
J. M. CULP, Traffic Manager. W. A. TURK, General Passenger Agent.

The Mutual Life Insurance Co.

OF NEW YORK,

RICHARD A. McCURDY, President,

Is the Largest Insurance Company in the World.

The Records of the Insurance Department of the State of New York SHOW THAT The Mutual Life

Has a Larger Premium Income - - -	($39,000,000)
More Insurance in Force - - - - -	($918,000,000)
A Greater Amount of Assets - - - -	($235,000,000)
A Larger Annual Interest Income - - -	($9,000,000)
Writes More New Business - - - -	($136,000,000)
And Pays More to Policy-holders - -	($25,000,000 in 1896)

THAN ANY OTHER COMPANY.

It has paid to Policy-holders since its organization, in 1843, - - $437,005,195.29

ROBERT A. GRANNISS, Vice-President.

WALTER R. GILLETTE, General Manager. FREDERIC CROMWELL, Treasurer.
ISAAC F. LLOYD, Second Vice-President. EMORY McCLINTOCK, Actuary.
WILLIAM J. EASTON, Secretary.

Burlington Route

BEST LINE
CHICAGO OR ST. LOUIS

TO
ST. PAUL
MINNEAPOLIS

Ripans Tabules cure headache.

The Fastest and Finest Train in the West . . . .

IS

UNION PACIFIC
THE OVERLAND ROUTE
WORLD'S PICTORIAL LINE

The Overland Limited

......TO......

UTAH and CALIFORNIA.

FROM 16 TO 20 HOURS
SAVED BY USING

"THE OVERLAND ROUTE."

Double Drawing-Room Pullman Sleepers.
Free Reclining Chair Cars.
Pullman Dining Cars.
Buffet Smoking and Library Cars.

Send for Descriptive Pamphlet "49-96,"
Folders and other Advertising Matter.
(Mention this publication.)

E. L. LOMAX,
General Passenger and Ticket Agent.
OMAHA, NEB.

THE CHICAGO, MILWAUKEE AND ST. PAUL RAILWAY

. . RUNS . .

Electric Lighted and Steam Heated Vestibuled Trains between **Chicago, Milwaukee, St. Paul and Minneapolis** daily.

Through Parlor Cars on day trains between **Chicago, St. Paul and Minneapolis.**

Electric Lighted and Steam Heated Vestibuled Trains between **Chicago and Omaha and Sioux City** daily.

Through Sleeping Cars, Free Reclining Chair Cars and Coaches between **Chicago and Kansas City, Mo.**

Only two hours from Chicago to Milwaukee. Seven fast trains each way, daily, with Parlor Car Service.

Solid trains between **Chicago** and principal points in **Northern Wisconsin** and the **Peninsula of Michigan.**

Through Trains with Palace Sleeping Cars, Free Reclining Chair Cars and Coaches between **Chicago** and points in **Iowa, Minnesota, Southern and Central Dakota.**

The **finest Dining Cars** in the World.

The **best Sleeping Cars. Electric Reading Lamps in Berths.**

The best and latest type of **private Compartment Cars, Free Reclining Chair Cars, and buffet Library Smoking Cars.**

Everything First-class. First-class People patronize First-class Lines.

Ticket Agents everywhere sell tickets over the Chicago, Milwaukee and St. Paul Ry.

GEO. H. HEAFFORD,
General Passenger Agent, Chicago, Ill.

WHENEVER YOU VISIT WASHINGTON . .

YOU ARE INVITED TO INSPECT THE

MAMMOTH DRY GOODS ESTABLISHMENT

OF

WOODWARD & LOTHROP

Where the **LATEST PARIS NOVELTIES** are always on Exhibition. The attention of those who anticipate purchasing . . . .

BRIDAL TROUSSEAUX

Is invited especially to extreme Paris Novelties in matched sets of French Hand-made Lingerie, including Gowns, Skirts, Chemises, Drawers, Corset Covers, &c. These can be furnished in any number of pieces desired. . . . .

HAND-MADE BRIDAL TROUSSEAUX, personally selected in Paris and exclusive in style and design: Three or more pieces . . . . **$10 to $250.**

CORRESPONDENCE SOLICITED. MAIL ORDERS RECEIVE PROMPT AND CAREFUL ATTENTION.

TENTH, ELEVENTH, AND F STREETS N. W. . . . . WASHINGTON, D. C.

Shortest Line
TO
St. Paul and Minneapolis
and the Northwest

CHICAGO
GREAT
WESTERN
RAILWAY

"Maple
Leaf
Route"

For tickets, rates or any detailed information apply to your home agent or write to

F. H. LORD,
Gen'l Pass'r and Ticket Agent,
CHICAGO.

A VITAL POINT

"IMPROVEMENT THE ORDER OF THE AGE."

A TYPEWRITER'S PRINTING MECHANISM

MUST BE SCIENTIFICALLY CONSTRUCTED. THIS POINT IS OF UTMOST IMPORT FOR

EASY OPERATION AND PERFECT EXECUTION.

The Smith..
Premier
Typewriters

Superior on This Point as Well as on All Others.

ONLY CORRECT PRINCIPLES EMPLOYED.

The Smith Premier Typewriter Co.,
SYRACUSE, N. Y., U. S. A.

Catalogues and Information at Washington Office, No. 1416 F Street.

AN IMPROVED METHOD OF KEEPING THE SCORE IN

DUPLICATE WHIST, COMPASS WHIST, STRAIGHT WHIST AND EUCHRE.

Since Duplicate and Compass Whist have come into fashion there has been an unprecedented revival of interest in the game, due to the fact that mere *luck* is to a large extent eliminated by a comparison of the scores made in the play of the same hands by different players.

The one thing needed to perfect the new method has been a convenient device by means of which the score made on the first round can be concealed until after the replay of the hands, as a knowledge of the first score often enables a good player to make a decisive gain, and matches are lost and won on just such little chances.

A Washington player has at length invented and put upon the market at a very low price a little device which admirably answers the purpose, and at the same time serves as a pretty and useful table ornament, marker, and pencil rest. It is called the "Cosmos Counter," and consists of a little polished wood tablet with a metal keyboard that can be clamped down on the score in such a way as to bring 24 little metal plates over the 24 spaces in the "score" column of the card, for use in concealing each first score as soon as recorded and until the hand is replayed (in duplicate whist) or the entire series finished (in compass whist).

Whist players will at once see the advantage of this new method of keeping the score, as it effectually prevents their opponents at the same or another table from taking advantage, either by accident or design, of a knowledge of what the hand is capable. The trouble with duplicate whist, especially, is that the replay is liable to be influenced by memory of the cards and score, and anything that helps to confuse such recollection is a great gain to fair play.

The "Cosmos Score Card," prepared for use with the counter, shows several new features, such as a heading for both Duplicate and Compass Whist and (on the reverse) for Straight Whist, Euchre, &c., thus enabling the same counter and score to be used for any game of cards.

Cosmos Counters, with tablet of quartered oak, maple, or birch, and metal in either gold or silver finish, 50 cts. apiece; 6 for $2.75; 12 for $5; by mail, 4 cts. apiece extra. Cosmos Score Cards, 25 cts. per package of 50; 12 packages for $2.50; by mail free of postage.

Ask to see samples at any stationer's, or order direct from the General Agents.

Cosmos Duplicate Whist Score

N .... E ....

S .... W ....

HAND	COMPASS WHIST: SCORE	TOTALS	TRUMP	OPPONENTS		HAND
	DUPLICATE WHIST: SCORE	GAIN	TRUMP	GAIN	SCORE	
1						1
2						2
3						3
4						4
5						5
6						6
7						7
8						8
9						9
10						10
11						11
12						12
13						13
14						14
15						15
16						16
17						17
18						18
19						19
20						20
21						21
22						22
23						23
24						24
TOTALS						TOTALS

Copyright, 1895, by Everett Hayden, Washington, D. C. For use with the Cosmos Duplicate Whist Counter, patented July 7, 1896.

...., 189......

E. MORRISON PAPER CO., 1009 Penna. Avenue, Washington, D. C.

NATIONAL GEOGRAPHIC MONOGRAPHS

On the PHYSICAL FEATURES OF THE EARTH'S SURFACE, designed especially to supply to teachers and students of geography fresh and interesting material with which to supplement the regular text-book.

LIST OF MONOGRAPHS COMPRISING VOLUME I:

GENERAL PHYSIOGRAPHIC PROCESSES	J. W. Powell
GENERAL PHYSIOGRAPHIC FEATURES	J. W. Powell
PHYSIOGRAPHIC REGIONS OF THE UNITED STATES	J. W. Powell
BEACHES AND TIDAL MARSHES OF THE ATLANTIC COAST	Prof. N. S. Shaler
PRESENT AND EXTINCT LAKES OF NEVADA	Prof. I. C. Russell
APPALACHIAN MOUNTAINS—NORTHERN SECTION	Bailey Willis
APPALACHIAN MOUNTAINS—SOUTHERN SECTION	C. Willard Hayes
MT. SHASTA—A TYPICAL EXTINCT VOLCANO	J. S. Diller
THE NEW ENGLAND PLATEAU	Prof. W. M. Davis
NIAGARA FALLS AND ITS HISTORY	G. K. Gilbert

Price for one set of ten monographs, **$1.50**. Five sets to one address, **$6.00**. Single monographs, **20c.**

Remit with order to AMERICAN BOOK COMPANY,

New York - Cincinnati - Chicago

Ripans Tabules assist digestion.

TERRESTRIAL MAGNETISM

An International Quarterly Journal

Edited by L. A. BAUER
With the Co-operation of Eminent Magneticians

WITH the March, 1897, issue, this Journal, devoted exclusively to Terrestrial Magnetism and allied subjects, such as Earth Currents, Auroras, Atmospheric Electricity, etc., entered on its second volume. The hearty co-operation extended by the workers in this promising field of investigation, as abundantly shown by the numbers thus far issued, has made this Journal the international organ for making known the latest achievements. The magnetic needle has become such a promising instrument of research, not only in terrestrial, but in cosmical physics, that this Journal appeals to a large class of investigators. The geographer, the geologist, the astronomer, the meteorologist—all are interested in the development of the subject of terrestrial magnetism. It should therefore receive their support.

Among the contributors of the main articles in the past have been Messrs. Barus, Borgen, Chree, Eschenhagen, Littlehales, Rücker, Schmidt, Schuster, and de Tillo.

Future numbers will contain:

"The Earth, a Great Magnet,"
BY DR. J. A. FLEMING.

"The Electrification of the Atmosphere,"
BY PROF. ALEXANDER McADIE.

"The Height of the Aurora,"
BY PROF. CLEVELAND ABBE.

"The Distribution of Magnetic Observatories,"
(Illustrated),
BY PROF. MAX ESCHENHAGEN,
etc., etc.

The size of the Journal is royal octavo, a volume embracing about 200 pages. Domestic subscription price: **Two dollars**; single numbers, **fifty cents**. Foreign subscription price: **Nine shillings, nine marks, or eleven francs.** Address:

TERRESTRIAL MAGNETISM,
The University of Cincinnati, Cincinnati, Ohio.

PEOPLE like to read about the great and wonderful country of the **Southwest**; of its quaint and curious towns, its ancient civilizations, its natural marvels. They like to get accurate information about **California and the Pacific Coast.** This is because most people want to some day see these things for themselves. . . . .

A charming book covering these facts is issued by the

PASSENGER DEPARTMENT

OF THE

Southern Pacific Railway,

and will be sent to any one, postpaid, on receipt of **TEN CENTS.**

THE BOOK IS ENTITLED

"Through Storyland to Sunset Seas,"

You can get a copy by writing to

S. F. B. MORSE,

General Passenger Agent,

Southern Pacific,

New Orleans,

and sending **10 cts.** to defray postage.

AND IS A WONDERFULLY HANDSOME VOLUME OF **205** PAGES, WITH **160** ILLUSTRATIONS. . . .

The paper used is FINE PLATE PAPER, and every typographical detail is artistic. It is a story of what four people saw on just such a trip as you would like to make. . . . .

CONTENTS OF WONDERLAND '97

THE GREAT NORTHWEST.
A chapter recounting briefly the historic incidents of the region from 1803, its geographic, politico-economic, and other valuable features. A chapter of special value to public-school teachers and pupils.

LAKE PARK REGION.
A short chapter descriptive of the beautiful lake region of Minnesota

RED RIVER VALLEY.
A brief description of this well-known farming section.

A GREAT CATTLE RANGE.
This chapter tells of one of the finest cattle ranges in the Northwest

YELLOWSTONE PARK.
A new and detailed description of the Wonderland of the World.

"GO, MAKE MONEY."
A pithy, varied study of the mining regions of Montana, Idaho, and the now renowned KOOTENAI country. Special visits were made to these regions to obtain data for this article

MOUNTAINS FOUR.
A chapter devoted to four of the mighty snow-covered peaks of the North Pacific Coast.

THE HEART OF THE OLYMPICS.
A new and wild region, LAKE CRESCENT, in the Olympic Range, N. W. Wash is brought to the Tourist's attention. The trout found there are something unusual.

ALASKA.
A brief article on this Wonder of Wonderlands.

THE NORTHERN PACIFIC RAILWAY desires to place this publication which is profusely illustrated, printed in good type, and has an attractive cover, in a **HUNDRED THOUSAND** or more homes.

Send SIX CENTS and your address to CHAS. S. FEE, General Passenger Agent, St. Paul, Minn.

Among the Contents of Forthcoming Numbers of

THE NATIONAL GEOGRAPHIC MAGAZINE

WILL BE THE FOLLOWING:

The Deserts and Forests of Arizona,

BY PROF. B. E. FERNOW, PH. D.,

CHIEF OF THE DIVISION OF FORESTRY, U. S. DEPARTMENT OF AGRICULTURE;

Prehistoric Man the Product of Geographic Environment,

BY HON. GARDINER G. HUBBARD, LL. D.,

PRESIDENT OF THE NATIONAL GEOGRAPHIC SOCIETY;

Down the Volga, from Nijni Novgorod to Kazan,

BY PROF. FREDERIC W. TAYLOR,

—— AND ——

Forest Reservation in the United States,

BY FREDERICK HAYNES NEWELL,

CHIEF HYDROGRAPHER OF THE U. S. GEOLOGICAL SURVEY.

JUDD & DETWEILER, PRINTERS, WASHINGTON, D. C.

The National Geographic Magazine

AN ILLUSTRATED MONTHLY

Editor: JOHN HYDE

Associate Editors

A. W. GREELY W J McGEE HENRY GANNETT
C. HART MERRIAM ELIZA RUHAMAH SCIDMORE

CONTENTS

WASHINGTON

PUBLISHED BY THE NATIONAL GEOGRAPHIC SOCIETY

AGENTS IN THE UNITED STATES AND CANADA

THE AMERICAN NEWS COMPANY, 39 AND 41 CHAMBERS STREET, NEW YORK
PARIS: BRENTANO'S, 37 AVENUE DE L'OPERA

Price 25 Cents $2.50 a Year

Entered at the Post-office in Washington, D. C., as Second-class Mail Matter.

THE

National Geographic Society

ORGANIZED, JANUARY, 1888

PRESIDENT

GARDINER G. HUBBARD

VICE-PRESIDENTS

MARCUS BAKER
WILLIAM H. DALL
G. K. GILBERT
A. W. GREELY
C. HART MERRIAM
HERBERT G. OGDEN

TREASURER

CHARLES J. BELL

RECORDING SECRETARY

EVERETT HAYDEN

CORRESPONDING SECRETARY

HENRY GANNETT

MANAGERS

H. F. BLOUNT
F. V. COVILLE
C. W. DABNEY, JR.
DAVID T. DAY
JOHN HYDE
W J McGEE
F. H. NEWELL
W. B. POWELL

SECRETARY'S OFFICE, 1517 H STREET N. W., WASHINGTON

The National Geographic Society, the object of which is the increase and diffusion of geographic knowledge, has a paying membership of 1,400. Its membership is not restricted to practical geographers, but is open to any person in good standing who may be sufficiently interested in its work to seek admission. The annual subscription is: for active members, $5.00 per annum; for corresponding members, $2.00 per annum. Active members pay also an entrance fee of $2.00 on election. THE NATIONAL GEOGRAPHIC MAGAZINE is sent regularly to all members, both active and corresponding.

Donations for the founding of Prize Medals and Scholarships are respectfully solicited.

ENGINEER-IN-CHIEF GEO. W. MELVILLE, U. S. NAVY

THE

National Geographic Magazine

Vol. VIII JUNE, 1897 No. 6

THE EFFECTS OF GEOGRAPHIC ENVIRONMENT IN THE DEVELOPMENT OF CIVILIZATION IN PRIMITIVE MAN*

By Hon. Gardiner G. Hubbard, LL. D.,

President of the National Geographic Society

I have selected as the subject for my annual address "The Effect of Geographic Environment on the Development of Civilization in Primitive Man."

The interest of this subject is not confined to the history of the various stages of life through which man has passed, for his past modifies our views of the present and is a prophecy of the future.

It is my province to treat of the effects of different environments on the development of primitive man. This development, though on the whole beneficial, has ever been a mingling of good and evil. Its progress has been hitherto intermittent—originally very slow, requiring thousands of years, possibly tens of thousands, to gain slight results; advancing sometimes with quicker pace, often retrograding, sometimes apparently dying out, probably because its progress is often invisible. It has never been uniform in any race, nation, or country, though progressing more rapidly in higher stages and in modern times.

That civilization has been and must be beneficial to mankind we cannot doubt, though every upward step has been the cause of suffering, loss, and death in many ways before unknown. The discovery of America was followed by the death of tens of thousands of negroes in Africa and of Indians in America. The civ-

*Annual presidential address, delivered before the National Geographic Society, March 1, 1897.

ilization of the Hawaiian and other islands of the Pacific ocean caused a great diminution in the number of their inhabitants and the entire extinction of some tribes. No discovery or invention was ever made, whether of fire, of the bow, of gunpowder, of printing, steam, or electricity, of the telegraph, telephone, or bicycle, that did not bring with it changes in civil, social, and private life and in business transactions. The greater the value of the invention, the greater the disturbance of established habits, trade, and business. The cotton gin enriched the South, but made slavery profitable and led to our civil war. The railroad, steamship, and telegraph revolutionized the entire commerce of the world, and ruined many wealthy and long established mercantile and commercial firms. The civilization of past ages was never the enlightenment and elevation of the whole nation, it was the upbuilding of the higher classes in knowledge, culture, wealth, and power, and the oppression and debasement of the lower classes.

Comfort, happiness, and length of life are ever increasing with civilization. Individual strife is prevented by law, warfare is controlled, new and improved varieties of food, shelter, and clothing add to the sum of human happiness. Civilized man has become a highly developed and sensitive organism, with increased susceptibilities to both pain and pleasure. It is the purpose and effect of modern civilization to offer opportunities which shall raise the whole race to an elevation never yet attained.

One of the most striking features in the development of civilization, though hitherto little considered, is its relation to and dependence on geographic environment. In our earliest studies of man we find him the creature of his environment, only progressing in those directions and at that rate to which he is forced by his necessities. As we follow him through different and progressive stages of development, we find still the influence of geographic environment in directing, in stimulating, or retarding his progress. Indeed, so marked is the effect of geographic environment on any primitive people that, given the environment, the geographer can determine the character, religion, and habits of life of that people.

We were formerly taught that some four or five thousand years back in the world's history a man, perfect and complete, was created, the ancestor of the human race, to whom was given lordship over the beasts of the field and the fowls of the air and dominion over all nature. Modern research and the discovery of the remains of ancient man have proved that no less than twenty thousand years, probably a much longer time, has passed since he first appeared upon the earth, and that he was then little superior, either in mental or moral qualities, to the animals by which he was surrounded, while greatly their inferior in strength. Whatever his origin, the causes which lifted him from this low estate proceeded from without and not from within.

The earliest traces of man are found in what is known by geologists as the Pliocene formation. They lie buried in deposits of gravel or in caves, and consist of fragments of chipped flints pointed into spear or arrow heads, and of bones (and in some cases of stones) shaped into rude fish-hooks.

With these flints are found bones of animals, with probably a few human bones. From these remains we gather that man had not only learned to defend himself from the wild animals about him, but probably to use their flesh for food and their skins for clothing. He lived in caves, in trees, or in rude huts sometimes built on piles or shell walls sufficiently separated from the land to make him secure from attack. We have no evidence that the use of fire was known to him. Gradually, step by step, we see him by slow advances become through geographic environment a hunter, a fisherman, a nomad. From a dweller in caves and trees he becomes a dweller in tents—finally gathering into families, tribes, cities, nations.

So much and so little do the gravels of river beds and rocks tell us of early man. But in existing peoples, in various parts of the earth—in the Dwarfs and Hottentots of Africa; in the Andamans of the Indian ocean; in the Papuans of the islands of the Pacific; in Tierra del Fuego; in the aborigines of Australia; in the inhabitants of the Arctic regions—we find man still in a very low stage of development, corresponding to, and little superior to, that of the drift and cave men. That these races have continued through so many ages in the same condition, and that others have risen through successive stages to the highest civilization, we believe to be the result of geographic environment. Had the environment been everywhere the same, progress must have been the same over the whole earth. But with every degree of latitude, every change of altitude, every variation of climate, every variation of rainfall, conditions are changed and progress is hastened or retarded.

Let us go back to primitive man as we still find him in Equatorial Africa, in the Arctic regions, in Central Asia, as he was in

Europe for countless ages, and trace the effect of geographic environment on his condition in each of these countries.

The whole of Africa was at one time probably occupied by the Dwarfs or Hottentots. The climate is warm, clothing is unnecessary; they require but slight shelter for protection against sun and rain. Their dwellings are either in trees or rude huts, with thatched roofs, sometimes open on every side. The streams and jungles furnish fish, birds, and animals for food and also roots and fruits. They become expert in laying snares and traps, in catching fish, and in hunting. Further needs they have none. There is neither necessity nor inducement for other exertion or for further development. Their environment has made them and keeps them what they are. A stronger race of negroes from the north, with better weapons, drove them into the hottest jungles of Central and South Africa; there they remain. Again, other races appeared, and to maintain their position the negroes must improve their weapons, must learn to make bows and poisoned arrows, spears and javelins, must clear spaces in the forest, erect palings around them, gather within these enclosures, and invent a system of alarms. To protect themselves from wild beasts they learned the use of fire and invented means of lighting a fire by friction. Gradually they gathered into families, and fire was used for cooking animal food. Sometimes the meat was hung over the fire on a spit; sometimes cooked in ant-holes with hot stones. The date and cocoanut palm supplied them with food, shelter, and light. They had advanced a stage beyond the Dwarfs and Hottentots, but as their environment encouraged no further progress they remained stationary.

In the Arctic regions the environment and therefore the conditions of life are different, but equally unfavorable to progress. In these regions clothing is a necessity, and to obtain the skins of sea and land animals the Arctic man was driven to invent snares and weapons and to make rude boats. In a land of snow and ice he must have a warm, tight shelter as well as clothing; so he builds huts of blocks of stone or ice covered with snow. He makes a fire and gathers moss for fuel. As his surroundings afford him scanty vegetable food, and that only in the short summer, he dries berries and mosses; he smokes and freezes the flesh of bear, seal, and walrus, and lays in a supply for winter use. The animals which surround him are generally not the ferocious beasts of warmer climates; the dog and reindeer become his companions and friends. Gradually he learns to use them in his service, and thus from the environment came the domestication of animals in the Arctic regions. The denizen of the far north cannot cultivate the ground, for the frozen earth refuses to yield any return for his labor. All the energies of the Arctic man are expended in contending with the elements and striving to secure from sea, snow, and ice the oil, skins, food, and habitation necessary for the support of life. His body is enervated by the intense cold, and his mental, physical, and moral growth is dwarfed and stunted.

Thus we see that the geographical environments of intense heat and intense cold develop different faculties, but in neither does man progress toward civilization.

Let us turn to a temperate climate, to the vast steppes and plateaus of Asia, which extend from southeastern Russia, past the Caspian and Ural seas, northeastward and eastward through upper Turkestan and Siberia to Mongolia; from the Black sea to Bering sea and the Pacific ocean—the greater part, indeed, of Asia. Here we have a different geographic environment—a temperate but arid climate, vast steppes, where, on account of the drought, agriculture has always been impossible. Over these steppes immense flocks and herds of wild goats, camels, wild horses, and buffalo roam now as thousands of years ago. Here, in ages past, man, following where they led, gradually gathered them into herds and tamed and domesticated them. The herds must be cared for, be kept together, and guarded; goats and cows must be daily milked; must be pastured in summer, and the wild grass gathered for their winter use. Man learned to breed cattle, to increase his flocks and herds, for on them he depended for food, for clothing, for covering for his tents, and for all the other necessaries of life. His environment forced him into habits of foresight, of thrift, of thoughtfulness; and thus man took the first step in civilization. He ceased to be a savage and became a nomad; he acquired property, and for thousands of years lived, as now, the shepherd's life. Flocks and herds belonged to the family or tribe, and the land where they grazed was regarded as the property of the tribe, from which the flocks and shepherds of other tribes were driven away.

Gradually the family relation was established. The father or his eldest or strongest son became the patriarch, and the families of a common ancestor were united into a tribe with the patriarch as its chief. Gradually the idea of social life and patriarchal government was developed, but there was neither city nor state, no close contact of man with man, no assembling into communities. The men tended their flocks; the women learned to spin and weave; some ideas of individual rights were developed. The nomad condition of life gave form to his habitation—a tent easily moved.

From Asia we turn to Europe, a country from its geographic environment better adapted for the *advancement* of civilization than any other quarter of the world. Its two long, narrow peninsulas, Greece and Italy, stretch southward into the Mediterranean; its seacoast, longer in proportion to the land surface than that of any other continent, is indented with excellent harbors on the north and south, with deep bays and gulfs; its islands of Great Britain, its temperate climate, its abundant rainfall and numerous rivers, its mountain ranges, easily crossed, afford facilities for the development of trade and commerce, of science, the arts, and civilization of all kinds not possessed by any other country; yet this land, so well suited for the progress of civilization, was unfitted to be the birthplace of civilization.

The life of primitive man in Europe has been longer and more thoroughly studied than in any other part of the world. Traces of the different stages in the development of primitive man through the Stone, Bronze, and Iron ages have been found in many places. We learn of the life of the Drift and Cave men and of the time when they lived from their implements and from the bones of animals. Their implements resemble those found in other continents. This, however, does not prove the acquaintance of one race with the work of another in a different continent, but that similar stages of development occurring in different places and at different times, produce a like results. These implements, which are very rude and simple, are made of the stones most easily worked, and show by their design that they could have been made only by man. In France and England these remains have been found in the banks of streams 50, 80, or even 100 feet above the present level of the river. The men of this period belong to the earliest Stone Age, and are called "Drift men." Their implements are found with fauna extinct before our earliest knowledge of natural history and known to us only as fossils, or else with the remains of such animals as the reindeer and woolly rhinoceros, now found only in arctic or tropical climates.

These Drift and Cave men lived the life of all primitive men, hunting and fishing. or eating roots and the fruits of trees. Neither in their physical nor mental condition were they much superior to the wild beasts among which they lived. They had the mind of a child, with the strong animal passions of a man.

Great mounds, or cromlechs or barrows, as they are called in England and France, were probably built by these early races, possibly at the same time that a race of semicivilized men were building the pyramids of Egypt. The cromlechs and barrows, made at different times, are of different forms. Many of them were used as burial places. In the long barrows the dead were generally buried in a crouching or sitting posture. Major Powell tells us that the property used exclusively by the individual, such as clothing, ornaments, and weapons, was inherent in the individual, and to prevent strife was buried with the owner, together with food for the long journey.

The family relation and marriage were in their first germ, and the idea of property was scarcely more than that of the wild beasts. Many wild animals protect their right of property in the prey they take and in the females of their kind.

We have no certain knowledge when these men lived, but the great geographic changes which have taken place must have required thousands of years. They seemed to disappear from Europe; possibly they were destroyed by the changes of climate during the glacial era, which, as is now known, was not as great and far-reaching in Asia as in Europe and America. Some geologists do not believe that man lived in the glacial period; others that the Drift men of Europe were conquered by immigrant hordes from the East, who had reached a progress somewhat higher, and that thus the first upward step in European progress came from the influence of the Orient.

The superiority of the men of the later Stone and Bronze Ages is confirmed by comparisons between the skulls and other remains of the Stone and Bronze Ages. The skulls of the Stone Age are narrower and the men smaller than those of the Bronze Age. Those who lived in a limestone or volcanic country, or where there were fissures and caves in the rocks, made their homes in the rocks and caves. In such places as the Marne valley, where the rocks are soft, they excavated caves, and later built their habitations of limestone, shaping them after the cave. The weapons they used were superior in workmanship and variety to those of the Drift men, being often ground and polished. Charred wood has been found in these caves, showing a knowledge of the use of fire, but no pottery.

Far removed and strange as this life of the Stone Age may seem to us, it is not more unlike our own than that of many of the tribes who within the present generation have lived in South America, Africa, Asia, and the islands of the Pacific. There is scarcely a custom, a habit, or an implement of primitive man that has not been found among one or more of these tribes. The Fuegians have been described by Darwin and Captain Ross, who visited Tierra del Fuego in 1839 and 1840. Captain Ross tells us "They are naked, except a sealskin mat thrown over the shoulders, living in a dome-shaped hut about the size of a hay stack, formed by branches of trees driven into the ground in a circle, the ends brought together at the top, and the interstices filled with smaller branches. They use stone fish-hooks and live on fish or any other food they can find, frequently eating it raw. They have no pottery, but make vessels for drinking and cooking of birch bark. They do not seem to have any form of government." Darwin says, "They are ill-looking, badly proportioned, stunted in their growth, their skins filthy and greasy, their voices discordant." On the Baltic, in a different environment, we find other traces of primitive man. Here are found great mounds of shells, bones, refuse of fish and wild animals, and a few pieces of earthenware, which show the beginning of pottery. In the mounds on the Baltic sea are found shells of salt-water oysters that do not now live in the Baltic, whose waters, formerly salt, are now brackish, showing the long period that must have elapsed since the mounds were formed. Thus the seashore adds its testimony to that of the rocks as to the antiquity of the race.

Their geographic environment taught them also navigation by the use of boats for fishing. The simplest form is a float, which may consist of a single log, trimmed of its branches, or of a great branch with the boughs remaining. Some races of people use bladders and inflated skins or cocoanuts, while the Californian ties reeds in bundles and thus forms a float. The earliest means of propulsion was paddling with the hands and feet. Gradually use was made of wind power, by holding up a leaf, bough, skin, or article of clothing as a sail; then a mat raised by one or two sticks. The mast and sail followed. The man who found that a pointed log made better headway than a square one had made great progress in shipbuilding. The shapely and skillfully constructed vessels of the present day are only the gradual evolution of the primitive log.

We have referred to the migrations of the men of the later Stone Age from the East. Without this habit progress and civilization would have been impossible. "No community," says Maine, "when first known by the historian, can certainly be said to occupy its original seat." No instance can be found where a race has risen from savagery to civilization without contact and intermingling with races from countries where different environments have developed different intellectual activities. If, however, the disparity is too great between the old and the immigrant race, then the inferior fades away, for scarcely a single race has been found that can bear the contact. In trying to civilize we destroy.

We have referred to the immigrants from the east as having advanced the progress of Europe. These emigrations were the result of environment. As population increased in the plains of Asia, the land became insufficient for the support of a nomad people, with their vast herds of cattle. Few realize the amount of land required for the support of even a single family; the hunter and fisher required for his sustenance and that of his family a tract of one hundred square miles. For a small nomad tribe on the steppes of Asia, 500 to 600 square miles are required. In these regions man will ever remain content to be a savage or a barbarian. Where agriculture, trade, and industry are combined, the same land that supported one hunter is sufficient for the sustenance, in India and Europe, of 10,000 inhabitants, and in the state of Massachusetts of 25,000. One-fourth of the population of the world—savages and barbarians, constant wanderers—require three-fourths of the surface of the earth for their support. As population increases, the time invariably comes when the land is insufficient for the support of the increased number. The people must die of hunger or immigrate to other lands. Such immigrations, apparently always from the east to the west, or from the north to the south, have frequently occurred in the world's history. They have usually followed the same route, through passes and over plains to rich fertile regions. Forced by hunger, great hordes of Huns and Mongolians gathered under great warriors, of whom no record exists, left the plains of Asia, long before the time of Alaric or Attila, and wandered over the steppes, through the Pass of Dariel in the Caucasus to Asia, and on across Asia Minor and the Dardanelles to Greece, or else traveled across Russia, north of the Black sea, into Hungary, and thence spread over Europe. These early nomads belonged to the period of the Stone and Bronze Ages, and met in Europe the men of the later Stone Age, and as their development was higher and their weapons were better, they easily overpowered the Europeans and mingling with them formed a new people or race. The Bronze Age was thus introduced into Europe. not as a progression from one stage to another, but by the invasion of a superior civilization. The immigrants drove their flocks and herds with them, for in the Bronze Age the larger proportion of the bones are those of domestic animals, while in the early Stone Age no bones of domestic animals are found, and very few in the later Stone Age. The inhabitants of Europe slowly passedfrom the Bronze to the Iron Age, from savagery to barbarism, and there progress ceased. How long this stagnation continued we cannot tell—possibly many thousands of years. The population of hunters and fishermen were satisfied and contented with their lot.

We have traced, in Equatorial Africa, in the Arctic regions, and in Europe the slow development of man, so far only as forced by his geographical environment. It is to the east that we must look for those conditions, which raised man through successive stages of savagery and barbarism to the highest civilization the world has ever known. In Egypt we find a people isolated on the north by the Mediterranean, on the east and west by the Desert, and on the south by the Cataracts, and thus protected for long ages from any foreign enemy. Their surroundings largely influenced the religion of the people. The desert which forever encroached on them was to them the type of death, while the Nile, their greatest blessing, to which they owed all the fertility of their valley, represented life. The sun and moon, in all their various phases, were deified and worshiped, as were the sky and wind. Every mysterious natural phenomenon which influenced their daily lives became an object of worship.

More wonderful than the Nile is the valley of Mesopotamia. It is about 1,200 miles in length, extending from the Persian gulf almost to the Mediterranean. A long range of mountains runs along the northern side; the boundless desert, on the other, stretches across Arabia and over the Red sea, through Africa to the Atlantic ocean. Through this valley flow the Euphrates and Tigris in nearly parallel lines, uniting shortly before they reach the Persian gulf. The fauna and flora of this valley are very rich and abundant; wheat and millet grow spontaneously. "So great was the fertility of the soil, according to Herodotus, grain commonly returned two hundred fold to the sower, and occasionally three hundred fold, while wheat, barley, sesame, ochrys, palms, apples, and many kinds of shelled fruit grew wild, as wheat still does in the neighborhood of Anah." Pliny, too, says that wheat was cut twice and afterward was good for sheep. The valley between the rivers varies in width from ten to one hundred miles. These rivers in different spring months bring down the rich detritus from the mountains, inundating the valley, and as the water subsides the valley is covered with rich and abundant vegetation.

Here, many believe, was the Garden of Eden, and the reputed site of the Tower of Babel is daily visited. The region was early inhabited, and its fertility made it in all ages one of the richest portions of the world. Its aborigines on the Persian gulf lived by fishing, but as the population increased, they were forced to follow up the Tigris and Euphrates into the desert. For awhile food was abundant, but with the increase of population the supply failed. The conditions of environment taught man to depend on the inundation and to increase the amount of habitable land by digging irrigating canals. Eventually, thousands of large and small streams connected the two rivers and flowed southward into the desert. The valley and the desert thus became a garden, and the population rapidly increased. The irrigating canals were continually being enlarged, and for many generations the country sustained a population so vast that an ancient writer says that "for hundreds of miles a nightingale could fly from branch to branch of the fruit trees and a cat walk from wall to wall and housetop to housetop."

As there is little rainfall, the country was almost destitute of wood, and the river mud was used instead of wood and made into bricks. These, with or without straw, were hardened by the sun or fire and used for building adobe houses. Tablets were also made of mud or bitumen, which is found here in large quantities, and while soft, cuneiform inscriptions were written upon them and hardened in the sun. These have remained even to the present day. Large quantities of mud and clay from the canals were thrown out, sometimes banked up, forming small hills or mounds, upon which temples and palaces were built. Canes and reeds, growing along the banks of the canals, were cut and used for the roofs of buildings. They were inclined toward each other, joined at the top, coated with clay, and formed the roofs of the houses. In the temples and great palaces the canes were bent into an arch, supported underneath by other canes, making a wicker arch-work, on which layer after layer of mud or bitumen was placed, until a solid roof was formed. Thus the architecture of the people here as elsewhere was the result of geographic environment.

As the population in Mesopotamia became dense, the people were forced into communities. These grew into towns and great cities. The patriarchal system still continued, though with greatly changed conditions. All related by blood or adoption were regarded as members of the tribe and all on an equality. The patriarch retained the ownership of the property, with power of life and death. With the increase of wealth, luxury, and power the people deteriorated. They lost the personal liberty and freedom of hunters and fishermen, and later of shepherds. The patriarch became a despot, the nomad a slave.

From the ruins of cities scattered all over this valley, we learn much of the history of this people, their character, habits, and manner of life. In Nipper, the city most recently excavated, by gentlemen connected with the University of Pennsylvania, the debris over one of its temples is 37 feet in thickness, the accumulation of about 4,000 years. Thirty feet below the ruins is the temple built by Mullil about 6,000 years before Christ, and here have been found monuments, pottery, and other evidences of civilization. The inscriptions even then had ceased to be pictures and were cuneiform; but the beginning of Babylonian writing lies far behind the foundations of the temple of Nipper. Recent writers tell us that "the flower of Babylonian art is found at the beginning of Babylonian history."

The inscription upon the temple tells us that "Millel, king of the universe, invested Lugal with the kingdom of the world. He filled all lands with his renown and subdued them from the rising of the sun to the setting of the sun—from the Persian gulf to the Upper Sea, where the sun sinks to rest, and granted him dominion over all things and caused all countries to dwell in peace." His capital was at Erech, which was called "The City." His empire extended from the Persian gulf to the Mediterranean, "the sea of the setting sun," and out into the Mediterranean to the island of Cyprus. Here lived Nimrod, "the mighty hunter before the Lord," and Ashur, "who builded Nineveh." Eighteen hundred years after Sargon, Abraham went forth from Ur of the Chaldees, near the mouth of the Euphrates, into the land of Canaan, and subsequently when Chedorlaomer, king of Elam, and Tidal, king of nations, took Lot, his nephew, and made him prisoner, Abraham armed his servants, attacked Chedorlaomer and Tidal by night, smote them, and liberated Lot.

About a thousand years later Sennacherib ruled, and about six hundred years before Christ Nebuchadnezzar lived, under whom the Jews were taken captive, "when by the rivers of Babylon they hung their harps." Bricks from the palace of Nebuchadnezzar, with his name and title still inscribed, now grace the walls of the most lowly Arab and Turkish dwellings. The names of all these kings have been recently found on some of the Babylonian tablets. The great rich valley of the Euphrates was filled with cities, some of them, such as Babylon and Nineveh, then and now the wonder of the world.

Here, 8,000 years ago, ruled Ensagana, "Lord of Kengi," "the land of canals and reeds." From the remains of the city and palaces he built, pieces of pottery have been recently taken of fine shape and as beautifully worked as the ancient pottery of Greece. Two thousand years later, or 3,800 years before Christ, flourished Sargon the First, founder of a new dynasty. On one of the statues the following inscription is found: "She placed me in a basket of rushes, with bitumen, the door of my ark she closed. She launched me on the river, which drowned me not. The river bore me along; to Akki the water-carrier it brought me. Akki the water-carrier in the tenderness of his heart lifted me up. Akki the water-carrier made me his gardener. And in my gardenership the goddess Ishtar loved me."

In Egypt, enclosed by the sea and desert, there was no need of large armies. Walled cities were not required, for there were few inhabitants in the desert, and for many centuries no hostile army appeared on its border. The geographic environment of Mesopotamia was different. On one side were mountains and valleys inhabited by numerous warlike wandering tribes, and beyond them the Nomads of Central Asia. The inhabitants of the valley must be ever ready to meet attacks, and this required an army and people accustomed to arms. Thus a different environment made peoples of different character. Their rulers were often great warriors, who led their armies in different directions, subduing countries far and near. As the mountains inhabited by these warlike tribes were near the plain, they were compelled to surround their cities with high and broad walls. Within these walls were large and populous cities; temples and palaces crowned the heights; the hanging gardens of Babylon were built; bridges connected the cities on either side of the Euphrates; cuneiform writing was largely used; libraries, filled with tablets, were founded, and civilization rose to the highest point yet reached, which must have had its beginning ten thousand years ago.

When we remember the wonderful cities that flourished in this valley, its great population and high civilization, and reflect that this civilization continued from five to six thousand years—several thousand years longer than our own civilization; when we remember that certain portions of the valley are low, often inundated; that in summer the climate is hot and unhealthy; that the government was a despotism and the people slaves; that there was a great inequality between the upper and lower classes; civilization, refinement, and luxury in the upper classes and degradation in the lower classes, when we reflect that these conditions continued thousands of years, our interest in the people and country which produced such results must ever increase.

During the wars that often laid waste the valley the inhabitants were sometimes conquered and driven from their homes, far to the north and west. Many crossed the Ægean into Greece and carried to Greece and through it to Europe the civilization of the Orient. By this means Europe gradually passed from the Iron Age to the civilization of the present.

It is asked why, with the same geographic environment as in the days of Nineveh and Babylon, Mesopotamia, once the garden of the world, should have become a desert. We must again look to its environment. On the easterly and northerly sides of the valley, living among the mountains, were powerful and warlike tribes. These tribes, tempted by the wealth of the cities of the plain, made frequent inroads, killing its inhabitants. If the ruler was strong and powerful, they were driven back to their mountains. If he was weak, his government was overthrown; the mountain tribes took possession of the valley, killing the inhabitants, and sometimes destroying the cities and forming a new dynasty. Thus in different ages the Sumarians, the Chaldeans, Babylonians, Assyrians, Elamites, Hittites, Scythians, Parthians, Medes, and Persians under Cyrus; Greeks under Alexander, and Romans under Ptolemy conquered and plundered the valley. It was afterwards conquered by the Mongolians, and five hundred years ago it fell into the merciless and destroying hands of the Turk; for five centuriės has been pillaged by its governors and officers; the taxes raised beyond the power of the people to pay, the water shut off from the land, the irrigating canals closed, the land laid waste, and famine and desolation followed. The sands from the desert drifted in until the valley becames a waste, rich only in mounds and ruins of old empires.

The geographic position of Mesopotamia made it for thousands of years the great highway of the world—connecting the east and the west, Europe and Asia. Over it great caravans were constantly passing; but the carriage by canal was slow, expensive, and finally became dangerous.

Columbus, in his efforts to find a better way to the Orient, discovered America. Magellan circumnavigated Africa and opened a new route around the Cape of Good Hope, which was followed for nearly four hundred years, when a shorter way was opened through the Suez canal and Red sea; but the route through Mesopotamia must once again become the highway connecting the two continents, for it is now the route of the telegraph, and railroads are gradually finding their way from the Mediterranean to the valley of the Euphrates, and down the valley, as the shortest route and easiest road between the east and west. When the Turkish rule is overthrown and a good government established the population will increase, new cities will arise, and this valley may once more become the garden of the world.

The civilization of the valley of the Tigris and Euphrates traveled eastward into Persia and India, over the mountains into China, and down its great rivers to the Pacific, across the desert southward and up the Nile to the interior of Africa. From Babylon it commenced its westward course, tarrying first at the Mediterranean, where it exchanged the cuneiform writing of Babylon for the Phœnician alphabet, founded Tyre and Sidon. There it met a new environment, for the ocean added shipping and commerce to the civilization of Babylon.

The population of Mesopotamia, Tyre, and Sidon and their colonies was of the Sumarian or Semitic race. They had material wealth, the patriarchal or despotic rule, with little personal freedom, and their work in advancing civilization, which they had carried on for so many thousand years, finally came to an end. Another country and a different race must carry forward civilization and develop art, science, and literature. From Tyre and Sidon and the Semitic race, civilization moved westward to Greece, and there met the Aryan race, with different political and personal training, its home amid lofty mountains, enclosing rich valleys, with shores indented with deep gulfs and bays, harbors studded with islands. Instead of one great despotism, geographic environment caused the creation of many small states; then a city became a state, frequently at war with its neighbors.

Literature, arts, and sciences, enriched with personal liberty and freedom of action, were added to the civilization of the Orient. In Greece all nature was on a small scale. Civilization needed a broader field, and from Greece it moved westward to Rome, where it acquired the principles of order and stable government and established its rule over many nations and peoples—savage, barbarian, and civilized. But personal freedom was, after the second century A. D., lost. The Roman tribune became an imperial Augustus, the world subject again to a single will. The Dark Ages followed, wherein the foundations of the states of modern Europe were laid. These ages of darkness must precede the Renaissance, and then for a short time the march of civilization was turned back toward the land of its birth. Constantinople was founded—that great and wonderful city, beautiful in situation, overlooking the Eastern and Western worlds; where continuous imperial power has existed longer than in any other city; where the literature, art, and science of the Old World were preserved that they might be handed down to Italy again when the Dark Ages were past. With the Renaissance, civilization finally turned westward and wended its way from Constantinople to Venice and Genoa. From Italy the culture of the Old World was carried on the great lines of travel to central and northern Europe.

With the Renaissance the lethargy of the Dark Ages was broken. Printing was invented, America was discovered, and civilization started on its westward course across the Atlantic to its home in a new world, where public schools, science, art, morality, and religion, with equality and freedom, are working out the civilization of the future.

We have seen that in the early life of our race man was not only dependent on his environment, but a slave to it. As he passed from savage to civilized life, he gradually threw off the yoke, relying more and more upon himself and becoming less and less dependent on his surroundings. Cold and heat, snow and rain, storm and sunshine, time and space, no longer control him. He not only rises superior to their power, but uses them for his own pleasure and purposes. In the infancy of his race the feeblest and most helpless of animals, the slave of his environment, he has in his manhood claimed and exercised the right to rule and become its master.

THE NATIONAL FOREST RESERVES

By Frederick H. Newell,

Chief Hydrographer, United States Geological Survey

Recent discussions in Congress regarding forest reservations have drawn public attention to matters relating to forestry, and many questions are being asked as to the nature, location, and purpose of our forest reservations. To answer these and similar questions it is necessary to have clearly in mind some fundamental facts concerning the geography of the country, with its resources and possibilities of development, especially in the portion west of the Great Plains.

The fact first in importance, and one that even in our own country needs to be strongly emphasized, is that the people of the United States, collectively as a nation, are still among the great landowners of the world. In the eastern half of the country nearly all the land formerly at the disposal of the national government has been disposed of, but in the western half the reverse is the case. Fully two-thirds of the land surface is still open to settlement under the homestead and similar acts, and with slight limitations is free to all citizens. In many of the states within this western half of the country less than one-fourth of the lands are subject to taxation, the great bulk being held by the national government. For example, in Nevada less than four per cent of the land surface has been disposed of and about one per cent has been reserved, over 95 per cent being still vacant; in Idaho less that seven per cent has been disposed of and about four per cent reserved, a little over 89 per cent being vacant. Similar conditions prevail to a somewhat less degree as regards the extent of public land in Wyoming, Utah, Montana, Arizona, New Mexico, and Colorado, while in the great state of California, with its comparatively dense population, over one-half of the area is vacant; the proportion in Oregon being still larger and in Washington a trifle less. In the Dakotas, the western half, excepting a small area around the Black Hills, may be considered as almost uninhabited, and the same may be said of the western third of Nebraska, excepting along the Platte river.

It is not due to any lack of fertility that so much land is still in the hands of the general government. On the contrary, the greater part of this area has on it soil far richer than that of the average farm lands of the east. The one obstacle to its use lies in the scarcity or the irregularity of distribution of moisture. As a rule. it is arid and cannot be depended upon to produce crops each season unless artificially supplied with water. It supports, however, a scanty vegetation except in a few relatively small spots where the drifting sands or the accumulations of earthy salts prevent the growth of the hardy desert plants. Many of these plants are valuable as forage, and thus the public lands in their native condition are as a whole valuable for grazing.

It must not be supposed that the soil, though fertile, is everywhere adapted for agriculture even with irrigation. The surface of the country is in places extremely rough, the West being characterized by the great mountain masses of the continent. Many of the mountains rise to heights of 10,000 feet and over, and on account of their altitude and precipitous slopes receive a larger amount of rain and snow than the broad lands of the adjacent valleys. On the plateaux and ranges, especially at an altitude of 7,000 feet and upward, where the moisture is sufficient, the desert plants are replaced by larger growth, and considerable areas of woodland and even of dense forest abound. This is especially true in the country to the north and west of the main body of arid lands, where the Sierra Nevada, Cascade, and Coast ranges are thickly clothed with forests, among which are the groves of giant sequoias, the largest of existing trees.

It has been estimated that in the aggregate there are on the public lands lying within the arid or semiarid portions of the western public land states over 75,000,000 acres of forest, and besides this over 118,000,000 acres of land upon which scattering trees suitable for firewood, fencing, or other farm purposes are to be found. The public land areas have in their forests vast potential values, the ultimate realization of which is dependent, however, upon proper protection and conservation.

The first necessity of the pioneer in the West is water; next to this grazing for his animals, and then wood for fuel and for purposes of construction. As settlement progresses the demand for wood increases—more houses must be erected, more fences built, more fuel consumed, and as mines are discovered and worked, wood in greater quantities is called for. The demand is ever growing, and many industries are dependent for success upon the ability to obtain lumber, timber, or firewood at low prices. With the great distances between centers of population and the expense of transportation in our sparsely settled West, the utilization of many resources is closely connected with the ability to obtain the neccessary wood near by, and with the relatively small areas of forest and the unfavorable conditions for rapid growth, it becomes important to perpetuate the wooded areas, so as to provide for the needs of the near future.

It is not alone, however, as furnishing a supply of material for industrial purposes that the forests have value. There is a belief prevailing throughout the country that the water supply for irrigation is dependent to a certain extent in quantity, and perhaps still more in continuity, upon the preservation of the forests upon the headwaters of the streams. Without water the great arid West is worthless, for not even mining can be carried on unless a moderate supply of water is available, and, as a matter of course, stock raising is also impracticable unless water exists near the open range. Everything, therefore, that affects the supply of water in a land of drought must be looked upon with the keenest solicitude, not only by the inhabitants of the country, but by the owners of the land, the people of the United States. It would seem, therefore, as though every effort should be made to ascertain the extent, value, and influence of the forest and to guard the perpetuity of the supplies of water and of wood.

In order to obtain a clear conception of the relative extent of the woodland and forest of the West, the following table is inserted, giving the area in acres of the seventeen western states and territories, and also the extent of the forest, the woodland, and the treeless area. There is also added a table showing the area of improved land in each of these political divisions in order to illustrate to what a small relative extent settlement has already progressed. In this table the classification has been attempted between the land which bears forests in whole or part and that where the conditions of soil and climate are such that only scattering wood is produced. Such a distinction must, of course, be arbitrary and crude, but for the present discussion it serves to convey general ideas.

*Forest, Woodland, Treeless, and Improved Areas in Western Public-land States**

States and Territories.	Land surface.	Forest.*a*	Woodland.	Treeless.	Improved.*b*
	Acres.	*Acres.*	*Acres.*	*Acres.*	*Acres.*
Arizona..	72,268,800	10,000,000	8,700,000	53,464,672	104,128
California........	99,827,200	18,000,000	27,000,000	42,604,361	12,222,839
Colorado.........	66,332,800	10,600,000	14,000,000	39,909,280	1,823,520
Idaho	53,945,600	10,800,000	21,600,000	20,939,238	606,362
Indian Territory.	19,840,000	8,000,000	5,000,000	6,840,000	....
Kansas	52,288,000	4,000,000	....	25,984,699	22,303,301
Montana.........	92,998,400	17,000,000	18,600,000	56,482,883	915,517
Nebraska........	49,177,600	1,500,000	....	32,429,895	15,247,705
Nevada..........	70,233,600	1,000,000	5,300,000	63,210,548	723,052
New Mexico.....	78,374,400	4,700,000	16,500,000	56,911,294	263,106
North Dakota....	44,924,800	400,000	....	39,866,785	4,658,015
Oklahoma	24,851,200	500,000	....	23,787,472	563,728
Oregon	60,518,400	20,600,000	17,000,000	19,402,400	3,516,000
South Dakota...	49,184,000	1,000,000	....	41,224,707	6,959,293
Utah	52,601,600	8,400,000	14,200,000	29,453,377	548,223
Washington......	42,803,200	23,500,000	9,000,000	8,482,368	1,820,832
Wyoming........	62,448,000	7,500,000	10,000,000	44,471,169	476,831
Total........	992,617,600	147,500,000	166,900,000	605,465,148	72,752,452
Per cent.........	100	14.86	16.81	61	7.33

a Report of the Secretary of Agriculture for 1893, pp. 317, 318.
b Abstract of the Eleventh Census, 1890, Washington, 1894, pp. 62, 63.

The figures given in this table have been used in the construction of the following diagram, which brings to the eye graphically the relative area of the different states and territories of the West and also the amount and proportion of the various classes of land. The length of the horizontal bar opposite the name of each state and territory is made proportional to the area of this political division. Each bar is divided into three or four divisions, the open or white part being proportional to the extent of the treeless land, the cross-hatched portion proportional to the area of the woodland, and the solid black to that of the forest. To the right of this in a few cases, notably in California, is given the relative extent of improved land. In some of the other states this is so small that it can scarcely be distinguished.

* The Public Lands and their Water Supply, by F. H. Newell. Extract from the 16th Annual Report of the U. S. Geological Survey, part ii, p. 482.

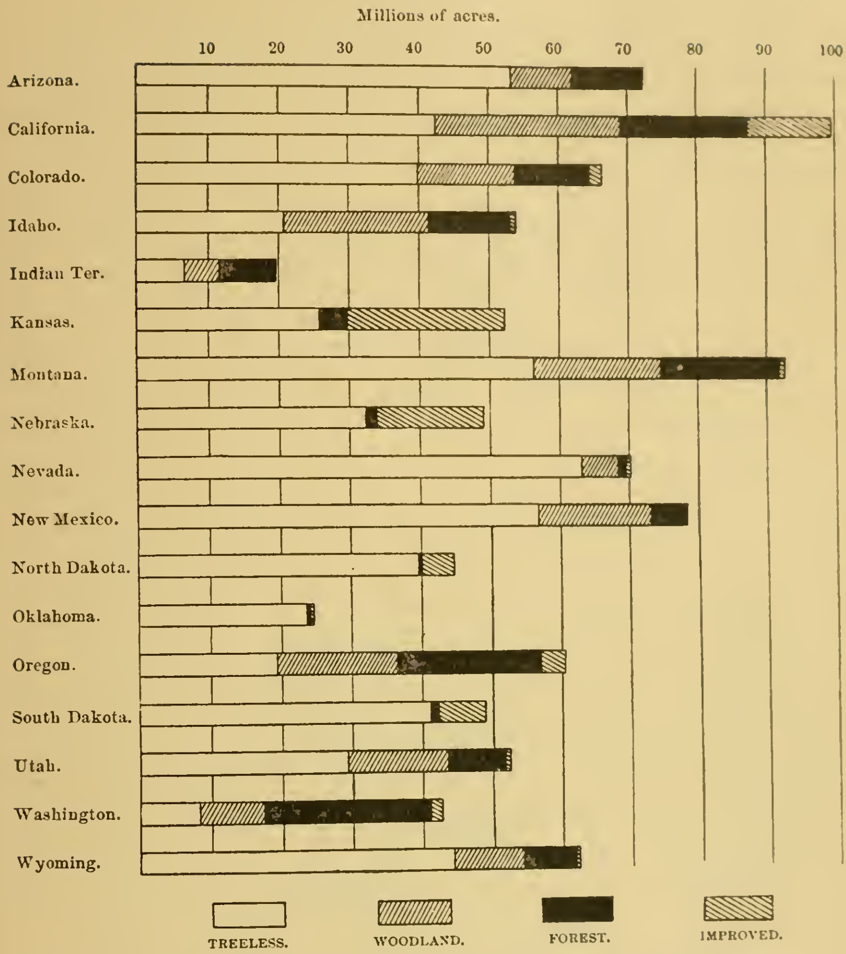


Diagram illustrating relative areas of forest, woodland, treeless, and improved land in the western states.

In the table and diagram the whole of each state and territory was considered, but since from 3 to 50 per cent or even more of the area of these states and territories has been disposed of, the general public, as the owners of the remainder, are more immediately concerned with that part which is still vacant. The *following table* gives the amount of vacant land in each of 15 states and territories, Kansas being omitted as having a very small area of public land, while Indian Territory is not considered, from the fact that all the land is at present reserved for the use of the Indians. There is also given in round numbers a classification of the vacant land into grazing or treeless, woodland, forest, and desert. To the right of this is appended a somewhat crude estimate as to the area that can be supplied with water for agricultural purposes, assuming that all the available supply is utilized. This assumption, of course, involves so many contingencies as regards conservation of floods, development of underground supplies, and other conditions that it is open to criticism, but nevertheless it may be useful as showing present opinions in the matter.

Vacant Lands in the Western Public-land States *

States and Territories.	Vacant.		Millions of acres.				
	Square miles.	Acres.	Grazing.	Wood.	Forest.	Desert.	Water supply.
Arizona	85,908	54,981,120	30	3	7	15	2
California	90,215	57,737,600	27	5	6	19	17
Colorado	66,934	42,837,760	30	7	6	0	8
Idaho	75,099	48,063,360	19	20	8	0	5
Montana	114,057	72,996,480	50	13	10	0	11
Nebraska	17,186	10,999,040	11	0	0	0	2
Nevada	104,571	66,925,440	42	5	0	20	2
New Mexico	85,302	54,593,280	45	8	2	0	4
North Dakota	33,090	21,177,600	21	0	0	0	1.5
Oklahoma	15,213	9,736,320	9	0	0	0	1
Oregon	55,887	35,767,680	17	11	9	0	3
South Dakota	25,204	16,130,560	15	0	1	0	1.5
Utah	67,308	43,077,120	16	11	6	10	4
Washington	32,757	20,964,480	6	5	10	0	3
Wyoming	83,644	53,532,160	36	8	5	5	9
Total	952,375	609,520,000	374	96	70	69	74

The following diagram has been prepared to show graphically the facts expressed by the figures in the foregoing table. By comparison with the preceding table and diagram it will be seen that a considerable proportion of the forest areas has already passed out of the hands of the government, but that in round numbers about seventy million still remain, and though only about half of the whole extent of forest it is still a matter of great importance, especially as nearly all of this is included within

* The Public Lands and their Water Supply, p. 494.

the boundaries of the arid region, where wood and water have the highest value.

It is now generally accepted that only a small proportion of the fertile lands of the West can ever be irrigated, owing to the inadequacy of the water supply. Such being the case, it is ob-

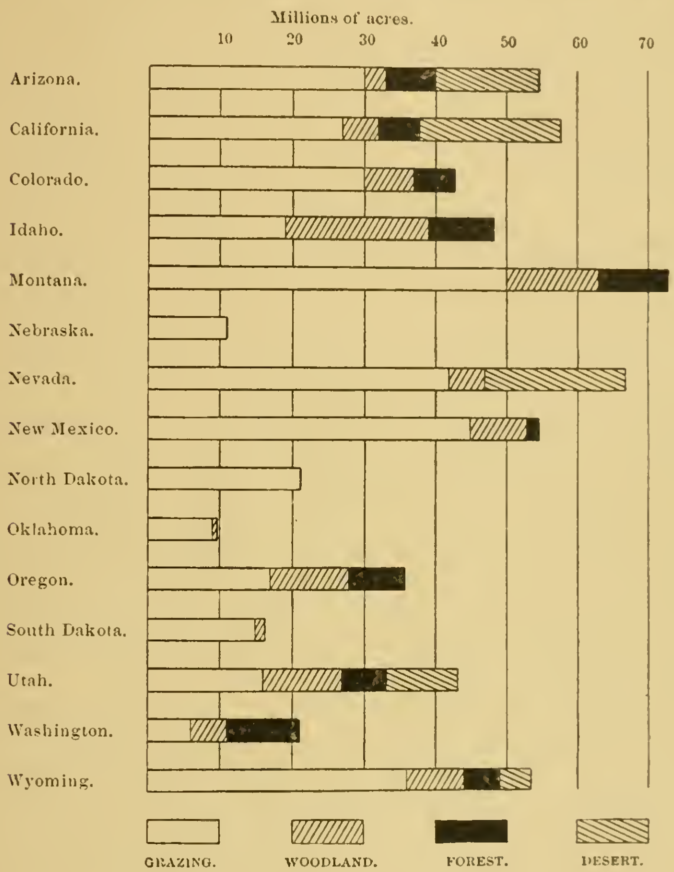


Diagram illustrating proportion of vacant lands, classified according to grazing, woodland, forest, and desert areas.

vious that much of the land has little or no value, except as furnishing scanty grazing. Agricultural land values thus rest directly upon the ability to obtain water, and as this is limited, the great bulk of the area of the West must apparently always be devoted to pastoral purposes or to the growing of trees, where the conditions are such that these will thrive. The United

States must therefore continue to be a great landowner, unless the lands are disposed of wholesale to states or to corporations. The unoccupied lands are now open, furnishing free pasturage to all persons who have cattle, horses, sheep, or goats, and the woodlands are almost equally free to be cut and burned by settlers. A few restrictions have been imposed with the intention of preventing the wholesale depredations of the forests by lumber companies, but these have in the main been ineffective, the great companies being able to cut almost without limit.

The question may be asked, Why should not the government allow every one to take what lumber he desires, as in the case of the mineral wealth, where mines, when found and operated, become the property of the discoverers, irrespective of their value? The radical difference between these two sources of wealth lies in provision for the future. In the case of mining, ordinarily no amount of foresight will increase the quantity of mineral available for the next generation, but with the forests the reverse is the case. It has been argued by men familiar with the subject that as matters are now proceeding the timber supply in many localities will be entirely destroyed within a half generation, while with a moderate exercise of prudence the supplies may be made practically continuous, guaranteeing the perpetuity of many industries. As owners of the forests, the people of the United States should, from motives of prudence, see that these resources are not wasted, and still more, as owners of vast tracts of land dependent for utilization to a greater or less degree upon the forests, should they make most strenuous exertions to indefinitely preserve the latter.

But it may further be asked whether any special steps need be taken to preserve the forests. Will not the local and individual interests be sufficient to guard against waste? Theoretically this may be possible, but the experience of mankind in the old world and in this has shown that individual and present profits are as a rule placed far above public and remote interests. In other words, while the farmer usually needs no interference or urging in maintaining the fertility of his wheat field and adopting methods that will secure the largest crop each year, he does require some strong incentive to maintain forests or woodlands in which he is but a small owner and from which the crop may be cut only once in a generation. An agency of longer life than that of ordinary men is needed to sustain the work of forest production—such an agency, in short, as is the state or nation.

If we admit that something should be done to secure the perpetuity of the great public forests, the query at once arises as to what it should be and how we should go about it. The most direct way would undoubtedly be to at once reserve all forest lands, have them surveyed and examined, appoint suitable men to take charge of them, to protect them from fire, to designate trees that may be cut, and to attend to the details of the utilization and preservation of the tree growth. A system of this kind once fairly under way would unquestionably be more than self-sustaining and would bring to the government a considerable and constantly increasing income, besides furnishing a perpetual supply of timber, protecting the sources of water, and adding to the natural attractions which draw tourists to remote parts of the country. But such a step involves many radical changes. The people as a whole are not educated up to it. Those in the West are afraid of interference in local concerns, and those of the East are fearful lest large expenditures should be incurred. As a compromise, therefore, the friends of forestry have proposed that, instead of taking all the forests, certain specified spots should be designated, and that these should be reserved for forestry purposes in the hope that later some provision might be made for carrying out a system outlined above, and that the system, if it proved efficient, might be extended gradually further and further. Accordingly many bills have been introduced into Congress, but have all failed from one cause or another. At length, after many failures, a clause was inserted in "An act to repeal timber-culture laws, and for other purposes," approved March 3, 1891, providing, "That the President of the United States may from time to time set apart and reserve in any state or territory having public land bearing forests, in any part of the public lands, wholly or in part covered with timber or undergrowth, whether of commercial value or not, as public reservations, and the President shall, by public proclamation, declare the establishment of such reservations and the limits thereof."

The then Secretary of the Interior, the Hon. John W. Noble, took great personal interest in this matter of forest reservation, and through his active assistance the friends of the forestry movement were able to secure the proclamation by President Harrison of fifteen reservations, having an aggregate area of over thirteen million acres. They then renewed their efforts to secure suitable legislation and energetically supported the attempts made to pass laws allowing the reservations to be protected and properly utilized. Among others, the McRae bill (H. R. 119) was passed twice by the House, and in a slightly different form once by the Senate, but failed of final consideration. Soon after the beginning of his administration President Cleveland proclaimed two reservations, one of these, the Cascade Range Forest Reserve, in Oregon, being of enormous size, embracing nearly four and a half million acres.

As session after session of Congress passed without the needed legislation to protect these reservations, the friends of forestry united upon a new line of action. The American Forestry Association, in its executive sessions, drew up a letter, subsequently signed by the Secretary of the Interior, the Hon. Hoke Smith, calling upon the National Academy of Sciences for information upon the whole subject. Secretary Smith also asked that Congress appropriate the sum of $25,000 for this purpose. In the act approved June 11, 1896, this amount was accordingly set aside "to enable the Secretary of the Interior to meet the expenses of an investigation and report by the National Academy of Sciences on the inauguration of a national forestry policy for the forested lands of the United States." The commission appointed by the President of the Academy at once took up the subject and as soon as practicable visited many of the forestry areas of the West, making a preliminary report to the Secretary of the Interior on February 1, 1897, recommending the establishment of thirteen additional forest reserves. The recommendation was at once acted upon, and on February 22 President Cleveland proclaimed the thirteen reserves, containing an estimated area of over twenty-one million acres.

The commission in this preliminary report recognized the difficulty of securing suitable legislation for the protection of the forests or of the reservations, and accordingly used, as one of its arguments for making these reservations, the fact that a greater number of persons would be induced by self-interest to urge upon Congress the enacting of laws which public interests alone have not been sufficient to bring about. The commission "believes that the solution of this difficult problem [of forest management] will, however, be made easier if reserved areas are now increased, as the greater the number of persons interested in drawing supplies from the reserved territory or in mining in them, the greater will be the pressure on Congress to enact laws permitting their proper administration." The wisdom of this argument was seen in the demand from the West for immediate action on the part of Congress. This demand resulted in the insertion in the sundry civil bill that became a law June, 1897, of a number of paragraphs which put into effect at once many of the provisions of the McRae bill. The legislation thus secured, while open to criticism in many directions, marks a distinct progress and is undoubtedly the best that can be had under the circumstances, where such a large and influential body of citizens are interested in preventing any measure which shall interfere with their obtaining practically for nothing the great stores of public timber.

The bill provides for the immediate survey of the boundaries and for the suspension until March 1, 1898, of the thirteen reservations proclaimed on February 22, 1897. It is explicitly declared that "no public forest reservations shall be established except to improve and protect the forest within the reservation, or for the purpose of securing favorable conditions of water flows, or to furnish a continuous supply of timber for the use and necessities of citizens of the United States; but it is not the purpose or intent of these provisions . . . to authorize the inclusion therein of lands more valuable for the mineral therein or for agricultural purposes than for forest purposes."

Authority is given to the Secretary of the Interior to make suitable regulations for protection against fire and depredations and for the sale of dead, matured, or large growth of trees. On the other hand, the rights of prospectors and miners are carefully guarded by the statement that "nor shall anything herein prohibit any person from entering upon such forest reservations for all proper and lawful purposes, including that of prospecting, locating, and developing the mineral resources. Settlers, miners, residents, and prospectors may be permitted to use timber for firewood, fencing, buildings, mining, and domestic purposes."

GEORGE W. MELVILLE

ENGINEER-IN-CHIEF, U. S. NAVY

THE NATIONAL GEOGRAPHIC MAGAZINE presents to its readers with this number a portrait of one of the most distinguished members of the Society of whose proceedings it is the exponent. Born in the city of New York January 10, 1841, young Melville, after graduating in the Polytechnic School of Brooklyn, acquired a thoroughly practical knowledge of engineering in the works of James Binns of that city. Stirred to patriotic effort by the outbreak of the rebellion, he entered the Navy July 29, 1861, and became an officer of the Engineer Corps of that service before attaining his majority. Constantly on sea duty, Melville saw service on the Great Lakes, in the North Atlantic blockading squadron, at the capture of Norfolk and in the operations on James river, on the Mississippi river, in the capture of the *Florida*, and as a volunteer in one of the torpedo boats at the capture of Fort Fisher. His most conspicuous war service was in connection with the capture of the *Florida* in the harbor of Bahia, Brazil, Melville, in civilian clothing, boarding the vessel in broad daylight and gaining the desired information as to the strength of her battery and the location of her machinery. In the capture of the *Florida* on the following morning Melville displayed his usual bravery, and was one of the three men wounded in the affair. His war services were such that Engineer-in-Chief Loring officially wrote, "With the high reputation this gentleman has throughout the service for professional skill, executive ability, energy, and zeal, . . . it is no disparagement to his fellows to say that he has not his superior in his corps."

The dangers of war past, Melville sought the first opportunity for adventurous service elsewhere, and volunteering for service in the *Tigress*, formed one of the search party for the missing crew of the *Polaris*. The *Tigress*, under Commander Greer, reached the deserted camp of the *Polaris*, near Littleton island, the success of the voyage being largely owing to Melville's "great fertility of resource, combined with thorough practical knowledge."

His most conspicuous arctic service was under Lieut. D. W. De Long in the *Jeannette*, which attempted to solve the polar problem *via* Bering strait. As will be recalled, the *Jeannette*, beset by the pack in the neighborhood of Wrangel island in September, 1879, drifted almost steadily to the westward until she was crushed by ice-floes and sank June 12, 1881, in 77° 15′ N., 155° E. During this long and monotonous drift Melville's qualities as a man and his efficiency as an officer were conspicuously displayed; now it was a series of engineering problems which saved from foundering the leaking *Jeannette*, again it was physical endurance and will-power as the leader of an exploring party that enabled him to reach and survey Henrietta island, the first of De Long's discoveries. It was under the most desperate conditions, however, that Melville's spirit and abilities were practically indispensable—when the *Jeannette* sank five hundred miles from the Lena Delta.

Lieutenant Danenhower being disabled and Lieutenant Chipp sick, De Long's main dependence was in his chief engineer, Melville, who was well, strong, energetic, and fertile in resources. It is unnecessary to dwell on the dangers and hardships which this unprecedented journey entailed on the members of this party, which were met with fortitude, courage, and energy that made its successful issue one of the most notable efforts in the history of man, overcoming obstacles almost insurmountable. It is only to be said that in this fearful journey for life Melville, as the right arm of De Long, was full of energy and expedients. Such was De Long's confidence in Melville, that, when the three boats left Bennet island, De Long placed the whale-boat entirely under his orders, although Danenhower was placed therein. This unusual step was fully justified by the events, as Melville's boat's crew was the only one that was saved, Chipp perishing at sea and De Long in the Lena Delta. When De Long's desperate condition became known, it was Melville's heroic spirit and personal daring that ventured the unsuccessful autumnal search and later, in the brighter but more fearful polar spring, discovered the remnant of De Long's unselfish crew and secured for them a Christian burial. Congress, in 1890, promoted him fifteen numbers "as a recognition of his meritorious services in successfully directing the party under his command after the wreck of the Arctic exploring steamer *Jeannette*, and of his persistent efforts, through dangers and hardships, to find and assist his commanding officer and other members of the expedition before he himself was out of peril."

In 1883 Melville volunteered to lead a relief party for the rescue of the Lady Franklin Bay Expedition, which had that autumn retreated under orders to Cape Sabine, and when the government rejected a proposition, the heroic Melville sailed in the expedition of 1884 commanded by Captain Schley, and was one of the first officers to reach the living remnant of the expedition, and thus closed with credit his service afloat.

Selected in 1887 as Chief Engineer of the Navy with the relative rank of Commodore, he has discharged the important duties of this office with such professional fitness and administrative ability as to merit universal praise. During this period the United States Navy has been substantially reorganized and with a degree of success that has enlisted the admiration of the world.

As the engineering head of more than sixty vessels of all types, from torpedo boats to battle ships, it may at least be said with perfect safety, that as much to Commodore Melville as to any other man in the Navy is due its remarkable degree of efficiency as regards its vessels and its materials.

In recognition of his professional ability, of his Arctic career, and of his qualities as a man, George Wallace Melville has been the recipient of distinguished honors from governments and scientific institutions not only of America, but also of foreign countries. A. W. G.

GEOGRAPHIC SERIALS

The Journal of the Royal Colonial Institute for May contains an extremely interesting article, entitled "Western Canada Before and Since Confederation," by Sir Donald A. Smith. It comprises an outline of the history of the region while it was under the control of the Hudson's Bay Company and a summary of its development since it became a part of the Dominion of Canada.

The June number of the same Journal contains a paper on the "Colony of Largos, by Sir Gilbert T. Carter. It is mainly a history of this little colony of Western Africa, with a summary of its present trade and social conditions.

The Scottish Geographical Magazine for May opens with an article by Nansen, entitled "Some Results of the Norwegian Arctic Expedition," accompanied by a map. It contains also an account of a trip to Mount Tarawera in New Zealand, with an account of the topographic changes produced by its great eruption in 1886. This is illustrated by a map showing the present topography of the surrounding region.

The June number of *The Scottish Geographical Magazine* contains an important article by Dr Robert Bell on the "Geographical Distribution of Forest Trees in Canada." Mr W. Saville Kent writes on "The Market Fishes and Marine Commercial Product of Australia."

The Geographical Journal contains several articles of interest. Nansen contributes "Some Results of the Norwegian Arctic Expedition," which is followed by a discussion on the North Polar problem. "The Mesopotamian Petroleum Field" is described by Capt. F. R. Maunsell. "The Formation of the Dungeness Foreland" is described by Mr F. P. Gulliver, and a summary is given of recent "Russian Expeditions in Tibet."

The Quarterly Journal of the Manchester Geographical Society contains a number of articles of interest, among them "The Growth and Progress of the Australian Colonies," by Mr W. Harper, which is accompanied by a relief map; "Meteorology of Queensland," by Mr Clement L. Wragge; "The Suez Canal," by Mr Isaac Bowes, and "The Nicaragua Canal, as Proposed by the Maritime Canal Company," by the same gentleman; "The Canals and Navigable Rivers of England," by Mr Lionel B. Wells;

"The Earthquakes of Iceland in 1896," by Mr John R. Newby; "Physical Geography of Northeast Lancashire," by Mr Herbert Bolton.

The Technological Quarterly for March contains, among other papers, an interesting article on "The Scientific Work of the Boston Party on the Sixth Peary Expedition to Greenland," by Mr G. R. Putnam. Besides giving a narrative of the expedition, this article contains a summary of the Magnetic and Pendulum Observations.

The Sierra Club Bulletin for May opens with an article on "The Conifers of the Pacific Slope," by Mr John G. Lemmon. An entertaining story is contributed by Helen M. Gompertz, entitled "Up and Down Bubbs Creek," and Mr Bolton Coit Brown continues his "Wanderings in the High Sierra."

The Journal of Geology for February-March contains an article by Prof. R. D. Salisbury on the "Drift Phenomena in the Vicinity of Devils Lake and Baraboo, Wisconsin," describing the formation of the strange glacial deposits of that region. The same journal for April-May continues the "Glacial Studies in Greenland" of Prof. T. C. Chamberlin.

The Journal of the Tyneside Geographical Society for May devotes half its space to Nansen's explorations. For the rest it contains a narrative of a journey in Benin by James Pinnock and T. B. Auchterlonie, and summaries of lectures delivered before the society.

H. G.

PROCEEDINGS OF THE NATIONAL GEOGRAPHIC SOCIETY, SESSION 1896–'97

Special Meeting, May 7, 1897.—President Hubbard in the chair. Mr Walter Dwight Wilcox read a paper, with lantern illustrations from original photographs, on Scenery and Camp Life in the Canadian Rockies.

Annual Meeting, May 14, 1897.—President Hubbard in the chair. The Treasurer read a progress report on the condition of the Society's finances, postponing the presentation of a complete report until the close of the fiscal year. A committee, consisting of Messrs W. A. De Caindry, H. C. Rizer, and S. A. Aplin, Jr., was appointed to audit the Treasurer's accounts. Mr Marcus Baker, Col. H. F. Blount, Lieut. E. Hayden, U. S. N., Dr C. Hart Merriam, and Prof. W. B. Powell were reëlected members of the Board of Managers, and Mr Frederick V. Coville, Botanist of the U. S. Department of Agriculture, was elected in place of Mr J. B. Wight, whose newly assumed duties as a Commissioner for the District of Columbia prevented him from offering himself for reëlection. The meeting adjourned until Friday, June 11, 1897.

Special Meeting, May 21, 1897.—President Hubbard in the chair. The meeting was devoted to the following papers in connection with the approaching excursion to Manassas Gap: The Blue Ridge and Piedmont Plateau, Prof. W J McGee; Manassas to Manassas Gap, a Chapter of War History, Major Jed Hotchkiss.

Annual Excursion and Field Meeting, May 22, 1897.—About 250 members and guests went by special train, leaving Washington at 9 a. m., *via* Manassas and Thorofare Gap, to Manassas Gap, Va. On arrival, at 11.15 a. m., a field meeting was held in the open air, President Hubbard in the chair, and addresses were delivered by Major Jed Hotchkiss, on War History; Mr M. R. Campbell, on the Geography and Geology of the Region; and Gen. Chas. H. Grosvenor, M. C. Lunch was then served, after which an ascent of Mt. Monterey, to the northward, was made by many of the party, a few climbing High Knob, to the southward. The return to Washington was made at 4.30 p. m., arriving at 6.30.

Adjourned Annual Meeting, June 11, 1897.—Vice-president Merriam in the chair. The annual report of the Recording Secretary was read and accepted. The annual report of the Treasurer was read and referred to the Auditing Committee. The Recording Secretary stated that as no printed notice of pending amendments to the By-laws had been sent to members, owing to his enforced absence from the city, they could not properly come up for final action at that meeting. Said amendments are as follows:

Article V. Add "No initiation fee shall be required of ex-members in case of their reëlection to membership. Annual dues shall be reduced one-half for the current season in the case of members elected after the end of January, or who resign before that date; and they shall be remitted altogether for the current season in the case of members elected in April and May, upon payment of full dues for the following season." Omit "Suitable rebates may be made, in the discretion of the Board of Managers, in the annual dues of members elected in April and May."

Omit "within thirty days after election" (payment of dues by new members), and add "upon notice of election, and no certificate of election shall be issued until the required first payment shall have been made."

After "Annual dues may be commuted and life membership acquired by the payment of fifty dollars" add ", or, by ex-members or members who have already paid in dues as much as fifty dollars, by the additional payment at one time of twenty-five dollars."

Add "Suitable restrictions may be made in the issue of tickets and publications to members in arrears."

Article VI. Omit "The Board of Managers shall set apart a time and place for the annual address of the President and Vice-presidents."

Article VII. Insert after "which (the magazine) shall be sent to all members of the Society," insert "not in arrears of dues." Add at end of same paragraph, "The number issued next after the annual meeting shall contain the By-laws and a list of the Officers and Members of the Board of Managers."

Elections—*May 7.*—Geo. F. Curtis, Elmer S. Farwell, Alpheus H. Hardy, Evert L. Harvey, Prof. Jos. V. Jackman, John P. Logan, Hon. L. T. Michener, Henry T. Offterdinger, Miss J. A. Read, Clinton Smith, Herbert Wright.

June 11.—L. S. Brown, Lieut. J. B. Cahoon, U. S. N., John G. Gosseling, Niels Grön, Judge Martin F. Morris, Miss Morris, James B. Pinkerton, Hon. Theodore Roosevelt, Miss Louise Taylor.

CHESAPEAKE & OHIO RY.

THE F. F. V. LIMITED is one of the finest trains hauled over any railway track in America. It runs solid between Cincinnati and New York, the route from Washington being over the Pennsylvania system. It has every modern convenience and appliance, and the dining-car service has no superior if it has an equal. The road-bed is literally hewed out of the eternal rocks; it is ballasted with stone from one end to the other; the greater portion is laid with one-hundred-pound steel rails, and although curves are numerous in the mountain section, the ride is as smooth as over a Western prairie.

One of the most delightful rides in all the route is that through the New River valley. The mountains are just low enough to be clad with verdure to the very top, and in the early spring every variety of green known to the mixer of colors can be seen, while the tones in autumn take on all the range from brown to scarlet.

These facts should be borne in mind by the traveler between the East and the West.

H. W. FULLER, *Genl. Pass. Agent, Washington, D. C.*

CLIMB MOUNT RAINIER

WITH THE MAZAMAS.

14,532 FEET HIGH.

14,532 FEET HIGH.

IN JULY AND AUGUST

NORTHERN PACIFIC.....

this club of mountaineers of the North Pacific Coast will ascend this mountain of ice. Men and women in large numbers are expected to accomplish the feat. They will remain one night on the summit, among the warm ice caves there.

The climb is not compulsory. Those who desire can remain in camp at Paradise Park and enjoy botanizing and exploring. Scientific work will be a part of the program.

Send six cents to CHAS. S. FEE, *Gen. Pass. Agent, N. P. R'y, St Paul, Minn.,*

For Wonderland '97 and a Mazama Pamphlet.

SOUTHERN RAILWAY

GREATEST SOUTHERN SYSTEM.

Penetrates with its main line or branches eight States South of the Ohio and Mississippi Rivers, and in conjunction with its friendly allied connections reaches all the commercial centers of the South and Southwest . . .

DOUBLE DAILY VESTIBULED LIMITED TRAINS

. . . BETWEEN . . .

Washington and Nashville via Salisbury, Asheville, Knoxville and Chattanooga.
Washington and Tampa via Columbia, Savannah and Jacksonville.
Washington and Memphis via Atlanta, Birmingham and K. C. M. & B.
Washington and New Orleans via Atlanta, Montgomery and Mobile.
Norfolk and Chattanooga via Salisbury, Asheville and Knoxville.

Pullman Sleeping Cars—Dining Cars—Day Coaches.
Additional Trains for local travelers . . . .

The direct line to the Winter Resorts of { FLORIDA, GULF COAST and TEXAS, ... MEXICO and CALIFORNIA,

—AND THE BEST—

Through Car Line to and from Asheville and Hot Springs—"The Land of the Sky."

Write for Map Folders.

R. D. CARPENTER, General Agent, 271 Broadway, New York City.
L. S. BROWN, General Agent Passenger Department, Washington, D. C.
J. H. WINGFIELD, Passenger Agent, Norfolk, Va.
S. H. HARDWICK, Assistant General Passenger Agent, Atlanta, Ga.
C. A. BENSCOTER, Assistant General Passenger Agent, Chattanooga, Tenn.
W. H. TAYLOE, Assistant General Passenger Agent, Louisville, Ky.
J. M. CULP, Traffic Manager. W. A. TURK, General Passenger Agent.

The Mutual Life Insurance Co.

OF NEW YORK,

RICHARD A. McCURDY, President,

Is the Largest Insurance Company in the World.

The Records of the Insurance Department of the State of New York SHOW THAT The Mutual Life

Has a Larger Premium Income - - -	($39,000,000)
More Insurance in Force - - - - - -	($918,000,000)
A Greater Amount of Assets - - - - -	($235,000,000)
A Larger Annual Interest Income - - -	($9,000,000)
Writes More New Business - - - - -	($136,000,000)
And Pays More to Policy-holders - -	($25,000,000 in 1896)

THAN ANY OTHER COMPANY.

It has paid to Policy-holders since its organization, in 1843, } - - $437,005,195.29

ROBERT A. GRANNISS, Vice-President.

WALTER R. GILLETTE, General Manager. FREDERIC CROMWELL, Treasurer.
ISAAC F. LLOYD, Second Vice-President. EMORY McCLINTOCK, Actuary.
WILLIAM J. EASTON, Secretary.

Burlington Route

TO

ST. PAUL

MINNEAPOLIS

BEST LINE

CHICAGO OR ST. LOUIS

Ripans Tabules cure headache.

The Fastest and Finest Train in the West . . . .

IS

UNION PACIFIC

THE OVERLAND ROUTE

WORLD'S PICTORIAL LINE

The Overland Limited

......TO......

UTAH and CALIFORNIA.

FROM 16 TO 20 HOURS
SAVED BY USING

"THE OVERLAND ROUTE."

Double Drawing-Room Pullman Sleepers.
Free Reclining Chair Cars.
Pullman Dining Cars.
Buffet Smoking and Library Cars.

Send for Descriptive Pamphlet "49-96,"
Folders and other Advertising Matter.
(Mention this publication.)

E. L. LOMAX,
General Passenger and Ticket Agent,
OMAHA, NEB.

THE CHICAGO, MILWAUKEE AND ST. PAUL RAILWAY

. . RUNS . .

Electric Lighted and Steam Heated Vestibuled Trains between **Chicago, Milwaukee, St. Paul and Minneapolis** daily.

Through Parlor Cars on day trains between **Chicago, St. Paul and Minneapolis.**

Electric Lighted and Steam Heated Vestibuled Trains between **Chicago and Omaha and Sioux City** daily.

Through Sleeping Cars, Free Reclining Chair Cars and Coaches between **Chicago and Kansas City, Mo.**

Only two hours from Chicago to Milwaukee. Seven fast trains each way, daily, with Parlor Car Service.

Solid trains between **Chicago** and principal points in **Northern Wisconsin** and the **Peninsula of Michigan.**

Through Trains with Palace Sleeping Cars, Free Reclining Chair Cars and Coaches between **Chicago** and points in **Iowa, Minnesota, Southern and Central Dakota.**

The **finest Dining Cars** in the World.

The **best Sleeping Cars. Electric Reading Lamps in Berths.**

The best and latest type of **private Compartment Cars, Free Reclining Chair Cars, and buffet Library Smoking Cars.**

Everything First=class. First-class People patronize First-class Lines.

Ticket Agents everywhere sell tickets over the Chicago, Milwaukee and St. Paul Ry.

GEO. H. HEAFFORD,
General Passenger Agent, Chicago, Ill.

WHENEVER YOU VISIT WASHINGTON . . .

YOU ARE INVITED TO INSPECT THE

✻ MAMMOTH DRY GOODS ESTABLISHMENT ✻

OF

WOODWARD & LOTHROP

Where the **LATEST PARIS NOVELTIES** are always on Exhibition. The attention of those who anticipate purchasing . . . .

BRIDAL TROUSSEAUX

Is invited especially to extreme Paris Novelties in matched sets of French Hand-made Lingerie, including Gowns, Skirts, Chemises, Drawers, Corset Covers, &c. These can be furnished in any number of pieces desired. . . . .

HAND-MADE BRIDAL TROUSSEAUX, personally selected in Paris and exclusive in style and design: Three or more pieces . . . . **$10 to $250.**

CORRESPONDENCE SOLICITED. MAIL ORDERS RECEIVE PROMPT AND CAREFUL ATTENTION.

TENTH, ELEVENTH, AND F STREETS N. W. . . . . . WASHINGTON, D. C.

Shortest Line
TO
St. Paul and Minneapolis
and the Northwest

CHICAGO GREAT WESTERN
RAILWAY

"Maple Leaf Route"

For tickets, rates or any detailed information apply to your home agent or write to

F. H. LORD,
Gen'l Pass'r and Ticket Agent,
CHICAGO.

A VITAL POINT

"IMPROVEMENT THE ORDER OF THE AG ."

A TYPEWRITER'S PRINTING MECHANISM

MUST BE SCIENTIFICALLY CONSTRUCTED. THIS POINT IS OF UTMOST IMPORT FOR

EASY OPERATION AND PERFECT EXECUTION.

The Smith.. Premier Typewriters

Superior on This Point as Well as on All Others.

ONLY CORRECT PRINCIPLES EMPLOYED.

The Smith Premier Typewriter Co.,
SYRACUSE, N. Y., U. S. A.

Catalogues and Information at Washington Office, No. 1416 F Street.

AN IMPROVED METHOD OF KEEPING THE SCORE IN

DUPLICATE WHIST, COMPASS WHIST, STRAIGHT WHIST AND EUCHRE.

Since Duplicate and Compass Whist have come into fashion there has been an unprecedented revival of interest in the game, due to the fact that mere *luck* is to a large extent eliminated by a comparison of the scores made in the play of the same hands by different players.

The one thing needed to perfect the new method has been a convenient device by means of which the score made on the first round can be concealed until after the replay of the hands, as a knowledge of the first score often enables a good player to make a decisive gain, and matches are lost and won on just such little chances.

A Washington player has at length invented and put upon the market at a very low price a little device which admirably answers the purpose, and at the same time serves as a pretty and useful table ornament, marker, and pencil rest. It is called the "COSMOS COUNTER," and consists of a little polished wood tablet with a metal keyboard that can be clamped down on the score in such a way as to bring 24 little metal plates over the 24 spaces in the "score" column of the card, for use in concealing each first score as soon as recorded and until the hand is replayed (in duplicate whist) or the entire series finished (in compass whist).

Whist players will at once see the advantage of this new method of keeping the score, as it effectually prevents their opponents at the same or another table from taking advantage, either by accident or design, of a knowledge of what the hand is capable. The trouble with duplicate whist, especially, is that the replay is liable to be influenced by memory of the cards and score, and anything that helps to confuse such recollection is a great gain to fair play.

The "Cosmos Score Card," prepared for use with the counter, shows several new features, such as a heading for both Duplicate and Compass Whist and (on the reverse) for Straight Whist, Euchre, &c., thus enabling the same counter and score to be used for any game of cards.

Cosmos Counters, with tablet of quartered oak, maple, or birch, and metal in either gold or silver finish, 50 cts. apiece; 6 for $2.75; 12 for $5; by mail, 4 cts. apiece extra. Cosmos Score Cards, 25 cts. per package of 50; 12 packages for $2.50; by mail free of postage.

Ask to see samples at any stationer's, or order direct from the General Agents.

Cosmos Duplicate Whist Score

N .... E ....

S .... W ....

HAND	COMPASS WHIST					HAND
	SCORE	TOTALS	TRUMP	OPPONENTS		
	DUPLICATE WHIST					
	SCORE	GAIN	TRUMP	GAIN	SCORE	
1						1
2						2
3						3
4						4
5						5
6						6
7						7
8						8
9						9
10						10
11						11
12						12
13						13
14						14
15						15
16						16
17						17
18						18
19						19
20						20
21						21
22						22
23						23
24						24
TOTALS.						TOTALS

Copyright, 1895, by Everett Hayden, Washington, D. C. For use with the Cosmos Duplicate Whist Counter, patented July 7, 1896.

.................................., 189......

E. MORRISON PAPER CO., 1009 Penna. Avenue, Washington, D. C.

NATIONAL GEOGRAPHIC MONOGRAPHS

On the PHYSICAL FEATURES OF THE EARTH'S SURFACE, designed especially to supply to teachers and students of geography fresh and interesting material with which to supplement the regular text-book.

LIST OF MONOGRAPHS COMPRISING VOLUME I:

GENERAL PHYSIOGRAPHIC PROCESSES	J. W. Powell
GENERAL PHYSIOGRAPHIC FEATURES	J. W. Powell
PHYSIOGRAPHIC REGIONS OF THE UNITED STATES	J. W. Powell
BEACHES AND TIDAL MARSHES OF THE ATLANTIC COAST	Prof. N. S. Shaler
PRESENT AND EXTINCT LAKES OF NEVADA	Prof. I. C. Russell
APPALACHIAN MOUNTAINS—NORTHERN SECTION	Bailey Willis
APPALACHIAN MOUNTAINS—SOUTHERN SECTION	C. Willard Hayes
MT. SHASTA—A TYPICAL EXTINCT VOLCANO	J. S. Diller
THE NEW ENGLAND PLATEAU	Prof. W. M. Davis
NIAGARA FALLS AND ITS HISTORY	G. K. Gilbert

Price for one set of ten monographs, **$1.50**. Five sets to one address, **$6.00**. Single monographs, **20c.**

Remit with order to AMERICAN BOOK COMPANY,

New York - Cincinnati - Chicago

Ripans Tabules assist digestion.

TERRESTRIAL MAGNETISM

An International Quarterly Journal

Edited by L. A. BAUER
With the Co-operation of Eminent Magneticians

WITH the March, 1897, issue, this Journal, devoted exclusively to Terrestrial Magnetism and allied subjects, such as Earth Currents, Auroras, Atmospheric Electricity, etc., entered on its second volume. The hearty co-operation extended by the workers in this promising field of investigation, as abundantly shown by the numbers thus far issued, has made this Journal the international organ for making known the latest achievements. The magnetic needle has become such a promising instrument of research, not only in terrestrial, but in cosmical physics, that this Journal appeals to a large class of investigators. The geographer, the geologist, the astronomer, the meteorologist—all are interested in the development of the subject of terrestrial magnetism. It should therefore receive their support.

Among the contributors of the main articles in the past have been Messrs. Barus, Börgen, Chree, Eschenhagen, Littlehales, Rücker, Schmidt, Schuster, and de Tillo.

Future numbers will contain:

"The Earth, a Great Magnet,"
BY DR. J. A. FLEMING.

"The Electrification of the Atmosphere,"
BY PROF. ALEXANDER MCADIE.

"The Height of the Aurora,"
BY PROF. CLEVELAND ABBE.

"The Distribution of Magnetic Observatories,"
(Illustrated),
BY PROF. MAX ESCHENHAGEN,
etc., etc.

The size of the Journal is royal octavo, a volume embracing about 200 pages. Domestic subscription price: **Two dollars**; single numbers, **fifty cents**. Foreign subscription price: **Nine shillings, nine marks, or eleven francs.** Address:

TERRESTRIAL MAGNETISM,
The University of Cincinnati, Cincinnati, Ohio.

PEOPLE like to read about the great and wonderful country of the **Southwest**; of its quaint and curious towns, its ancient civilizations, its natural marvels. They like to get accurate information about **California and the Pacific Coast.** This is because most people want to some day see these things for themselves. . . . .

A charming book covering these facts is issued by the

PASSENGER DEPARTMENT
OF THE
Southern Pacific Railway,

and will be sent to any one, postpaid, on receipt of **TEN CENTS.**

THE BOOK IS ENTITLED

"Through Storyland to Sunset Seas,"

AND IS A WONDERFULLY HANDSOME VOLUME OF **205** PAGES, WITH **160** ILLUSTRATIONS. . . .

The paper used is FINE PLATE PAPER, and every typographical detail is artistic. It is a story of what four people saw on just such a trip as you would like to make. . . . .

You can get a copy by writing to

S. F. B. MORSE,
General Passenger Agent,
Southern Pacific,
New Orleans,

and sending **10 cts.** to defray postage.

THE

MAZAMA

(Spanish for Mountain Goat)

CLUB

OF MOUNTAINEERS

OF THE

NORTH PACIFIC COAST

have a GRAND OUTING

—PLANNED FOR—

JULY 17—AUGUST 9

on the slopes of **MOUNT RAINIER, WASHINGTON.** An ascent of the Peak, **14,532 feet high** and covered with ice, is part of the program.

Scientific **KITE FLYING** from the Summit, and various scientific observations under direction of men from Colleges and Government Surveys, etc., will be carried on. The general camp will be made in **PARADISE PARK.** Special arrangements for guests—everybody invited.

Address, enclosing **six cents** for literature and detailed information,

CHAS. S. FEE,

Gen. Pass. Agent, Northern Pacific Railway, St. Paul, Minn.

Among the Contents of Forthcoming Numbers of

THE NATIONAL GEOGRAPHIC MAGAZINE

WILL BE THE FOLLOWING:

The Deserts and Forests of Arizona,

By PROF. B. E. FERNOW, Ph. D., LL. D., etc.,

Chief of the Division of Forestry, U. S. Department of Agriculture;

Down the Volga, from Nijni Novgorod to Kazan,

By PROF. FREDERIC W. TAYLOR,

—— AND ——

Several of the geographical papers to be presented at the Toronto Meeting of the British Association for the Advancement of Science.

JUDD & DETWEILER, PRINTERS, WASHINGTON, D. C.

The National Geographic Magazine

AN ILLUSTRATED MONTHLY

Editor: JOHN HYDE

Associate Editors

A. W. GREELY   W J McGEE   HENRY GANNETT
C. HART MERRIAM   ELIZA RUHAMAH SCIDMORE

CONTENTS

WASHINGTON
PUBLISHED BY THE NATIONAL GEOGRAPHIC SOCIETY

AGENTS IN THE UNITED STATES AND CANADA
THE AMERICAN NEWS COMPANY, 39 AND 41 CHAMBERS STREET, NEW YORK
PARIS: BRENTANO'S, 37 AVENUE DE L'OPERA

Price 25 Cents $2.50 a Year

Entered at the Post-office in Washington, D. C., as Second-class Mail Matter

THE

National Geographic Society

ORGANIZED, JANUARY, 1888

President

GARDINER G. HUBBARD

Vice-Presidents

MARCUS BAKER
WILLIAM H. DALL
G. K. GILBERT
A. W. GREELY
C. HART MERRIAM
HERBERT G. OGDEN

Treasurer

CHARLES J. BELL

Recording Secretary

EVERETT HAYDEN

Corresponding Secretary

HENRY GANNETT

Managers

H. F. BLOUNT
F. V. COVILLE
C. W. DABNEY, Jr.
DAVID T. DAY
JOHN HYDE
W J McGEE
F. H. NEWELL
W. B. POWELL

SECRETARY'S OFFICE, 1517 H STREET N. W., WASHINGTON

The National Geographic Society, the object of which is the increase and diffusion of geographic knowledge, has a paying membership of 1,400. Its membership is not restricted to practical geographers, but is open to any person in good standing who may be sufficiently interested in its work to seek admission. The annual subscription is: for active members, $5.00 per annum; for corresponding members, $2.00 per annum. Active members pay also an entrance fee of $2.00 on election. The National Geographic Magazine is sent regularly to all members, both active and corresponding.

Donations for the founding of Prize Medals and Scholarships are respectfully solicited.

TYPICAL VIEW FROM THE BRINK OF THE GRAND CANON OF THE COLORADO

THE

National Geographic Magazine

Vol. VIII | JULY-AUGUST, 1897 | Nos. 7-8

THE VENEZUELAN BOUNDARY COMMISSION AND ITS WORK

By Marcus Baker

Cartographer, U. S. Geological Survey

On the northeast shoulder of South America, between the mouths of the great rivers Amazon and Orinoco, lies Guiana. On the extreme east and nearest the Amazon is French Guiana, or Cayenne; just west of this is Dutch Guiana, or Surinam, while the next division to the west is British Guiana, a colony of Great Britain; and this in turn is bordered on the west by Venezuela, one of the South American republics.

Between these last two, British Guiana and Venezuela, current maps show a boundary line which, starting at or near the southern mouth of the Orinoco (for there are many mouths in its 150-mile-wide delta), runs in a southerly direction into the interior. This line, speaking in only the most general terms, is the now famous Schomburgk line. This boundary is in dispute, and has been so for more than half a century. It has been a source of prolix and interminable diplomatic correspondence and negotiation, a correspondence couched in politest phrase, without concealing the earnestness, nay, bitterness, underneath. Proposals and counter-proposals had been made, but without success. Arbitration had been proposed, but until recently Great Britain had steadily refused to submit the entire disputed territory to arbitration. So the case dragged on for weary years. Finally, in 1886, some 10 years ago, Venezuela severed diplomatic relations with Great Britain and sent her official representative away.

Venezuela then sought to bring about indirectly, through the friendly aid of a third power, a settlement of the long standing and irritating controversy. The matter was taken up by our own foreign office (the Department of State) and correspondence carried on in 1895 between Secretary Olney and Lord Salisbury. Secretary Olney, in a document resembling a lawyer's brief much more than it does the ordinary diplomatic dispatch, stated the case as it appeared to him and asked that it be arbitrated. To this Lord Salisbury replied in two careful and most courteous dispatches (as diplomatists are wont to call letters), declining general arbitration.

Thereupon President Cleveland, on December 17, 1895, sent to Congress this correspondence, accompanied by a brief but now famous message—a message of which, without exaggeration, it may be said that it startled the civilized world. After summarizing the correspondence and commenting upon Lord Salisbury's two replies, President Cleveland proceeded as follows:

In the belief that the doctrine for which we contend (the Monroe doctrine) was clear and definite, that it was founded upon substantial considerations and involved our safety and welfare, that it was fully applicable to our present conditions and to the state of the world's progress, and that it was directly related to the pending controversy, and without any conviction as to the final merits of the dispute, but anxious to learn in a satisfactory and conclusive manner whether Great Britain sought, under a claim of boundary, to extend her possession of territory fairly included within her lines of ownership, this government proposed to the government of Great Britain a resort to arbitration as the proper means of settling the question, to the end that a vexatious boundary dispute between the two contestants might be determined and our exact standing and relation in respect to the controversy might be made clear.

It will be seen from the correspondence herewith submitted that this proposition has been declined by the British government upon grounds which, in the circumstances, seem to me to be far from satisfactory. It is deeply disappointing that such an appeal, actuated by the most friendly feelings toward both nations directly concerned, addressed to the sense of justice and to the magnanimity of one of the great powers of the world and touching its relations to one comparatively weak and small, should have produced no better results.

The course to be pursued by this government, in view of the present condition, does not appear to admit of serious doubt. Having labored faithfully for many years to induce Great Britain to submit this dispute to impartial arbitration, and having been now finally apprised of her refusal to do so, nothing remains but to accept the situation, to recognize its plain requirements and deal with it accordingly. Great Britain's present proposition has never thus far been regarded as admissible by Venezuela, though any adjustment of the boundary which that country may deem for her advantage and may enter into of her own free will cannot of course be objected to by the United States.

Assuming, however, that the attitude of Venezuela will remain unchanged, the dispute has reached such a stage as to make it now incumbent upon the United States to take measures to determine with sufficient certainty for its justification what is the true divisional line between the Republic of Venezuela and British Guiana. The inquiry to that end should of course be conducted carefully and judicially, and due weight should be given to all available evidence, records, and facts in support of the claims of both parties.

In order that such an examination should be prosecuted in a thorough and satisfactory manner, I suggest that the Congress make an adequate appropriation for the expenses of a commission, to be appointed by the Executive, who shall make the necessary investigation and report upon the matter with the least possible delay. When such report is made and accepted it will, in my opinion, be the duty of the United States to resist by every means in its power as a willful aggression upon its rights and interests the appropriation by Great Britain of any lands or the exercise of governmental jurisdiction over any territory which, after investigation, we have determined of right belongs to Venezuela.

In making these recommendations I am fully alive to the responsibilities incurred and keenly realize all the consequences that may follow.

I am nevertheless firm in my conviction that while it is a grievous thing to contemplate the two great English-speaking peoples of the world as being otherwise than friendly competitors in the onward march of civilization and strenuous and worthy rivals in all the arts of peace, there is no calamity which a great nation can invite which equals that which follows a supine submission to wrong and injustice and the consequent loss of national self-respect and honor, beneath which are shielded and defended a people's safety and greatness.

This short message went to Congress December 17, 1895, where it was read and referred to the Committee on Foreign Affairs. The following day, December 18, the chairman of that committee, the Hon. R. R. Hitt, reported a bill (H. R. 2173) appropriating $100,000 for the expenses of a commission to investigate and report upon the true divisional line between British Guiana and the Republic of Venezuela. This bill was passed by the House of Representatives forthwith and unanimously; it was then sent to the Senate. It was on the following day, the 19th of December, referred to the Committee on Foreign Relations in the Senate. The next day it was reported back, debated, and passed without amendment. The following day, December 21, it was a law, having received the signatures of the Speaker of the House, the Vice-President, and the President. Thus President Cleveland's suggestion on December 17, that a commission be created, was four days later the law of the land, and made so with an unanimity almost, if not quite, unparalleled. No vote against it was recorded in either branch of Congress. On January 4, 1897, the commission was appointed, and consisted of five persons, viz :

Hon. David J. Brewer, one of the justices of the Supreme Court of the United States ; Hon. Richard H. Alvey, Chief Justice of the Court of Appeals of the District of Columbia ; Mr Frederick R. Coudert, a distinguished member of the New York bar, who had acted as counsel for the United States in the Bering Sea arbitration case ; Hon. Andrew D. White, historian and diplomatist, and Dr Daniel C. Gilman, a learned geographer, president of the Johns Hopkins University. This commission organized by electing Mr Justice Brewer president and Mr Severo Mallet-Prevost, of the New York bar, as secretary.

Upon this commission were laid two duties : *first*, to investigate, and *second*, to report. Obviously investigation was first, not merely in order, but in the amount of labor involved and in importance. In the early sessions of the commission the whole subject was canvassed, and the work of investigation planned, organized, and assigned. Professor George L. Burr, of Cornell University, a painstaking and accurate historian and linguist, was sent to Holland to investigate the Dutch archives. Later on he was joined there by Mr Coudert, of the commission. For assistance in the preparation of maps and in geographical investigation, application was made to the U. S. Geological Survey. To this work I was assigned, and from January to May, 1896, gave to it such time as could be spared from Survey duties. In May, 1896, I was, however, detailed to the service of the commission, and continued to serve on this detail till the close of the commission's labors and the publication of its results in June, 1897.

When, in November, 1896, it was made known that Great Britain and Venezuela had at last come together and had agreed to submit their dispute to arbitration, the commission found itself set free from the need of pronouncing judgment. As the contending parties had themselves agreed to submit their differences to an arbitral tribunal, it was obviously for that tribunal to pronounce judgment. Moreover, as Mr Justice Brewer had been chosen as a member of the arbitral tribunal, it was obviously improper that he should pronounce judgment in advance of his sitting with that tribunal. The commission accordingly decided to withhold any conclusions it might have reached and to publish only its investigations. Thus the facts gathered have become public property. The investigations undertaken were unfinished when arbitration was agreed upon, but the commission decided to stop short and print in as complete and systematic form as time permitted the facts then gathered.

The facts gathered by the commission are set forth in three octavo volumes and an atlas comprising 76 maps. The atlas constitutes volume 4 of the report and was the first volume completed. It is composed, as above stated, of 76 maps, divided into three groups or parts.

Part I comprises 15 maps, all printed on the same base. This base map was specially compiled and engraved for the commission, and is designed to represent the latest and best information as to the natural features of the Orinoco-Essequibo region. It is based chiefly on the so-called great map of the colony, dated 1875, and published by E. Stanford, of London, in 1877. Various other maps were also made use of in its compilation. The disputed territory along the seacoast is so differently shown on maps of high authority that a compromise seemed impossible, and accordingly two different maps of the same tract are shown side by side on the base map. Map 1 shows various boundary lines proposed or claimed. map 2 the forests and savannas, map 3 the principal drainage basins, and map 4 the geology of the region as far as known. Maps 5 to 14 are historical maps, showing European occupation at various dates from the earliest down to 1814. "These eleven historical maps," says Professor Burr, "have been prepared to illustrate my report on the evidence of Dutch official documents as to occupation and claims in the region between the Essequibo and the Orinoco, and are an attempt to show graphically the conclusions reached by that report." It may be noted in passing that if title to the disputed tract is to be determined by *occupation*, these maps showing occupation are of great significance and importance.

Part II of the atlas comprises 41 maps, facsimile reproductions of the "mother maps" of the region—produced during a period of about 300 years. Volume 3 of the commission's report contains a paper by the secretary, Mr Severo Mallet-Prevost, on the Cartographical Testimony of Geographers. The 41 maps mentioned illustrate that report and exhibit the gradual evolution of our geographical knowledge of the disputed area, and also the evolution of the various boundary lines. It constitutes an interesting and instructive group of maps and makes available for students a number of scarce ones.

Part III comprises 20 maps of an official or semi-official character, of which 12 are from manuscript originals not hitherto published. The origin of these maps, their character and meaning are set forth by Professor Burr in a paper in volume 3.

In describing the atlas, we have in part anticipated the description of volume 3, which is devoted to geography. It is an octavo volume of 517 pages and contains 6 papers. The first is by the secretary of the commission on the cartographical testimony of geographers. In its 80 pages the historical evolution of lines showing territorial division are worked out with great care, and the size of the paper inadequately measures the labor needful to gather and arrange and clearly set forth and discuss the facts therein contained.

The second paper is by Dr Justin Winsor, librarian of Harvard College, and it deals with the same topics as the preceding paper, but in a different manner. This paper was submitted to the commission very early, its date being March 4, 1896, just two months after the commission was appointed. The third and fourth papers are by Professor Burr.

The fifth paper, entitled Notes on the Geography of the Orinoco-Essequibo Region, South America, is by the present writer. It consists of a prosaic compilation of statements made by various travelers and explorers in the region as to its geography, with references, in foot-notes, to the sources of these statements. All the geographic names found applied in the region, whether now in use or not, were recorded in these notes, which are fully indexed. Thus it is possible to proceed quickly by means of the index and foot-notes to the original sources of geographic information touching any part of the country described in these notes.

The last paper in the volume is a partial list of maps of the region, also prepared by the writer. It was hoped to make an exhaustive list, but time did not suffice for this, nor for the preparation of a bibliography of the region.

Volume 2 is given mainly to extracts from Dutch archives. There are 353 of these extracts, comprising 662 pages. They are printed in double columns, the original Dutch forming one column and the English translation the parallel column. Some miscellaneous manuscript documents, filed with the commission by the government of Venezuela, close the volume.

Volume 1, first in order but last to be published, is now in press and will shortly be published. It is to contain the report of the commission, which, however, is not new to the world, having been published May 25, 1897, as Senate Document No. 106, 55th Congress. 1st session. It is to contain also a report by Professor J. F. Jameson, of Brown University, on the Treaty of Münster of 1648, and also Professor Burr's report upon what he found in the Dutch archives bearing upon the boundary matter. Exact reproductions of those Dutch documents with translations constitute the major part of volume 2. Professor Burr's report, however, will tell a connected story of Dutch occupation and doings in the disputed territory, as gathered from these old manuscript chronicles of the Dutch.

With the publication in the summer of 1897 of these four volumes the labors of the Venezuelan Boundary Commission end. The controversy, however, is not ended, but its settlement has been relegated to a new tribunal—a tribunal of arbitration, to be composed of five of the world's leading jurists.

The commission, whose work now ends, it will be remembered, is wholly a United States commission. The United States devised it, created it, and maintained it; and it did this "to determine with sufficient certainty, for its own justification, what is the true boundary line between British Guiana and Venezuela." It is a high compliment to the character of the commission that both Great Britain and Venezuela promptly and cordially aided it to the fullest extent by furnishing information fully and freely. Neither was bound so to do, and neither had agreed to accept its conclusions. But as time progressed it became clear that this quasi or involuntary arbitration, if I may say so, might well be turned into an actual arbitration—an arbitration where all the facts could be sifted out, judicially weighed, and a just conclusion reached. Accordingly, at the Lord Mayor's banquet in London last November, Lord Salisbury announced that an agreement had been reached by which the long-drawn-out controversy was on its way to a peaceful, amicable, just, and final determination; an agreement to arbitrate had been reached.

That the action taken by the United States some eleven months before was a powerful agency toward securing this much-to-be-desired end does not admit of doubt. Such is the prevailing opinion. Such is the opinion of the commission itself, which in its report says: "A wise and just view of the case is that the commission has been a potent factor in bringing the two nations into a consent to submit the matter in dispute to an arbitral tribunal."

In addition to the influence exerted by the commission in initiating the peaceful settlement of the dispute, the contribution which it has made to the scholars of the world should not be overlooked. The investigations in history and geography set forth in the papers accompanying its report have a value wholly apart from the case to which they owe their origin.

A few words about the arbitral tribunal and the work before it must end this already too long article.

On February 2, 1897, a treaty of arbitration as to the boundary was signed in Washington by Señor José Andrade, for Venezuela, and by Sir Julian Pauncefote, for Great Britain. It consists of 14 articles, describing in precise legal and formal phraseology how the dispute is to be disposed of. A printed copy of that now public treaty lies before me as I write. Let me summarize it.

First. An arbitral tribunal is to be named forthwith.

Second. It is to be composed of five jurists, two named by Venezuela and two by Great Britain. Venezuela names Chief Justice Fuller and Mr Justice Brewer, of the United States Supreme Court, and Great Britain names Baron Herschell and Sir Richard H. Collins, of Her Majesty's privy council. These four are to select, on or before September 14, 1897, a fifth arbiter, a jurist, who is to be president of the tribunal. In the event of failure to do so, the fifth arbiter is to be chosen by the King of Sweden.

Third. The tribunal is to determine what belonged to the Netherlands and what to Spain at the time when Great Britain acquired from the Dutch what is now British Guiana.

Fourth. The tribunal shall take account of all pertinent facts, shall be governed by the principles of international law, and by three rules, viz:

(*a*) Adverse possession or prescription for 50 years to constitute a good title.

(*b*) The arbitrators may recognize and give effect to laws supported on any other valid foundation (than adverse possession) and which conform to international law.

(*c*) In determining the boundary, if the tribunal shall find that the territory of one party was at the date of this treaty occupied by citizens or subjects of the other, it shall give to such occupation the effect which in its opinion is required by reason, justice, the principles of international law, and the equities of the case.

Fifth. The arbiters are to meet in Paris within 60 days after the printed arguments have been submitted, and decide the questions submitted; all questions to be decided by a majority; each party to appoint an agent to assist the tribunal.

Sixth. Within eight months, *i. e.*, on or before February 14, 1898, the case is to be submitted, with proofs, documents, etc.

Seventh. Within four months thereafter, *i. e.*, on or before June 14, 1898, the counter-case is to be similarly submitted, and may contain new matter, with proofs.

Eighth. Within three months thereafter, *i. e.*, on or before September 14, 1898, the agent of each government must submit his argument in print. Oral arguments may then be had.

Ninth. The arbiters may lengthen each period above named by 30 days.

Tenth. Decision to be rendered within three months after the case has been argued, to be in duplicate, in writing, and signed by the arbiters who assent to it.

Eleventh. An exact journal of proceedings is to be kept.

Twelfth. Each government is to pay its own agent, and the cost of the arbitration shared equally.

Thirteenth. The parties agree to be bound by the decisions rendered.

It thus appears that the controversy bids fair to reach its final stage sometime during the winter of 1898–'99.

MINERAL PRODUCTION IN THE UNITED STATES

The mineral products of the United States in the calendar year 1896 had a total value, according to a recent report of the U. S. Geological Survey, of $621,969,943, the value of the metallic products being more by $4,868,931, and that of the non-metallic less by $5,586,656, than in 1895.

The great increase in the production of pig iron, so much commented upon last year, has not been maintained, the output having fallen off more than 800,000 long tons, representing a decrease in value of nearly $15,000,000. On the other hand, the production of gold has increased from $46,610,000 to $53,088,000, that of silver from $36,445,000 to $39,655,000, and that of copper from $38,682,347 to $48,698,267. Gold shows an increase of over 60 per cent in four years, the production of silver is the largest since 1893, and even the output of copper has almost doubled since 1889. The most remarkable increase, however, is that of aluminum, the production of which has increased from 18,000 pounds, worth $59,000, in 1887, to 1,300,000 pounds, valued at $520,000, in 1896, the value per pound having fallen, as will be perceived, from $3.28 to 40 cents within the period named.

To return to a comparison of the statistics of 1896 and 1895, an increase in the production of bituminous coal from 135,-118,193 to 137,640,276 short tons has been accompanied by a sufficient decline in prices to reduce the total value of the output from $115,749,771 to $114,891,515. On the other hand, a considerably smaller production of Pennsylvania anthracite has represented almost as great a value in the market as the output of the previous year. The production of building stone has been the smallest in point of value (quantities not being reported) since 1888, but the estimated production of brick clay is still represented by the same round figures, $9,000,000, that have done duty for the last half-dozen years.

There appears to have been a considerable increase (nearly 4,000,000 gallons, or over 18 per cent) in the sale of mineral waters. It would be interesting to know how far this remarkable increase is due to the use of non-medicinal mineral waters for table purposes, and how far it is to be attributed to the apparently largely increased use of lithia water as a remedy for certain bodily ailments that seem to be peculiarly characteristic of our time. Of the remaining principal products reported upon, petroleum reaches, in 60,960,361 barrels, the highest figures its production has ever attained; salt shows a slight increase in production, with a considerable decrease in value, and the production of borax—no less than 13,508,000 pounds—is the largest on record, with the single exception of that of 1894. J. H.

THE FORESTS AND DESERTS OF ARIZONA*

By Bernhard E. Fernow, Ph.D., LL.D., etc.,

Chief of the Division of Forestry, U. S. Department of Agriculture

It is a notable fact that but few of our people have any adequate conception of the vastness and the varied conditions of their country, and still less do they realize its opportunities for future growth. The horizon of the majority, even of those who have made hasty overland trips, rarely reaches beyond the limits of their personal observation, and as to the possibilities of the future—even those who have studied our past development fail to realize them. Our imagination—save in the professional boomer—lags behind reasonable expectation.

When I told my friends that a happy accident—the invitation of a generous and public-spirited friend—would take me for the summer months to and through Arizona, two expressions were most frequent: one of commiseration at my prospects of summer temperatures, the other a somewhat astonished inquiry as to what a forester could find of interest in that country of cactus and desert. That a large part of the territory of Arizona can boast of an ideal summer climate, unequaled for camping, was a revelation to them; and that some of the most interesting mountain forests—botanically speaking—are to be found there, and the most lovely and most extensive, as well as most economically important pineries that exist between the great forests of the Pacific coast and the western border of the Atlantic forest in Texas and Arkansas, a thousand miles away in either direction—this seemed to them almost incredible.

Why should this particular forest area become a subject of investigation? The question is worthy of answer. Here is a territory still undeveloped, still undespoiled for the larger part—a territory needing for its best future development not only the material which these forest areas can furnish forever, but dependent on irrigation for its agricultural future, and thus requiring that protection of its water sources which a forest cover is supposed to afford. Would it not be wisdom to study the relation of this resource to the whole development of the country, and

*An address delivered before the National Geographic Society, February 5, 1897 to study the conditions under which this resource could be rationally managed, so as to avoid as far as practicable the devastation that has characterized our occupation of other sections, and thus pave the way for a rational use of this important, yet limited, resource? To be sure, this is hardly the way we are wont to do, for with regard to our resources, especially our forests, we take a position somewhat similar to that of the old gentleman from Arkansas: "When it was raining he could not mend his roof, and when it was not he did not need a roof anyway."

Arizona, the unknown and maligned; the land of thorns and spines; the province of apparently hopeless deserts and yet of rich promise; the land of dreary wastes and yet of infinite variety and contrasts; the territory most picturesque and full of interest to the geologist and botanist and ethnologist, even to the mere sightseer, and yet the least visited; the earliest discovered of the western territories and yet the last to pass from the redman's dominion and the least developed; the land of a high prehistoric civilization, of cave-dwellers and cliff-dwellers, and of the peaceful agricultural Hopi and Pima, and yet until a decade ago terrorized by the most warlike of the Indians, the Apache—Arizona is one of the most interesting of all our provinces.

It is curious that the health-inspiring, rejuvenating quality of Arizona's dry air did not impress itself upon the Spanish seekers after the Fount of Eternal Youth, one of whom was destined, while balked in his search for the latter, to first set foot on this part of the continent. Alva Nuñez Cabeza de Vaca, with two Spaniards and one Negro as companions, all four fugitives by land from slavery among the Seminole Indians in Florida and finding their way across the continent, were the first to see the "Seven Cities of Cibola," the Hopi villages; were the first to pass under the shadows of San Francisco mountain and to share the hospitalities of the Pima Indians just 360 years ago. Three years later (in 1540) an exploring expedition under Vasquez de Coronado visited the same country, and it was then that one of his lieutenants, Don Garcia Lopez de Cardenas, gazed—the first white man—on the wonders of the Grand Cañon of the Colorado. Forty years later another of the conquistadors, Antonio de Espejo, ventured forth and claimed and named the country for Spain, Nuevo Mexico, under which name it came to the United States; the portion north of Gila river by the treaty of Guadalupe Hidalgo in 1848, the portion south of the Gila by the treaty and purchase negotiated by the then Minister to Mexico, James Gadsden, in 1854, for the purpose of obtaining a suitable route for a southern Pacific railroad, the price paid for the latter portion being $10,000,000.

Spanish development was confined entirely to the lower portions, and consisted mainly in the establishment of missions to convert the agricultural Indians, and in the location of presidios at Tucson and Tubac to protect the missions and the few haciendas and silver mines then worked, the hostile Apache constantly harassing their Indian and Spanish neighbors alike and withstanding the progress of civilization.

In 1863 the territory of Arizona was segregated from New Mexico, the name probably being a modification of Arizonac, a Papago Indian name of uncertain meaning which had been applied to a native village and was extended to the lower portion of what is now our southwestern province by the Spaniards.

The expeditions of the War Department under Sitgreaves, Williamson, Whipple, Parke, Gray, Beale, and Ives during the years from 1852 to 1860 give us the first definite knowledge of the country. Almost simultaneously with these, immigration and mining development began under protection of military forts Buchanan and Breckinridge.

From 1863, when the territory was segregated from New Mexico, to 1874, the history of Arizona is written in blood. It took a hardy man to run the risk of tomahawk and scalping-knife in order to benefit from the rich mineral discoveries in southern and middle Arizona. Nor were the mining communities themselves without their internal strife and shotgun administration of desperadoes and Mexican laborers. The successful campaigns of General Custer, however, broke the war spirit of the Indians and led to the treaty of 1874, when these Indians were placed on reservations. The advent of the Southern Pacific railroad in 1878 stimulated anew the development of the mining districts, and since the Apache Indians, with their cunning leader, Geronimo, were removed to Florida in 1886 the peaceful progress of the territory is assured, and one may travel through the country with no more fear of a hold-up than in Texas or New York.

Three centuries and three score years of history! Yet the beginnings of civilization and of the development of the territory date back hardly a score of years, and it is only a little over a decade since a really peaceful progress has begun—since the marauding Apache has been removed!

Arizona, with an area of about 114,000 square miles, equaling the combined areas of New York and the New England states, or of Ohio, Indiana, and Illinois, is in the main a plateau rising from the southwestern corner toward the north and east. From an altitude of not more than 40 feet above sea-level, at or near Yuma, the plateau level rises to 7,000 feet or more, and, with the many mountain ranges that overtop the plateau, every altitude is found up to 12,800 feet in the rude stone monument erected by Mr Gilbert on the highest peak of San Francisco mountains. There is, however. a convenient and significant altitudinal subdivision of the plateau to be noted, by which the northeastern section, with about one-third of the territory, is segregated as the Colorado plateau—a part of the great plateau which extends northward, with an average elevation of over 4,000 feet, the southwestern two-thirds forming a lower plateau, with an average elevation of probably over 1,000 feet, studded with rugged sierras which sometimes reach up nearly 10,000 feet. The division between these sections is sharp and sudden; in most parts it is a line of cliffs and steep slopes, varying from 600 to 1,200 feet and more in height, which form a rim to the higher plateau, popularly known among the Mexicans as the Mogollon and among Americans as "the rim." This great escarpment forms so abrupt a boundary line that a stone may be hurled from one region into the other. Immediately below this rim there is a climatically and botanically intermediary region or transition zone which only accentuates the two main divisions.

The convenience of this subdivision extends beyond topographic distinction, for the two sections differentiate climatically almost as abruptly as the surface, giving rise, from the standpoint of the visitor, to a summer section and a winter section, with corresponding differences in flora, fauna, and economic conditions. Thus the range of summer and winter climate which a latitudinal difference of a thousand miles effects from Maine to Florida is here effected approximately by altitudinal differences within a hundred miles.

Furthermore, the two sections are best reached, and until a few years ago could only be approached, by rail on two independent railroad systems—the Southern Pacific affording passage through the southern section and the Atlantic and Pacific (now part of the Santa Fé system) traversing the northern section. At present there is a connection between the two trunk lines by way of Phœnix and Prescott, giving access to the central section. These three lines, with a few short feeders, comprise the entire railroad system of the territory.

The tourist starting for Arizona in July will probably enter the territory by the northern route and spend the warm months on the plateau, making Flagstaff his headquarters or base of supplies. After the hot and dreary ride over the featureless plains of western Kansas and eastern Colorado and through the hardly less dreary though more varied mountain scenery of New

PETRIFIED STUMP, ARIZONA

Mexico, and after passing through the desert country of the eastern border county of Arizona (containing the celebrated petrified forests, strewn in huge logs over the sandy waste), it is a relief when suddenly the piñon and juniper appear in dense masses, and finally the pine forest is entered within an hour of reaching Flagstaff. To add to the feeling of comfort and new interest which this unexpected forest scene creates, the grand peaks of the San Francisco mountains come in sight, possibly with a white veil of freshly fallen snow that vanishes before the day is over.

Then when the heavy up-grade puffing of the engine and the rumbling of the cars cease and we alight at the terminus of the railroad journey and the beginning of our camping tour in the oddly-named town, Flagstaff, in the midst of this lovely pinery, we feel at home at once, without any misgivings as to the comfort or interest of the expedition.

Coming to study the forests, we are naturally attracted by the chimneys and lumber piles in the distance, which suggest what becomes of the grand pines that we have just learned to admire. Although the sun is low—the train arriving late in the afternoon—the sawmills, which, with the cattle and sheep interests, form the *raison d'être* of the little settlement of 1,500 people, call for immediate inspection. At the mills and offices we learn that of the 24,000,000 feet of lumber now cut in the territory annually, the various sawmills of Flagstaff, supplied by a logging road of 20 miles, produce about one-half, besides some 200,000 railroad ties, supplying the local demands of the northern part of the territory and also of southern California and New Mexico. We learn from inspection of the yards that the pine lumber of the pine (*Pinus ponderosa*) is only of medium quality, yet good enough for all local uses. With a lumberman's eye we have noticed that the trees cannot yield much clear timber, and this impression is verified by the books of the sawmill men, which show that not more than 6 to 7 per cent of the logs reaching the mill yield first-class material; and we have also noted that the cut per acre must be far below what eastern lumbermen would expect. These conditions are fully realized in Flagstaff. The opinion of the president of the Arizona Lumber Company, conveyed to the governor of the territory and printed by him in his report for 1893, is suggestive:

I believe that it is the duty of every person who can give the matter thought and who is in position to influence any one's action in the premises, to make some endeavor to perpetuate our forest conditions for the benefit of future generations in the territory. Upon the rational use of our forests will depend the happiness and welfare, and I may say the absolute existence, of any *large* population in this territory; and the time to act is the present, when the least possible injury will be done to vested rights.

I believe the government ought to withdraw all timber lands it possesses and ought to appoint a competent forester who would make it his sole duty to see that the covering which nature has afforded our mountain tops should be preserved, to the end that the valley land of the territory be protected either from droughts or floods in the years to come.

The next morning we are naturally eager to start out early to climb that magnificent mountain which rises north of the little hamlet in solitary grandeur, a huge volcano whose fires have but recently been extinguished, now unique in its symmetrical and striking outlines, the most impressive feature in the landscape. The elevation of Flagstaff being about 7,000 feet, a steady ascent is made from the town for ten or twelve miles to the foot of the cone at 8,000 feet, and then comes a steeper climb. The road is through a lovely forest of bull pine (*Pinus ponderosa*), a

PETRIFIED LOGS, ARIZONA

species common from British Columbia southward, both along the Sierra Madre and the Rocky mountains, down to Mexico. The forest is open and parklike, the trees standing in groups, with here and there an old stager which was a good-sized sapling when the first white conquistadors passed through this wilderness 360 years ago. The open stand of the stately pines rearing their heads 100 and more feet into the remarkably blue sky naturally causes the formation of a long and rather symmetrical crown which adds to the scenic beauty, but not to the commercial value of the timber. Since the rainy season has not yet set in, there is but little grass and lower vegetation visible; hardly any undergrowth impedes the view; yet here and there a clump of the scrubby Rocky mountain white-oak (*Quercus gambelii*) forms a pleasing contrast.

As we reach an altitude of 9,000 feet a change of scene occurs; the yellow-green, heavy-foliaged bull pine is supplanted by the graceful, dark-green white pine of the Rockies (*Pinus flexilis*) and the still more striking Douglas spruce, which in scattered individuals studs the now really grassy slope, for at this higher altitude more moisture and less evaporation favor the grassy growth. One thousand feet higher and we reach the region of the Foxtail pine (*P. aristata*), well named, for the long, flexible branchlets closely beset at their ends with crowded needles exhibit strikingly the appearance of a fox's tail. As we ascend, the Engelmann spruce, as widely distributed over the west as the bull pine, joins these trees and with them forms a more or less dense forest, the trunks short and much branched and gnarly, of little or no economic value. Here we find also in a few individuals a beautiful fir, a new accession to our flora, which Dr Merriam has this summer described as the Arizona cork fir (*Abies arizonica*) from specimens gathered on this very trip from this very tree. At 11,500 feet the last Engelmann spruce, tousled and shorn by the wintry blasts at this high elevation, and low creeping junipers, denote timber line. Toward the northeast we look down into what was once an enormous volcano, one side blown out; the three peaks are still above us.

A short climb of a thousand feet more over large blocks of lava or gravelly detritus brings us to the top of Humphrey's peak. From here the eye sweeps over a goodly portion of the northern part of the territory, and the vast expanse of the pine land can be traced. Toward the north stretches the Coconino forest, flanking the Grand Cañon, whose sheer walls on the opposite side are dimly discerned. Eastward and northeastward the color of the clouds indicates the position of the Painted desert, separated from the San Francisco forest by a fringe of junipers and piñons at the levels between 6,000 and 7,000 feet; toward the south and southeast, far as the eye can imagine sight—to the Mogollon and White mountains—and westward beyond the three-peaked landmark of Bill Williams mountain and Mount Sitgreaves, stretches the sea of pines, covering altogether an area of not less than 3,000 square miles.

It is proper that we should give full consideration to San Francisco mountains, for not only are they among the most picturesque and interesting to the sightseer, geologist, and plant geographer, but they are of importance economically; not merely for the pasturage that might be gleaned from their slopes, or for their timber (which on the higher levels is not worth the cutting), but for their meteorological effect, which is increased by the forest cover. Their peaks arrest and precipitate the clouds, which would otherwise pass over the plateau and find no cause for precipitation over the eastward desert. Nu-va-ti-ky-ōbi (Home of the High Snows) is the name the Indians give to them. They form the only elevation in Arizona on which snows can and do accumulate, giving up their stores in spring, furnishing supplies for many springs and washes and to at least one perennial stream—Oak creek. From this consideration it would be proper to make into a forest reservation all the area above the level of 8,500 feet.

We may take our descent on the western face of the mountain, passing one of the loveliest spots where a never-failing spring of cold delicious water invites us to camp among the aspen growth which intermingles with the spruces and white pines; and we may also extend our excursion to pay a brief visit to Walker lake or to Crater lake, whose yawning mouth, once spouting molten masses, is now sealed by a sheet of water, a welcome find to the cattle herds roaming over the plateau to pick the sometimes scanty herbage.

Water even on the plateau is the one deficiency of the whole territory; not that there is not sufficient and even too much at times, but in its distribution it is uncertain and extreme, both by localities and by seasons, and even within the rainy season the dry air makes constant and excessive demands.

Here, as in the southern portion of Arizona, there are two wet seasons, winter and summer. On the plateau, after the beautiful days of Indian summer in November, winter begins with Christmas. While mostly clear and calm, with temperatures rarely below 22° at night, ranging to 50° or 60° in the day, snows come every ten to fourteen days to a depth of 4 to 24 inches, drifting badly, but rarely lying long, except on the higher levels, and even the frozen ground becomes soft in the middle of the day. Spring begins about the middle of April and is the dry season—windy, dusty, the first half cooler, the last half warmer, than one would wish. With the first week of July the rainy season sets in, lasting until September. With it comes the profusion of flowers which is characteristic of the Rocky mountains, and which by and by will fill the pine woods below with gay beauty and luxuriance. Whole fields of the blue flag (*Iris versicolor*) bloom; there are magnificent carmine *Gilias* and *Pentstemons*, the dark purple and golden *Primula parryi*, the yellow columbine, and a host of others changing off through the season and making this plateau a veritable flower-garden.

The rains hardly ever come as land rains, but their nature and quantity are very variable. A short shower each afternoon is said to be the regulation rain, but the season of 1895 excelled in terrific downpours, with most boisterous thundering and brilliant lightning, not even respecting the nightly rest of the tentless camper. Yet the dry air soon obliterates the dampness. The temperature, however, is kept at a most delightful, uniform degree, never much above 75° or 80°, and the sunsets after a late thunderstorm are the most gorgeous to be seen anywhere. The nights are cool, toward morning occasionally even cold. Altogether the summer climate in the pines is ideal.

While preparing for our trip of exploration there are many points of interest around Flagstaff to visit. We may descend into Cosnino or Walnut cañon, a deep, narrow cut, with its long rows of cliff-dwellings built into the limestone walls reminding us of bygone millenniums, when a teeming population must have lived here. These dry ridges and plateau portions are wooded with the low trees, rarely over 30 feet high, often shrublike in form, of the piñon or nut pine (*Pinus edulis*), whose sweet seeds are gathered for food by the Indians, and the western juniper (*Juniperus utahensis*), fit only for firewood, interspersed with shrubs of striking form and foliage, almost always spiny and of peculiar interest. Among these are the pink-flowered locust, the yellow-flowered, prickly-leafed barberry, the fruit making excellent jam, the trifoliate, red-fruited squawberry, of delicious acid taste, and the snowy, white-tufted cliff rose, which is not a rose at all, yet fills the air with a rare fragrance.

An inspection of the logging operations gives an opportunity to make measurements of the rate of growth of the pines and to observe the differences in their development, giving rise to the lumberman's classification into jack pines, the younger or quickly grown, and yellow pines, the older or slowly grown, which are from 250 to 300 years and more old.

Presently we start southward, looking back on the hospitable town of Flagstaff and its grand mountain and forest entourage, across the waste which the logger and the unavoidable forest fire have made, and the natural prairie or glade south of it. Such glades, from a few acres to several square miles in extent, are a very general and interesting phenomenon throughout these woods, furnishing not only most pleasing vistas but opportunity for pasturage and agricultural use. Their soil is usually rich black loam washed from the surrounding hills, rather compact and liable to a wide range of moisture conditions on account of deficient drainage, and hence inimical to tree-growth, but readily supporting a greensward of grass. In wet seasons these depressions sometimes turn into lakes. Mormon lake, which we pass, is such a prairie, some five miles long and one to two miles wide, which, when the Mormons arrived there, had the appearance of a rich meadow, inducing them to settle and go into dairy farming; after a few years the glade filled up with water and became a lake; in 1895 it was all dry except a small remnant of water in the lowest depression. As these patches of fertile land, forming about 15 to 20 per cent of the forested area, are destined to become objects of agricultural development—they have begun to be so used—and in that way to be helpful in the rational management of the surrounding forest country, it would be of interest to experiment as to their best treatment; many of them by judicious ditching, by which the moisture extremes may be abated, can undoubtedly be made to produce various crops besides the potato and alfalfa or oats which the short season and the cold condition of the soil now permit.

As we proceed we presently pass a most forbidding spot, where the limestone soil is covered with black blocks of lava, giving rise to soils locally known as malapai, corrupted from the Spanish *mal pais*, bad lands, although the soil is not so bad after all, at least for tree-growth. One of the great lava fields of the world, made up of basalt and trachyte, extends from San Francisco mountains southward and northward, covering fully 20,000 square miles with its overflow.

As we progress through the forest we learn from the differences of soils and consequent differences in development of the trees something of the geology of this plateau. Archæan, Silurian, Carboniferous, Juratrias, Cretaceous, and igneous rocks are found. Three soil formations are readily recognized—limestone here, sandstone there, and over both, irregularly, the decomposed beds of lava which have overflowed thousands of square miles, giving rise to the malapai. So far as tree-growth is concerned, wherever the decomposition of the lava blocks has been thorough and limestones have added their quota, the soil is by no means unfavorable. The limestone soils seem to produce the best timber, the sandstone soils the poorest.

Water is to be found in springs only at rare intervals, and hence camping places must be known; yet the few wells which have been dug here and there, furnishing deliciously cool and good water, suggest that the development of water resources could be extended.

As we become familiar with the woods and observe how the trees always stand in groups with open spaces between, and how the young growths, from the seedling to the sapling, also occur only in groups and patches; and as we lie in our tentless bed in an open spot, where neither cones nor caterpillars can drop on us, and ponder over the reasons for this aspect of tree distribution, we come to the conclusion that water conditions or soil conditions affected by drainage must account for it. Those portions of the rocky and unevenly disintegrated soil which permit a temporary storage of sufficient moisture at the proper season will alone reproduce and permit the young growth to thrive. Another interesting observation regarding these pine forests is that young growth seems to appear only in irregular periods, from three to ten years intervening between the groups of young trees. After a fortnight's progress of the rainy season, millions of little seedlings spring up all through the wood, carrying their seed shells in characteristic manner above ground, a rich promise of a dense, young aftergrowth, yet probably all doomed to perish from frost, because the short season does not permit the ripening of their wood. The reproduction, to be permanent, must take place in the spring, induced by a wet winter and spring season, which occurs only at considerable intervals.

The farther south we progress on our journey the denser, statelier, and more valuable grows the pine forest, undisturbed as yet by the hand of man. Presently we emerge from its shady recesses, and as we pass the last pines a candelabrum of flaming red and yellow lights—a century plant in bloom, messenger of warmer climes, that has found its way up along a cañon from the lower levels—tells us that soon we shall be in the region of cactus, yucca, and catsclaw.

If we had time we would visit those picturesque red rocks which loom up in the west, forming the cañons of Oak creek, the perennial daughter of San Francisco mountains, the clearest mountain stream in this entire region, in its upper part famed for beautiful trout pools. In its middle part, hardly known to even the nearest neighbors and not at all to the outside world, it affords the most romantic and most picturesque rock country

SAN FRANCISCO MOUNTAINS, ARIZONA, WITH MOUNTAIN MEADOW AND TYPICAL PINE FOREST imaginable, the celebrated Garden of the Gods in Colorado being an insignificant imitation only. The manifold, curious, wind-carved shapes of the red sandstone rocks rising abruptly from the ground, contrasted with the green of the surrounding plain, are worth a long journey to see. The few who have visited this secluded valley will also not forget the remarkable bouquet and aroma of the grape, raised by one of the more enterprising ranchers on these sun-warmed sand bottoms, which promises some day to outrank the finest vintage of Bordeaux.

Presently a wide view opens before our eyes; far below us stretches Verde valley, and we are looking over the rim into the borderland of the southern desert region. In red and white and yellow and brown tints glare the arid gravels, studded thinly with a scant, shrubby vegetation, dry and gray. The fresh, bright green spots that catch the eye we find afterward to be groups of opuntias, large prickly pears, whose red, acid fruit we appreciate later in the season, after we have learned how to avoid the prickles which almost invisibly cover them in small tufts. Among the trees, the first we meet is a peculiar, leafless, shrub-like form, with long, slender, green branches, the falsely so-called paloverde, *Canotia holacantha* of the botanists. The majority of the shrubs of the brush desert belong to the Acacia tribe, all with symmetrically rounded heads, and, like every other plant here, provided with thorns or spines, the peculiar adaptation to desert conditions making the labors of the collector a hard task. Many unfamiliar plant forms excite the curiosity of the new-comer.

We have suddenly dropped to the 3,000-foot level, and begin to feel the difference in temperature; the canteen is often called into requisition. By-and-by the heat of the early afternoon sun leads us to wish that camp were near. Uncertain of the road, we ascend one of the glaring, white limestone hills, and lo! what an unexpected sight meets our eye. The contrast is so great that we think a mirage must have risen to mock our heated brain. There lies at our feet, stretching away for several miles, a land of green vegetation, rich and luscious as in the most favored spots of the Alleghanies in early summer, a broad river of foliage, interrupted here and there by fields of alfalfa and corn, with orchards from which the red roofs peep out hospitably. We are looking into the valley of Beaver creek, one of the affluents of Rio Verde, which, like all these water-courses, hidden away under a dense cover of deciduous trees, are the surprises of the deserts through which they flow, and furnish the water for the irrigated fields of the rancher.

Here we find not only the cottonwoods, hackberry, and ash of several species, as along the streams of the more eastern plains, but a tree alder of excellent shape, peculiar to Arizona, and a plane or sycamore much more striking and beautiful in its foliage than those which are planted in our eastern streets and parks. There is the same tangle of luxuriant vegetation, with grapevines trailing over bushes and trees, that we find in the bottom lands of our Gulf states, with rock and debris and driftwood and sand carried by the flood waters of the stream which comes from the pine plateau—the forest watering the plain. Down in this bower of green, a real paradise after the weary desert ride, we gladly camp and enjoy a refreshing bath in the soda springs.

In addition to the creek and these interesting soda springs, there is a still more remarkable sheet of water to be found in the well-known Montezuma well, a deep hole in the limestone hills, probably originally a large limestone cave, the roof of which fell in when the water collected in it. Here also we find reminders of the cliff-dwellers, who, a thousand years ago or more, built their abodes in the walls of this huge well and used its never-failing water, which passes through a subterranean tunnel into the creek, to irrigate their fields, as do the ranchers of today. Not only the line of the ancient ditch has been found clearly defined, but the petrified ditch itself has been dug out, the lime of the water having completely filled the original ditch with its deposit.

A thrifty agricultural population, with whom agriculture, and especially horticulture, evidently pays, has now taken the place of these prehistoric tillers of the soil, who have left the signs of their existence and their activity everywhere through the territory in more or less preserved ruins, the largest and most elaborate of which, named Montezuma castle, probably because of its size and elaborateness, is found not many miles from Montezuma well. Little is known of these prehistoric people, but after seeing the present abodes and ways of the Hopi and Zuñi Indians, there remains but little doubt in our minds that the ancients were the ancestors of these natives, perhaps not so many centuries removed; and observing that these cliff-dwellings are as a rule situated near or overlooking agriculturally available grounds, and recalling the history of the Apache raids, we conclude that they were agricultural Indians driven to construct their dwellings in inaccessible places for defense against their enemies.

Resuming our journey, a few miles bring us to Verde—the abandoned military post known as Camp Verde—where 2,000 of the wild Apache surrendered to General Crook in 1883, then and there breaking the war spirit of the race which had harassed for centuries peaceful Indians and white settlers alike. Except in the irrigated valley, everything looks brown and sear and uncompromising under the July sun.* The cattle industry used to thrive in this valley, as in many others of the territory, and also on the plateau; but, just like lumbering in other regions, it was carried on recklessly, the natural meadows being overstocked far beyond their capacity; so that large areas which twelve years ago were luxuriant grass-producers are now absolutely barren, with not a spear of grass visible.

The broad valley of Rio Verde, which carries the drainage from the plateau to Salt river, is capable of agricultural development to a much greater extent than has been attempted; but, as in other parts of the territory, this requires systematic storage and utilization of the water. By careful management the cattle, sheep, and goat industry would no doubt be able to use advantageously the large nonirrigable areas. The home market for this secluded valley is mainly in Jerome, which is the seat of one of the largest copper mines and reduction works in the United States, with an annual output of about one million dollars in value. Prescott and the mining districts surrounding it are also within reach by a long day's ride.

There is hardly a drearier ride to be imagined than that from Verde valley over the Black Hills to Prescott. Up and down hill, over dry ridges studded with chaparral, scrub oak, manzanita, and the like, we traverse a region for which, but for the mineral wealth that may be under ground, no use suggests itself. Arriving at Prescott, we reach once more the altitude of the pines in Bradshaw mountains; but we find that there is little timber left, the town and the mining districts surrounding it having used up most of it. Prescott was once the capital of the territory and is still the metropolis of central Arizona, the supply-base of many outlying mining districts and the cattle ranches in the large valleys on the north and west.

Here we may take train for the southern portion of the territory. A branch road starts from Ash Fork on the Atlantic and Pacific railroad, whence it passes through the Black forest—not of spruces, firs, and pines, like the celebrated forest of that name

* When we passed this way again, in September, after the rains had had opportunity to be effective, the country was almost unrecognizable; the dry, brush desert had changed into a beautiful prairie, and for the first time in eight years the grass had grown large enough to be cut for hay.

in Germany, but of somber, low-topped cedars and piñon—the road running over trestles and loops to get from the plateau into the valley. Passing southward from Prescott on this line, we traverse a rugged, dry, mountain country, which contains rich mining ground where a man may wash his day's wages in gold from the soil anywhere in the creek bottoms or cañons. Deficiency of water alone retards this mining development; yet some large mines are worked by pumping water six and eight miles over the mountain.

As we descend into the plain from the 6,000-foot level of Prescott the temperature seemingly rises in geometric ratio, and as we reach the plain, at about 1,200 feet, we begin to suspect our friends were right after all in commiserating our fate. We reach Phœnix at night, and the broad waters of Salt river in the moonlight at least suggest coolness, and the night, warm enough to sleep outdoors, does indeed afford relief from the excessive heat of the day, when the thermometer was at 110°.

The southern portion of Arizona can be subdivided into two sections fairly well differentiated topographically, climatically, and economically. The eastern district is elevated and mountainous; it is bounded on the west by the high mountain ranges of Santa Rita, El Rincon, Santa Catalina, and Tortilla and Superstition mountains. The western part is a vast desert plain out of which, like islands from the sea, rise abruptly, in parallel lines ten to thirty miles apart, in black and purplish hues, rugged and towering granite mountains, reflecting the sun's rays with dazzling brilliancy. These mountains are mostly devoid of vegetation and mostly also of soil, awful in their barrenness, while the desert below may be just as barren in places or else is studded with the sparse vegetation of cacti, agave, yucca, catsclaws, paloverde, mesquite, etc.—a paradise of spines and thorns. There would appear on general principles nothing more depressing than such a country; so it is when viewed from the car-window; yet, as a matter of fact, to the explorer it is full of interest, a stimulus to the curiosity and furnishing real entertainment; and, finally, much of this hopeless desert promises to the future many a paying enterprise. Not only do the desert mountain ranges contain minerals of value—gold and silver and others—while salt, borax, gypsum, sulphur, asbestos, kaolin, and pumice-stone may be found in the plain, but the soil is capable of producing profusely in this southern clime, if only water can be brought to it. Water is the great problem here. The little rain that falls over the vast region fills the water-courses, where there are any, for only a few hours, after which what is not evaporated sinks into the loose sand and the river continues underground, the bed above "running dry." Yet, as to the possibility of finding enough water to irrigate the most of it, who will foretell?

There are really only two rivers which run always full—the Colorado and the Gila. While Gila river and its affluents, the San Pedro, Salt, and Hassayampa, which run dry occasionally, furnish only a limited quantity, the mighty Colorado river carries a volume of water not only six times as rich in fertility as that of the Nile, but of almost limitless and continuous supply, which would suffice to irrigate several million acres. To be sure, the bed lies considerably below the level of the plain, yet when the economic conditions of the country require it, there will be no difficulty in devising the mechanical means to bring this water upon the land, as is being done now in a small way at Yuma. And, with the addition of artesian wells, perhaps it may only be a question of time when these dreary wastes will be turned into fertile fields and gardens such as are beginning to grow up around Phœnix, Yuma, and other cities—a revival of bygone times when an ancient and industrious people occupied the Gila bottom lands, of whose existence now only the ruins of long-fallen towns, the remnants of large aqueducts, and widely distributed fragments of pottery testify. Phœnix, the capital, already boasts of being a garden spot, all owing to the extensive irrigation canal system which derives its waters from Salt river, and certainly the green alfalfa fields and extensive orchards of peach and almond, olive and pomegranate, are a most pleasing contrast to the surrounding cheerless brush desert. The city, embowered in the tropic foliage of palms and pepper trees, with its luxurious hotels, is bound to become—nay, has already become—a Mecca of the seeker after a mild winter climate and relief from pulmonary complaints. While its summer temperatures may be said to lack nothing in generosity, for eight months in the year the climate is said to be perfect.

The eastern mountain region is mainly a pasturing region; the valleys are clothed with hardy grass and stunted acacias, while the mountains, when over 6,000 feet high and massive enough to induce precipitation, are wooded; the drier exposures and lower altitudes support an open growth of stubby live-oaks, the trees varying in height from 12 to rarely over 25 feet, which in the distance have the appearance of an old apple orchard.

Higher above the 6,000-foot level and reaching to the tops at 10,000 feet at most, the pines appear, including several most interesting species, which are at home further south in Mexico, together with some of more northern nativity.

In these mountains, within a day's ride from Tucson, we may find the most lovely, cool recesses of a trout-stream either in the Santa Catalina mountains or, with a few hours of railroad added, in the Chiricahua range, where we may readily forget that we are in the dryest and hottest—erroneously so believed—portion of the United States. Here, at the higher elevations among the pines, the air is most delightful, and while the days are just about right, the nights may, even in September, be frosty enough for a double blanket. Tucson being 2,400 feet above sea-level at the eastern border of the desert is the rival of Phœnix; not indeed with regard to agricultural development, for this old presidio of the Spaniard placed there to protect the mission of San Xavier among the Papago Indians, still in existence, lies high and dry beyond sufficient water supplies, unless some time artesian wells may be developed; but it is or will be a rival as a health resort, excelling the capital in the conditions and quality of the air, helpful in pulmonary diseases.

Returning to the plateaus of northern Arizona, there are two trips which we must take together from Flagstaff, for without them a visit to the territory is decidedly incomplete—one to and through the Painted desert to the villages of the Hopi Indians, the other to the Grand Cañon.

Having heard that within three days the celebrated snake dance is to take place at Oraibi, one of the Hopi villages 100 miles northward, we get ready our camp outfit for a plunge into the desert. Once more we skirt the San Francisco mountains, which will remain our guide and landmark through the whole trip, visible at any time and to the last. Once more we pass through the pine forest and over the black lava sands of the juniper and piñon belt, coming out on the rocky limestone plateau, with its scanty pasture and low shrub growth.

Water is scarce on this trip, and although spring wells and so-called tanks—clayey soil depressions and rock cavities in which rain-waters collect—may be found at distances of 25 to 40 miles apart, it is safer to carry water in the approved fashion. We reach the river, the Colorado Chiquito, or Little Colorado, marked in the distance by the line of cottonwoods, on the morning of the second day, and find its bed, which is usually dry, filled to the brim with a yellow loam puddle, a rushing torrent.

We should have to camp here until the flood abates but for the enterprise of a trader, who has spanned the river with a steel cable by means of which we transfer our packs, swimming our horses. Now we have in truth entered a desert, such as we have met nowhere else in the territory.

The scene is one of utter desolation. Not a tree or a shrub breaks the monotony of the flat table-land; here it is eroded into deep, dark, varicolored green, blue, and yellow-brown ravines and chasms, there overtopped by high mesas with flaming red edges, the sands reflecting the sun's rays in a white and yellow glare, and the white summer clouds in turn reflecting not only the heat but the colors of the desert. In the distance peculiarly shaped purplish peaks and pinnacles and solitary buttes mark the limit of the desert proper and our destination two days hence, while now and then a mirage brings into view a sheet of water so distinct and natural that in spite of our knowledge of the immaterial nature of the apparition our eyes refuse to accept the reasoning of our minds. Now and then we pass over different soils, alkali in nature and still more forbidding than the sand; then again heavy loam soils with scant brush growth. If there ever was a region which would be thought beyond the possibilities of useful occupation, you would think that this was the one; and yet as we reach the trading post of the enterprising German whose cable helped us over the river we are as ready to distrust our eyes believing to see a mirage as when we found ourselves deceived in the phantasmal lakes, but there certainly seem to be green corn-fields. We are not, however, deceived; there is real corn of various kinds, and sugar-cane and potatoes and other garden truck, not less than 40 acres in cultivation right in the sand and without irrigation.

Listen to what the enterprising cultivator writes of his success in the first year's experiment: "Our crop has furnished us 80 tons of hay and fodder; sugar-cane did the best, 8 feet high; corn, the old Indian variety, has done well; watermelons, onions, and sweet potatoes seem to be at home here, and all that without a drop of rain for 18 months. Our trial plantings have fully paid us. Now we have a lake here, made by construction of a mud-dam across a dry wash, and filled by the floods from the upper country, 1 by 1½ miles in extent and 20 feet deep. The reservoir was filled about September 15, and has lowered until now, January 3, hardly 15 inches. Irish potatoes were small, but perhaps would have made good-sized tubers but that they were drowned; yet we caught ducks in return, which we shot from our boat. The cottonwoods planted have done well; expect to plant 10,000 this spring. There are a million acres around me which can do the same."

How is it possible, you ask, without water? It is due to the moisture held in storage from occasional rains and drainage by the sand, whose structure prevents its evaporation as well as its sinking away. Who will foretell the possibilities of the future?

After this experience we are not surprised to find further on the cornfields of the Navajo Indians on the sandiest sites, much more primitive, to be sure, and when we reach the village of Oraibi the thrifty fields, small garden patches, and peach orchards show that these sands and dry deserts can yet support a goodly population.

Here we are at last, after a weary ride over the sand and through the cornfields and bean patches of the Hopi Indians—called Moki by alien tribes in opprobrium and by some whites through objectionable imitation—at the base of a precipitous mesa, perched on which, 300 feet above, stands Oraibi, one of the "Seven Cities of Cibola," where for hundreds, perhaps thousands, of years the original race of Indians have lived peacefully, closely packed in their stone houses. There can be no more picturesque sight than this town, with its inhabitants, clad in blankets of bright colors, grouped on the tops of the gray limestone houses, watching the snake dance, nor is there anything more fascinating than to watch these ceremonies. There is hardly a more promising field for ethnological study than these primitive house-builders and agriculturists, but they are foreign to our chief subject, and we can only glance at a few features in rapid succession.

This has been a festive time, and hence the usual filth has been in part removed and a general house-cleaning and cleaning of hair and body has taken place, so that inspection of the dwellings, which the good-natured children of Nature rather court, is comparatively satisfactory. The wealthier householders have even whitewashed their houses outside and inside, and their stores of corn are in ship-shape order. The ceremonies of the snake dance last nine days in all, partly in public, partly in their secret temples, where, as a rule, only the priests of the two orders—the Antelope and Snake—are admitted. Today is the last day, and the snake dance is the end of the ceremonies, the purport of which is to bring rain for the suffering crops. The Antelope priests—painted, masked, and decorated—coming from their kiva in single file, perform a rhythmic round march and place themselves on guard before the snake hut made of cottonwood boughs, in which the reptile partners to the dance are placed. The snake priests perform the same round march, and then, placed in rows opposite each other, the two lines begin a low incantation, accompanied by rhythmic motions in unison, sidewise, to and fro.

Weird is their song, weird are their looks, and weird their motions, but weirder still all these when their wriggling, writhing partners enter the circle and the round march with the snakes begins. For this the snake priests divide into sets of three, the carrier holding the reptile, venomous or not, and in full possession of its fangs, between his teeth, and rhythmically swinging its curling body, the charmer following him, with eagle feathers stroking the hair and shoulder of the carrier or else his burden, while the catcher trips on the outside, ready to pick up with unfailing accuracy the reptile. When it has done its service it is laid on the ground and darts away for liberty. The dexterity with which this act is performed, the man taking time to first strew the sacred meal and apply the charm of eagle-brush to the escaping rattler, makes the catcher the hero of the hour. When all these 20 or 30 reptiles have thus passed through the rite, it only remains to carry them toward the north, south, east, and west, whence they came, and set them free, unhurt, for they are the personified spirits of ancestors, who have in the ceremony been induced to intercede with the deities.

The result of the prayer for rain, which is the purport of the whole ceremony, seemed to follow immediately in a most tremendous downpour, which turned the dry wash at which we are encamped into a raging torrent 60 feet wide and 5 feet deep. This result, however, was promptly disclaimed by the snake priests, for their prayer is for gentle rain—a drizzle, as it were—which they rarely get.

But we must hurry away for our last trip, the one by which we shall always remember Arizona if all else be forgotten—the Grand Cañon of the Colorado.

A flying stage from Flagstaff brings us in a long day's ride, yet not a dreary one, through the pine woods past San Francisco mountain, again through the cedars, over open mesas and through pine woods once more to a neat tent city—a hotel establishment well fitted to its surroundings and well kept—nestled in a depression among the stately pines close to the cañon. We are within a hundred steps of the object of our visit, but there is no indication of its presence; nothing but commonplace landscapes, albeit in the lovely setting of the shady pine boughs. We ascend the slope, unsuspecting what it is that makes people who have seen it so unreasonably effusive when speaking of it; and then suddenly the sight bursts upon us; the earth has sunk away at our feet to illimitable depths.

The first sensation is one of awe and bewilderment; a shock, a sense of oppression, perhaps of horror, overpowers you. There

is nothing you have seen before that has given you even a hint of what this is; nothing you can compare it to. It is an innovation in nature which it takes time to comprehend—to appreciate; then as you gaze grows on you a realization of the enormousness, the gorgeousness, the weirdness, the grandeur, majesty, and sublimity of the scene. Speechless you gaze on the vast sea of ghostly, giant shapes, and are overcome by the feeling of your own insignificance as in the presence of infinity. Only gradually are you made fully conscious that you behold the most sublime of all earthly spectacles.

No picture has ever conveyed an idea, language there is none that can ever give an adequate conception of the ensemble of this great chasm—its vast proportions, its intricate plan, the nobility of its architecture, its colossal buttes, its wealth of ornamentation, the splendor of its rich colors. It is not a cañon at all that you see—the word belittles the scene; it is a labyrinth of an infinite number of chasms and cañons that press themselves upon your view all at once, a mighty mountain country filled with most fantastically carved, gigantic, rock masses, cyclopean castles thousands of feet in height, gracefully towering gothic cathedrals, round-topped Moslem mosques, Greek and Indian temples, frowning rock cities, pyramids, and obelisks, battlemented fortresses, all the wonders of the Arabian Nights multiplied and heaped together in a wild chaos, stimulating your fancy beyond its power.

And not only is the ensemble present the most stupendous sight; even the least imposing portions of the cañon are as impressive as any scenery that can be found in the world. For 200 miles of the river bed, with a breadth of 10 to 12 miles and more, is here revealed the interior of the workshop of Nature and the secrets of the building up of our earth's crust. The surrounding plateau country is scored by intricate mazes of side cañons. In these and in the main chasm to a depth of 6,000 to 8,000 feet geological history is exhibited in precipitous walls with a clearness unparalleled in any portion of the world, telling of æons of rock-building and of millenniums of rock-carving by wind and water. Far below, hardly recognizable if at all visible from above, flows the great river, which in its ceaseless rush has carried to the sea the sands and debris, results of the denudation of more recent formations; has cut through the pale gray limestones of the Permian, the pink and brilliant red sandstones and the purplish and vermilion limestones of the Triassic, the deep brown rocks of the Carboniferous, down to the somber, iron-black granites of the Silurian and Archæan ages, through which the river now rolls its yellow waters, gathered from thousands of square miles in the mountains of Colorado and the plateaus of Utah and Arizona—here in placid and majestic dignity, there with a wild current in roaring rapids, over boulders and rocks and precipitous falls.

"Great as is the fame of the Grand Cañon of the Colorado, the half remains to be told," wrote Major Dutton in 1881, in his superb monograph on the cañon; and this is still true today, and will be for many years. While its geology has been unfathomed with considerable detail by that philosophical geologist, we have but fragmentary knowledge of its flora and fauna, and we have hardly yet dared to think of its undiscovered wealth of minerals and its other economic possibilities.

We arrive at the brink on Sunday night; a thunderstorm has left a deep black nimbus, a dense glowering sheet, in the sky to the east, on which two beacon-lights appear, the bases of an unfinished rainbow, standing straight, like two sentinels, on each rim of the cañon. To the west, the sinking sun paints the horizon in deep crimson, surrounded with a golden glory, each one a cluster of small black clouds, while in the north a wild, yellow hail-cloud casts its lurid glare. It was in this setting that through rising mists in purplish hues the mystery of the cañon, awful in the utter stillness, revealed itself to us—"a thought of God on earth expressed, all meaner thoughts expelling."

Whatever may become of Arizona in the future, it will always be known to the world as the country of the Grand Cañon, the wonderland of the Southwest.

MOUNT ST. HELENS

By Lieut. Charles P. Elliott, U. S. A.

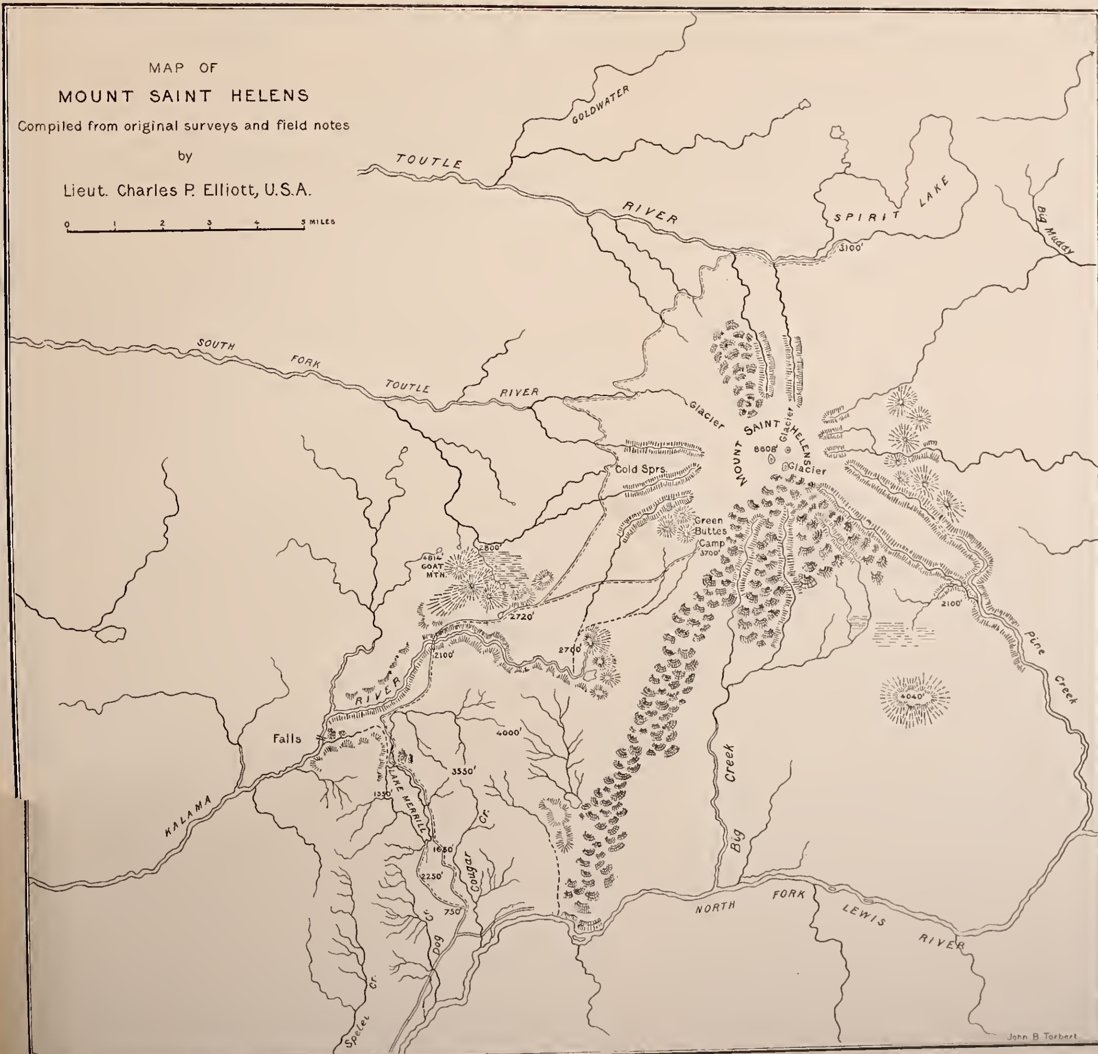
In going by steamer from Portland, Oregon, to Vancouver, Washington, on a clear day it is possible to see from the pilot-house five snow-capped mountains—Hood, Jefferson, Adams, Rainier, and St. Helens. The last mentioned is more to the west than the others, and has the appearance of a regular, inverted cone, truncated and rounded off. The mountain presents this same appearance from all sides when the observer is at any distance. Two seasons spent on this extinct volcano have enabled the writer to get a general idea of the effects of volcanic action on the local geography and to make a topographic map of the district. Since it is within plain view of many prominent points astronomically established, it seems strange that Mt. St. Helens should not be accurately placed on any map which the writer has examined, either as to its own position or relatively as regards the other snow-clad peaks.

Mt. St. Helens lies east of Vancouver Barracks, north of Lewis river, west of the Columbia, and south of the Cowlitz; it is west of the divide of the Cascade range, even more to the west than Mt. Rainier. From rough triangulation based on recent surveys, the writer's map shows the summit to be in the northeast corner of township 8 north, range 5 east, of the Willamette meridian, and its altitude taken on a clear, still day, with an excellent aneroid, is 8,608 feet.

The approach to the mountain is by wagon road up the north fork of Lewis river to the foot of the trail to Lake Merrill, around the lake to and across the Kalama river, up the Kalama for a short distance, then toward and by Goat mountain and in a northeasterly direction to what is known as Butte camp, at an elevation of 3,700 feet. From this point horses can be taken to the bench above, but there is no water and but little wood, and Butte camp is the proper place from which to climb the mountain unless you are thoroughly familiar with the very rough country around the base. Formerly the approach was from Lewis river, four miles above the trail to Lake Merrill, and up a continuous run of lava, sloping gradually up from the river, to Butte camp, a rough, hard trail, in many places over broken lava. Mt. St. Helens is not difficult of ascent, and is probably the least dangerous of any of the snow-clad mountains of the Cascade range. In going from Lewis river the trail leads up a steep hill, rising 900 feet in two miles, and then drops down 100 feet, when you most unexpectedly find yourself on the south edge of a small lake about two miles from Lake Merrill, without any apparent reason for its existence. On going to the northern end of the lake you find a mass of lava extending entirely across the axis of what was originally a mild cañon.

There are a few small streams flowing into Lake Merrill, but there is no visible outlet. The difference between high and low water is more than thirty feet. The rainfall in autumn and spring and the snowfall in winter are very great, and the fall in the level of the lake at the close of the spring rains is much too great to be accounted for by evaporation. On a very still day during September, 1895, I searched carefully at the north end of the lake and found in the sandy bottom, about fifty yards from the shore, a deep, funnel-shaped hole, evidently the beginning of the outlet. Further to the north and toward the Kalama river, where the lava flowed over the standing trees (the places of the trunks now forming wells in the lava), running water can be heard, and with a strong cord and bucket drawn up. Still nearer the Kalama a bold stream breaks out of the lava and flows into the river just below a beautiful fall formed by the Kalama flowing over the edge of the same run of lava that dammed up the waters of Lake Merrill. The space between the lake and river on the north is comparatively level, the lava in many places being covered with soil, and that with a heavy growth of timber. Where the sand and ashes predominate the growth is poor. The flow of lava, volcanic sand, etc., that ends at Lake Merrill and the falls of the Kalama, starts from the west and southwest sides of Mt. St. Helens, flows against the Green Buttes and neighboring hills, almost filling up the space between these elevations and the mountains, passes around the buttes, unites and fills in between Goat mountain and the high ridge northeast of it, forming a swampy meadow at the base of Goat mountain, the waters of which are strongly impregnated with iron, while to the south of the ridge runs a clear, cold stream coming from the lava at Cold Springs and joined by a second stream coming from the snow directly west of the summit. To the south from Green Buttes the country is filled in until checked by a semicircle of hills that turn to the west and extend south of the Kalama river. A small lake fills the level space between the hills. The Kalama river bursts as a full-fledged stream, bubbling up like a fountain from the southwest side of the more northerly hill, flows south to the lake, then turns to the north of west, flowing at first through willows and swampy ground, then gradually gains strength and cuts down in the volcanic sand and boulders on its north bank, the high ridge being to the south. Finally, near where the trail crosses the river, it cuts through the volcanic formation and ends by leaving all the volcanic deposit on the south side, a spur from Goat mountain forming its north bank. When the river tumbles over the falls it leaves the volcanic formation and runs through a growth of fine timber to the Columbia river at the town of Kalama. Except where lava and bed rock are exposed, the country below the level of 5,000 feet is covered with a dense growth of timber and brush.

To the east of the head of Kalama river is a run of lava that starts near the summit of St. Helens and extends with a nearly uniform slope to the north fork of Lewis river. This lava has filled up the country in its course, flowing around hills as a river around islands. About two miles from the river it has crossed the course of a small stream, forming during the wet season a large pond, with an underground outlet sufficient to carry off the flow of the stream during the dry months and the excess, due to rain and snow, after the dry season sets in. The water from the pond and stream finds its way into Lewis river under


MAP OF
MOUNT SAINT HELENS
Compiled from original surveys and field notes
by
Lieut. Charles P. Elliott, U.S.A.
0 1 2 3 4 5 MILES
GOLDWATER
TOUTLE RIVER
SPIRIT LAKE
3100'
Big Muddy
SOUTH FORK TOUTLE RIVER
Glacier
MOUNT SAINT HELENS
8608'
Glacier
Glacier
Cold Sprs.
Green Buttes Camp 3700'
4814 GOAT MTN.
2800'
2720'
2700'
2100'
2100'
Pine Creek
4040'
RIVER
Falls
4000'
3550'
1350'
LAKE MERRILL
1650'
2250'
750'
Cougar Cr.
Cr.
Dog Cr.
Big Creek
KALAMA
NORTH FORK LEWIS RIVER
Speler Cr.
John B Torbert

the surface of the lava. East of the lava run is a bold stream with several branches, some coming from the snow and some from a swamp east of south from the mountains. The black lava spreads out like a fan on this side. Where it stops the slopes are covered with boulders, and as the high ground to the south arrests the flow of volcanic sand, etc., and is filled in, a comparatively level swamp is formed, with streams flowing into Big creek on one side and Pine creek on the other. Northeast of the lava and nearly due east of the summit the most considerable glacier on the mountain is found. The glacial stream issuing from it flows through boulders, ashes, pumice-stone, etc., as a dirty stream for about three miles, when it sinks with high banks of volcanic sand on both sides, but soon appears as a clear stream, between very high, white, sand banks, until within a few miles of Lewis river, where the volcanic deposits disappear.

Going to the northeast and across Pine creek you find a succession of buttes that form the watershed between Pine creek and the Big Muddy, and also act as a barrier for the sand and pumice-stone, now very plentiful, that has formed a nearly level and barren plateau between the base of the mountain cone and the tops of the buttes. Two small streams—one clear, the other muddy—run gently over the level and, having joined, pitch over the steep slope and join the Big Muddy. To the north of the hills a third stream flows down from the ice and snow and finds its way also to the Big Muddy. Northeast of the mountain the deposit of sand, ashes, and pumice-stone is greater than on any other side. This deposit, passing to the north and keeping west of the high ground of the original formation, has formed a dam across a cañon, and the result has been Spirit lake, a deep and quite considerable body of water. The outlet over the dam is known as Toutle river. Following down Toutle river from the lake, the flow at first is very gentle, then a shallow pond is formed about a quarter of a mile long, and below that the stream gets more rapid, but remains clear until about two miles below the lake, where a muddy stream comes in from the mountain. One mile further down a second stream comes in from near the base of the mountain. Leaving the river on what is called the Spirit Lake trail, through dense underbrush and pine thickets, you pass below the lower edge of a run of lava from the northeast side of the mountain and across a swamp, formed as before by volcanic agencies; also across two small streams, from springs below the lava, and climbing steadily up, over ground covered with boulders and heavy timber, the edge of the cañon of the South Toutle is reached. The north side of the cañon is of fine white sand, and is very steep and hard to climb. The South Toutle flows from under a glacier in plain view, and runs in a bed of boulders directly toward the point where the trail first strikes the edge of the cañon, then turns more to the west and with a constantly widening bed of sand and rocks, filling the original cañon to a width of a half mile or more, the stream flows sometimes on one side, sometimes on the other. The water occasionally forms a dam in one of its temporary beds among the rocks, and having gathered sufficient head, bursts the dam and comes down, bringing large boulders with it. After leaving the South Toutle and passing over high ground a second and smaller cañon is crossed, with a bold stream running from the mountain into South Toutle, then up to a high bench and down to Cold Springs, which crops out under the lava and flows toward Goat mountain and finally into Toutle river.

The circuit of the mountain on the lower levels is now complete. At the summit of the mountain the highest point is bare rock. South of east and also north of east are two other bare points; the intervening space is covered with snow, and between the two easterly points the largest glacier issues, from which Pine creek runs. Almost directly north of the head of this glacier and across the northern point of rocks the second glacier begins, the water from it flowing into the North Toutle, and northwest of the highest point is the third glacier, the source of the South Toutle.

Snow falls to a great depth over all this country in winter, but in early summer the warm rains and hot sun melt the snow very rapidly and the black lava on the mountain, to its very summit, is exposed in streaks radiating from a common center.

GEOGRAPHIC LITERATURE

Magnetic Declination in the United States. By Henry Gannett. From the Seventeenth Annual Report of the U. S. Geological Survey. Washington, 1896. Pp. 203-440, with map of the United States showing the lines of equal magnetic declination for the year 1900.

This memoir of 237 pages sets forth and discusses the data used in making the magnetic map which accompanies it. This map, whereon the curves of equal declination or isogonic lines for the year 1900 are shown, is about 18 by 28 inches in size, and is printed in four colors: black for projection lines, names, and all cultural features; blue for streams; green for the oceans and large lakes, and brown for the hill and mountain features. These relief features are shown by contour lines. The contour interval, from 2,000 feet upward, is 1,000 feet. Below the 2,000-foot contour the interval is variable. Over this base map the magnetic curves are printed in red.

The magnetic declination, popularly called variation of the compass, is subject to several known periodic changes. Of these the most important is the secular change—a change with a period running through centuries; hence its name. As this secular change is progressive from year to year for long periods, and as it amounts in the United States to from 2′ to 5′ per year, it is for the surveyor and mariner the most important of the periodic changes. Indeed, it is the only one of much practical importance at present. It is to this practically important quantity that Mr Gannett has wisely devoted the greater part of the labor expended on this memoir. The weakness of similar maps hitherto produced has been recognized by both their makers and users to be largely due to defective knowledge of the secular change.

Of the 237 pages comprised in the memoir 82 are devoted to *data for secular change*. A table of results by counties occupies 135 pages, while the remaining 20 pages are given to introductory matter, discussion, statement of sources of data, etc.

The sources of the data are the Coast Survey, Lake Survey, the Wheeler, Hayden, and Powell Surveys, New York State Survey, New Jersey Geological Survey, Boundary Surveys, United States Corps of Engineers, Army Exploring Expedition, National Academy of Sciences, and others; but it is chiefly from the records of the United States General Land Office and from county surveyors that a vast quantity of hitherto unused material has been derived. Indeed, so abundant are data in the General Land Office that it was only needful to select for the older "land office" States such as were desired. The mass is much greater than is needed to produce a map sufficient for all practical needs. As to this Mr Gannett says:

"I have not attempted to make a complete collection of this material. The amount is too vast to make it worth while. I have, however, collected all the observations which appear upon the plats of exteriors and standard lines (the Land Office requires that in the survey of all standard and exterior lines the declination be observed), supplementing them wherever needed by observations made in connection with the subdivision of townships. Altogether, I have abstracted from the plats of the General Land Office nearly 20,000 observations, and these form, perhaps, nine-tenths of the material herewith presented."

As the work of subdivision and accompanying magnetic observations began a century ago, it is obvious that these Land Office records constitute a veritable storehouse of information on secular change—a storehouse of which Mr Gannett is the first to make general use.

In addition to these data a circular was sent to all the county surveyors in the United States, and from the returns much valuable information was obtained.

As the accuracy of the material from the Land Office and county surveyors is not of the highest, the adopted mode of reduction was not the most accurate. The graphic methods used were rapid and sufficiently accurate for the purpose, which was to present in the form of a map and the form of a table the best knowledge available as to the magnetic declination in the year 1900. The work was planned and executed as a practical matter and chiefly for the use of surveyors.

The only wonder is that the great stock of data in the General Land Office has not been hitherto made use of. Now that it has been, perhaps some of the colleges and universities in the land office States may be stimulated to undertake a similar work for their own States, going over all the data and supplementing them by observations where such are found to be desirable. M. B.

Carpenter's Geographical Reader. Asia. By Frank G. Carpenter. Pp. 304, with maps and illustrations. New York: American Book Co., 1897.

This little book treats of the various countries of Asia, mainly with relation to the occupations, social customs, amusements, etc., of their inhabitants. Being derived in the main from personal observation and experience, its descriptions are vivid and characteristic, with plenty of local color. H. G.

Studies in Indiana Geography. Edited by Charles Redway Dryer, M. A., M. D., Professor of Geography in The Indiana State Normal School. First series. Pp. 113, quarto. Terre Haute, Indiana: The Inland Publishing Company. 1897. 50 cents.

This is a geographic reader, treating of local geography, shaped on the lines of modern science. The dedication to Professor William M. Davis is an index to the character of the book. The opening chapter, entitled "The New Geography," is a most excellent statement of what geography should be. The general physical geography of the State is given in broad outlines, clearly and simply. The topography of the State being largely the result of glacial deposition, this subject receives considerable attention under the chapter headings "The Glacial Deposits of Indiana" and "The Morainal Lakes of Indiana." The natural resources of the State—coal, gas, petroleum, soils, building stone, clays, etc.—receive a chapter. An interesting subject, only too briefly treated, is the changes which have taken place in the surface of the State during the period of white occupation. As a specimen of what might be done for all our great cities, the book contains "A Study of the City of Terre Haute." This consists of a number of questions intended to draw out from schoolboys a full account of the origin, history, location, mode of government, municipal improvements, and social condition of the city. It is exhaustive, extremely suggestive, and altogether admirable. The book closes with a history of the Great Lakes, which seems rather out of place in this connection.

The maps in the book are by no means in keeping with the quality of the text, being crudely drawn and poorly executed.

The work as a whole is a most valuable addition to the teaching of geography, and its influence will be felt not only in the State of Indiana, but elsewhere. H. G.

C&O ROUTE

F.F.V. LIMITED

CHESAPEAKE & OHIO RY.

THE F. F. V. LIMITED is one of the finest trains hauled over any railway track in America. It runs solid between Cincinnati and New York, the route from Washington being over the Pennsylvania system. It has every modern convenience and appliance, and the dining-car service has no superior if it has an equal. The road-bed is literally hewed out of the eternal rocks; it is ballasted with stone from one end to the other; the greater portion is laid with one-hundred-pound steel rails, and although curves are numerous in the mountain section, the ride is as smooth as over a Western prairie.

One of the most delightful rides in all the route is that through the New River valley. The mountains are just low enough to be clad with verdure to the very top, and in the early spring every variety of green known to the mixer of colors can be seen, while the tones in autumn take on all the range from brown to scarlet.

These facts should be borne in mind by the traveler between the East and the West.

H. W. FULLER, *Genl. Pass. Agent, Washington, D. C.*

YELLOWSTONE PARK

ON OUR LINE

Spend your vacation there in 1897.

Send SIX CENTS for our New '97 TOURIST BOOK.

Northern Pacific

CHAS. S. FEE,
General Passenger Agent, St. Paul, Minn.

SOUTHERN RAILWAY

GREATEST SOUTHERN SYSTEM.

Penetrates with its main line or branches eight States South of the Ohio and Mississippi Rivers, and in conjunction with its friendly allied connections reaches all the commercial centers of the South and Southwest . . .

DOUBLE DAILY VESTIBULED LIMITED TRAINS

. . . BETWEEN . . .

Washington and Nashville via Salisbury, Asheville, Knoxville and Chattanooga.
Washington and Tampa via Columbia, Savannah and Jacksonville.
Washington and Memphis via Atlanta, Birmingham and K. C. M. & B.
Washington and New Orleans via Atlanta, Montgomery and Mobile.
Norfolk and Chattanooga via Salisbury, Asheville and Knoxville.

Pullman Sleeping Cars—Dining Cars—Day Coaches.
Additional Trains for local travelers . . . .

The direct line to the Winter Resorts of { FLORIDA, GULF COAST and TEXAS, ... MEXICO and CALIFORNIA,

—AND THE BEST—

Through Car Line to and from Asheville and Hot Springs—"The Land of the Sky."

Write for Map Folders.

R. D. CARPENTER, General Agent, 271 Broadway, New York City.
L. S. BROWN, General Agent Passenger Department, Washington, D. C.
J. H. WINGFIELD, Passenger Agent, Norfolk, Va.

S. H. HARDWICK, Assistant General Passenger Agent, Atlanta, Ga.
C. A. BENSCOTER, Assistant General Passenger Agent, Chattanooga, Tenn.
W. H. TAYLOE, Assistant General Passenger Agent, Louisville, Ky.

J. M. CULP, Traffic Manager. W. A. TURK, General Passenger Agent.

The Mutual Life Insurance Co.

OF NEW YORK,

RICHARD A. McCURDY, President,

Is the Largest Insurance Company in the World.

The Records of the Insurance Department of the State of New York SHOW THAT The Mutual Life

Has a Larger Premium Income - - -	($39,000,000)
More Insurance in Force - - - - -	($918,000,000)
A Greater Amount of Assets - - - -	($235,000,000)
A Larger Annual Interest Income - - -	($9,000,000)
Writes More New Business - - - -	($136,000,000)
And Pays More to Policy-holders - -	($25,000,000 in 1896)

THAN ANY OTHER COMPANY.

It has paid to Policy-holders since its organization, in 1843, } - - $437,005,195.29

ROBERT A. GRANNISS, Vice-President.

WALTER R. GILLETTE, General Manager. FREDERIC CROMWELL, Treasurer.
ISAAC F. LLOYD, Second Vice-President. EMORY McCLINTOCK, Actuary.
WILLIAM J. EASTON, Secretary.

Burlington Route

TO

ST. PAUL

BEST LINE

CHICAGO OR ST. LOUIS

MINNEAPOLIS

Ripans Tabules cure headache.

The Fastest and Finest Train in the West....

IS

UNION PACIFIC

THE OVERLAND ROUTE

WORLD'S PICTORIAL LINE

The Overland Limited

......TO......

UTAH and CALIFORNIA.

FROM 16 TO 20 HOURS
SAVED BY USING

"THE OVERLAND ROUTE."

Double Drawing-Room Pullman Sleepers.
Free Reclining Chair Cars.
Pullman Dining Cars.
Buffet Smoking and Library Cars.

Send for Descriptive Pamphlet "49-96," Folders and other Advertising Matter.
(Mention this publication.)

E. L. LOMAX,
General Passenger and Ticket Agent.
OMAHA, NEB.

THE CHICAGO, MILWAUKEE AND ST. PAUL RAILWAY

. . RUNS . .

Electric Lighted and Steam Heated Vestibuled Trains between **Chicago, Milwaukee, St. Paul and Minneapolis** daily.

Through Parlor Cars on day trains between **Chicago, St. Paul and Minneapolis.**

Electric Lighted and Steam Heated Vestibuled Trains between **Chicago and Omaha and Sioux City** daily.

Through Sleeping Cars, Free Reclining Chair Cars and Coaches between **Chicago and Kansas City, Mo.**

Only two hours from Chicago to Milwaukee. Seven fast trains each way, daily, with Parlor Car Service.

Solid trains between **Chicago** and principal points in **Northern Wisconsin** and the **Peninsula of Michigan.**

Through Trains with Palace Sleeping Cars, Free Reclining Chair Cars and Coaches between **Chicago** and points in **Iowa, Minnesota, Southern and Central Dakota.**

The **finest Dining Cars** in the World.

The **best Sleeping Cars. Electric Reading Lamps in Berths.**

The best and latest type of **private Compartment Cars, Free Reclining Chair Cars, and buffet Library Smoking Cars.**

Everything First-class. First-class People patronize First-class Lines.

Ticket Agents everywhere sell tickets over the Chicago, Milwaukee and St. Paul Ry.

GEO. H. HEAFFORD,
General Passenger Agent, Chicago, Ill.

WHENEVER YOU VISIT WASHINGTON . . .

YOU ARE INVITED TO INSPECT THE

MAMMOTH DRY GOODS ESTABLISHMENT

OF

WOODWARD & LOTHROP

Where the **LATEST PARIS NOVELTIES** are always on Exhibition.
The attention of those who anticipate purchasing . . . .

BRIDAL TROUSSEAUX

Is invited especially to extreme PARIS NOVELTIES in matched sets of French Hand-made Lingerie, including Gowns, Skirts, Chemises, Drawers, Corset Covers, &c. These can be furnished in any number of pieces desired. . . . .

HAND-MADE BRIDAL TROUSSEAUX, personally selected in Paris and exclusive in style and design: Three or more pieces . . . . **$10 to $250.**

CORRESPONDENCE SOLICITED. MAIL ORDERS RECEIVE PROMPT AND CAREFUL ATTENTION.

TENTH, ELEVENTH, AND F STREETS N. W. . . . . WASHINGTON, D. C.

Shortest Line
TO
St. Paul and Minneapolis
and the Northwest

CHICAGO
GREAT
WESTERN
RAILWAY.

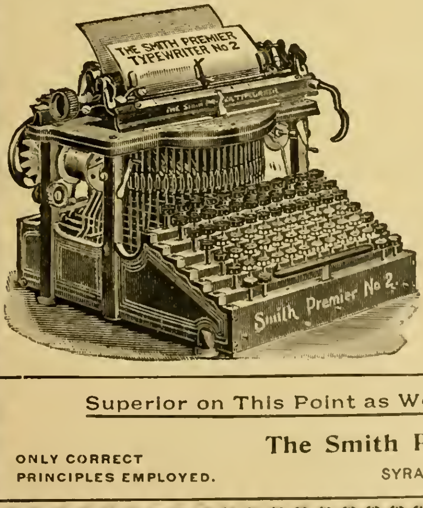
"Maple
Leaf
Route"

For tickets, rates or any detailed information apply to your home agent or write to

F. H. LORD,
Gen'l Pass'r and Ticket Agent,
CHICAGO.

A VITAL POINT

"IMPROVEMENT THE ORDER OF THE AGE."



A TYPEWRITER'S PRINTING MECHANISM

MUST BE SCIENTIFICALLY CONSTRUCTED. THIS POINT IS OF UTMOST IMPORT FOR

EASY OPERATION AND PERFECT EXECUTION.

The Smith..
Premier
Typewriters

Superior on This Point as Well as on All Others.

ONLY CORRECT PRINCIPLES EMPLOYED.

The Smith Premier Typewriter Co.,
SYRACUSE, N. Y., U. S. A.

Catalogues and Information at Washington Office, No. 1416 F Street.

AN IMPROVED METHOD OF KEEPING THE SCORE IN

DUPLICATE WHIST, COMPASS WHIST, STRAIGHT WHIST AND EUCHRE.

Since Duplicate and Compass Whist have come into fashion there has been an unprecedented revival of interest in the game, due to the fact that mere *luck* is to a large extent eliminated by a comparison of the scores made in the play of the same hands by different players.

The one thing needed to perfect the new method has been a convenient device by means of which the score made on the first round can be concealed until after the replay of the hands, as a knowledge of the first score often enables a good player to make a decisive gain, and matches are lost and won on just such little chances.

A Washington player has at length invented and put upon the market at a very low price a little device which admirably answers the purpose, and at the same time serves as a pretty and useful table ornament, marker, and pencil rest. It is called the "Cosmos Counter," and consists of a little polished wood tablet with a metal keyboard that can be clamped down on the score in such a way as to bring 24 little metal plates over the 24 spaces in the "score" column of the card, for use in concealing each first score as soon as recorded and until the hand is replayed (in duplicate whist) or the entire series finished (in compass whist).

Whist players will at once see the advantage of this new method of keeping the score, as it effectually prevents their opponents at the same or another table from taking advantage, either by accident or design, of a knowledge of what the hand is capable. The trouble with duplicate whist, especially, is that the replay is liable to be influenced by memory of the cards and score, and anything that helps to confuse such recollection is a great gain to fair play.

The "Cosmos Score Card," prepared for use with the counter, shows several new features, such as a heading for both Duplicate and Compass Whist and (on the reverse) for Straight Whist, Euchre, &c., thus enabling the same counter and score to be used for any game of cards.

Cosmos Counters, with tablet of quartered oak, maple, or birch, and metal in either gold or silver finish, 50 cts. apiece; 6 for $2.75; 12 for $5; by mail, 4 cts. apiece extra. Cosmos Score Cards, 25 cts. per package of 50; 12 packages for $2.50; by mail free of postage.

Ask to see samples at any stationer's, or order direct from the General Agents.

Cosmos Duplicate Whist Score

N .... E ....

S .... W ....

HAND	COMPASS WHIST: SCORE	TOTALS	TRUMP	OPPONENTS		HAND
	DUPLICATE WHIST: SCORE	GAIN	TRUMP	GAIN	SCORE	
1						1
2						2
3						3
4						4
5						5
6						6
7						7
8						8
9						9
10						10
11						11
12						12
13						13
14						14
15						15
16						16
17						17
18						18
19						19
20						20
21						21
22						22
23						23
24						24
TOTALS						TOTALS

Copyright, 1895, by Everett Hayden, Washington, D. C. For use with the Cosmos Duplicate Whist Counter, patented July 7, 1896.

...., 189......

E. MORRISON PAPER CO., 1009 Penna. Avenue, Washington, D. C.

NATIONAL GEOGRAPHIC MONOGRAPHS

On the PHYSICAL FEATURES OF THE EARTH'S SURFACE, designed especially to supply to teachers and students of geography fresh and interesting material with which to supplement the regular text-book.

LIST OF MONOGRAPHS COMPRISING VOLUME I:

GENERAL PHYSIOGRAPHIC PROCESSES	J. W. Powell
GENERAL PHYSIOGRAPHIC FEATURES	J. W. Powell
PHYSIOGRAPHIC REGIONS OF THE UNITED STATES	J. W. Powell
BEACHES AND TIDAL MARSHES OF THE ATLANTIC COAST	Prof. N. S. Shaler
PRESENT AND EXTINCT LAKES OF NEVADA	Prof. I. C. Russell
APPALACHIAN MOUNTAINS—NORTHERN SECTION	Bailey Willis
APPALACHIAN MOUNTAINS—SOUTHERN SECTION	C. Willard Hayes
MT. SHASTA—A TYPICAL EXTINCT VOLCANO	J. S. Diller
THE NEW ENGLAND PLATEAU	Prof. W. M. Davis
NIAGARA FALLS AND ITS HISTORY	G. K. Gilbert

Price for one set of ten monographs, **$1.50.** Five sets to one address, **$6.00.** Single monographs, **20c.**

Remit with order to AMERICAN BOOK COMPANY,

New York - Cincinnati - Chicago

Ripans Tabules assist digestion.

TERRESTRIAL MAGNETISM

An International Quarterly Journal

Edited by L. A. BAUER
With the Co-operation of Eminent Magneticians

WITH the March, 1897, issue, this Journal, devoted exclusively to Terrestrial Magnetism and allied subjects, such as Earth Currents, Auroras, Atmospheric Electricity, etc., entered on its second volume. The hearty co-operation extended by the workers in this promising field of investigation, as abundantly shown by the numbers thus far issued, has made this Journal the international organ for making known the latest achievements. The magnetic needle has become such a promising instrument of research, not only in terrestrial, but in cosmical physics, that this Journal appeals to a large class of investigators. The geographer, the geologist, the astronomer, the meteorologist—all are interested in the development of the subject of terrestrial magnetism. It should therefore receive their support.

Among the contributors of the main articles in the past have been Messrs. Barus, Börgen, Chree, Eschenhagen, Littlehales, Rücker, Schmidt, Schuster, and de Tillo.

Future numbers will contain:

"The Earth, a Great Magnet,"
BY DR. J. A. FLEMING.

"The Electrification of the Atmosphere,"
BY PROF. ALEXANDER McADIE.

"The Height of the Aurora,"
BY PROF. CLEVELAND ABBE.

"The Distribution of Magnetic Observatories,"
(Illustrated),
BY PROF. MAX ESCHENHAGEN,
etc., etc.

The size of the Journal is royal octavo, a volume embracing about 200 pages. Domestic subscription price: **Two dollars**; single numbers, **fifty cents.** Foreign subscription price: **Nine shillings, nine marks, or eleven francs.** Address:

TERRESTRIAL MAGNETISM,
The University of Cincinnati, Cincinnati, Ohio.

PEOPLE like to read about the great and wonderful country of the **Southwest**; of its quaint and curious towns, its ancient civilizations, its natural marvels. They like to get accurate information about **California and the Pacific Coast**. This is because most people want to some day see these things for themselves. . . . .

A charming book covering these facts is issued by the

PASSENGER DEPARTMENT
OF THE
Southern Pacific Railway,

and will be sent to any one, postpaid, on receipt of TEN CENTS.

THE BOOK IS ENTITLED

"Through Storyland to Sunset Seas,"

You can get a copy by writing to

S. F. B. MORSE,
General Passenger Agent,
Southern Pacific,
New Orleans,

and sending **10 cts.** to defray postage.

AND IS A WONDERFULLY HANDSOME VOLUME OF **205** PAGES, WITH **160** ILLUSTRATIONS. . . .

The paper used is FINE PLATE PAPER, and every typographical detail is artistic. It is a story of what four people saw on just such a trip as you would like to make. . . . .

SEND
FOR
IT

SEND
FOR
IT

SEND
FOR
IT

THE NEW WONDERLAND BOOK
OF THE
NORTHERN
PACIFIC
RAILWAY
For 1897.

NEW COVER
NEW ILLUSTRATIONS
NEW TEXT

Send six cents.

CHAS. S. FEE, Gen. Pass. Agent, St. Paul, Minn.

Among the Contents of Forthcoming Numbers of

THE NATIONAL GEOGRAPHIC MAGAZINE

WILL BE THE FOLLOWING:

Modification of the Great Lakes by Earth Movement,

BY PROF. G. K. GILBERT,

U. S. GEOLOGICAL SURVEY;

Down the Volga, from Nijni Novgorod to Kazan,

BY PROF. FREDERIC W. TAYLOR,

—— AND ——

The principal geographical papers to be presented at the Toronto Meeting of the British Association for the Advancement of Science.

JUDD & DETWEILER, PRINTERS, WASHINGTON, D. C.

The National Geographic Magazine

AN ILLUSTRATED MONTHLY

Editor: JOHN HYDE

Associate Editors

A. W. GREELY W J McGEE HENRY GANNETT
C. HART MERRIAM ELIZA RUHAMAH SCIDMORE

CONTENTS

WASHINGTON

PUBLISHED BY THE NATIONAL [illegible]

AGENTS IN [illegible]

THE AMERICAN NEWS COMPANY, [illegible]
PARIS: BRENTANO [illegible]

Price 25 Cents

Entered at the [illegible]

THE

National Geographic Society

ORGANIZED, JANUARY, 1888

PRESIDENT

GARDINER G. HUBBARD

VICE-PRESIDENTS

MARCUS BAKER
WILLIAM H. DALL
G. K. GILBERT
A. W. GREELY
C. HART MERRIAM
HERBERT G. OGDEN

TREASURER

CHARLES J. BELL

RECORDING SECRETARY

EVERETT HAYDEN

CORRESPONDING SECRETARY

HENRY GANNETT

MANAGERS

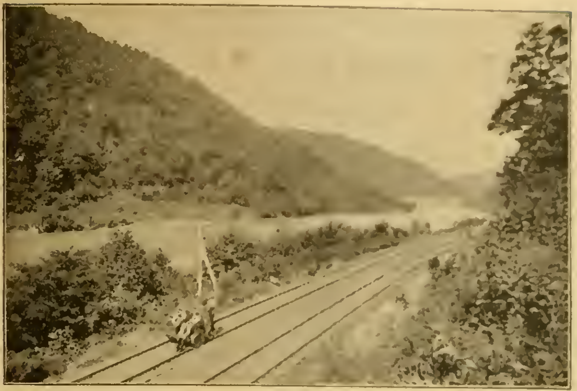
H. F. BLOUNT
F. V. COVILLE
C. W. DABNEY, JR.
DAVID T. DAY
JOHN HYDE
W J McGEE
F. H. NEWELL
W. B. POWELL

SECRETARY'S OFFICE, 1517 H STREET N. W., WASHINGTON

The National Geographic Society, the object of which is the increase and diffusion of geographic knowledge, has a paying membership of 1,400. Its membership is not restricted to practical geographers, but is open to any person in good standing who may be sufficiently interested in its work to seek admission. The annual subscription is: for active members, $5.00 per annum; for corresponding members, $2.00 per annum. Active members pay also an entrance fee of $2.00 on election. THE NATIONAL GEOGRAPHIC MAGAZINE is sent regularly to all members, both active and corresponding.

Donations for the founding of Prize Medals and Scholarships are respectfully solicited.

C&O ROUTE



F.F.V.

CHESAPEAKE & OHIO RY.

THE F. F. V. LIMITED is one of the finest trains hauled over any railway track in America. It runs solid between Cincinnati and New York, the route from Washington being over the Pennsylvania system. It has every modern convenience and appliance, and the dining-car service has no superior if it has an equal. The road-bed is literally hewed out of the eternal rocks; it is ballasted with stone from one end to the other; the greater portion is laid with one-hundred-pound steel rails, and although curves are numerous in the mountain section, the ride is as smooth as over a Western prairie.

One of the most delightful rides in all the route is that through the New River valley. The mountains are just low enough to be clad with verdure to the very top, and in the early spring every variety of green known to the mixer of colors can be seen, while the tones in autumn take on all the range from brown to scarlet.

These facts should be borne in mind by the traveler between the East and the West.

H. W. FULLER, *Genl. Pass. Agent, Washington, D. C.*

The Jumping-off Place

of the United States in Northwestern Washington is a region of unusual grandeur.

A wild, craggy range of mountains, the OLYMPICS, looks out upon the waters of the Pacific Ocean and the strait of Juan de Fuca. The high peaks of the range are crested with eternal snow and ice. Deep in their hollows are lakes of great depth and crystal purity. The flanks of the mountains are covered with the finest timber in the United States. Giant pines, cedars and firs rise 100, 200, and even 300 feet in the air. The streams race through wild ravines and are full of mountain-trout.

It is a paradise for the woodsman and angler. The lakes have large and new varieties of trout in them that fight viciously for life. It is a land little known and explored—perhaps less so than any region of equal area in the United States.

The **NORTHERN PACIFIC'S** new tourist book, **WONDERLAND '97,** has a chapter on this section, and it will be sent to any address by CHARLES S. FEE, General Passenger Agent, St. Paul, Minnesota, upon receipt of SIX CENTS in postage-stamps.

SOUTHERN RAILWAY

GREATEST SOUTHERN SYSTEM.

Penetrates with its main line or branches eight States South of the Ohio and Mississippi Rivers, and in conjunction with its friendly allied connections reaches all the commercial centers of the South and Southwest . . .

DOUBLE DAILY VESTIBULED LIMITED TRAINS

. . . BETWEEN . . .

Washington and Nashville via Salisbury, Asheville, Knoxville and Chattanooga.
Washington and Tampa via Columbia, Savannah and Jacksonville.
Washington and Memphis via Atlanta, Birmingham and K. C. M. & B.
Washington and New Orleans via Atlanta, Montgomery and Mobile.
Norfolk and Chattanooga via Salisbury, Asheville and Knoxville.

Pullman Sleeping Cars—Dining Cars—Day Coaches.
Additional Trains for local travelers . . . .

The direct line to the Winter Resorts of { FLORIDA, GULF COAST and TEXAS, ... MEXICO and CALIFORNIA,

—AND THE BEST—

Through Car Line to and from Asheville and Hot Springs—"The Land of the Sky."

Write for Map Folders.

R. W. POLLOCK, General Agent, 271 Broadway, New York City.
J. C. HORTON, Passenger Agent, 106 E. German Street, Baltimore, Md.
L. S. BROWN, General Agent Passenger Department, Washington, D. C.
J. H. WINGFIELD, Passenger Agent, Norfolk, Va.
S. H. HARDWICK, Assistant General Passenger Agent, Atlanta, Ga.
C. A. BENSCOTER, Assistant General Passenger Agent, Chattanooga, Tenn.
W. H. TAYLOE, Assistant General Passenger Agent, Louisville, Ky.

J. M. CULP, Traffic Manager. W. A. TURK, General Passenger Agent.

The Mutual Life Insurance Co.

OF NEW YORK,

RICHARD A. McCURDY, President,

Is the Largest Insurance Company in the World.

The Records of the Insurance Department of the State of New York SHOW THAT The Mutual Life

Has a Larger Premium Income - - -	($39,000,000)
More Insurance in Force - - - - -	($918,000,000)
A Greater Amount of Assets - - - -	($235,000,000)
A Larger Annual Interest Income - - -	($9,000,000)
Writes More New Business - - - -	($136,000,000)
And Pays More to Policy-holders - -	($25,000,000 in 1896)

THAN ANY OTHER COMPANY.

It has paid to Policy-holders since its organization, in 1843, } - - $437,005,195.29

ROBERT A. GRANNISS, Vice-President.

WALTER R. GILLETTE, General Manager. FREDERIC CROMWELL, Treasurer.
ISAAC F. LLOYD, Second Vice-President. EMORY McCLINTOCK, Actuary.
WILLIAM J. EASTON, Secretary.

Burlington Route

TO

ST. PAUL
MINNEAPOLIS

BEST LINE
CHICAGO OR ST. LOUIS

Ripans Tabules cure headache.

The Fastest and Finest Train in the West . . . .

IS

UNION PACIFIC
THE OVERLAND ROUTE
WORLD'S PICTORIAL LINE

The Overland Limited

......TO......

UTAH and CALIFORNIA.

FROM 16 TO 20 HOURS
SAVED BY USING

"THE OVERLAND ROUTE."

Double Drawing-Room Pullman Sleepers.
Free Reclining Chair Cars.
Pullman Dining Cars.
Buffet Smoking and Library Cars.

Send for Descriptive Pamphlet "49-96,"
Folders and other Advertising Matter.
(Mention this publication.)

E. L. LOMAX,
General Passenger and Ticket Agent,
OMAHA, NEB.

THE CHICAGO, MILWAUKEE AND ST. PAUL RAILWAY

. . RUNS . .

Electric Lighted and Steam Heated Vestibuled Trains between **Chicago, Milwaukee, St. Paul and Minneapolis** daily.

Through Parlor Cars on day trains between **Chicago, St. Paul and Minneapolis.**

Electric Lighted and Steam Heated Vestibuled Trains between **Chicago and Omaha and Sioux City** daily.

Through Sleeping Cars, Free Reclining Chair Cars and Coaches between **Chicago and Kansas City, Mo.**

Only two hours from Chicago to Milwaukee. Seven fast trains each way, daily, with Parlor Car Service.

Solid trains between **Chicago** and principal points in **Northern Wisconsin** and the **Peninsula of Michigan.**

Through Trains with Palace Sleeping Cars, Free Reclining Chair Cars and Coaches between **Chicago** and points in **Iowa, Minnesota, Southern and Central Dakota.**

The **finest Dining Cars** in the World.

The **best Sleeping Cars. Electric Reading Lamps in Berths.**

The best and latest type of **private Compartment Cars, Free Reclining Chair Cars, and buffet Library Smoking Cars.**

Everything First-class. First-class People patronize First-class Lines.

Ticket Agents everywhere sell tickets over the Chicago, Milwaukee and St. Paul Ry.

GEO. H. HEAFFORD,
General Passenger Agent, Chicago, Ill.

WHENEVER YOU VISIT WASHINGTON . . .

YOU ARE INVITED TO INSPECT THE

MAMMOTH DRY GOODS ESTABLISHMENT

OF

WOODWARD & LOTHROP

Where the **LATEST PARIS NOVELTIES** are always on Exhibition. The attention of those who anticipate purchasing . . . .

BRIDAL TROUSSEAUX

Is invited especially to extreme PARIS NOVELTIES in matched sets of French Hand-made Lingerie, including Gowns, Skirts, Chemises, Drawers, Corset Covers, &c. These can be furnished in any number of pieces desired. . . . .

HAND-MADE BRIDAL TROUSSEAUX, personally selected in Paris and exclusive in style and design: Three or more pieces . . . . . **$10 to $250.**

CORRESPONDENCE SOLICITED. MAIL ORDERS RECEIVE PROMPT AND CAREFUL ATTENTION.

TENTH, ELEVENTH, AND F STREETS N. W. . . . . WASHINGTON, D. C.

Shortest Line
TO
St. Paul and Minneapolis
and the Northwest

CHICAGO
GREAT
WESTERN
RAILWAY

"Maple
Leaf
Route"

For tickets, rates or any detailed information apply
to your home agent or write to

F. H. LORD,
Gen'l Pass'r and Ticket Agent,
CHICAGO.

A VITAL POINT

"IMPROVEMENT THE ORDER OF THE AGE."

A TYPEWRITER'S
PRINTING MECHANISM

MUST BE SCIENTIFICALLY CONSTRUCTED. THIS POINT IS OF UTMOST IMPORT FOR

EASY OPERATION AND
PERFECT EXECUTION.

The Smith..
Premier
Typewriters

Superior on This Point as Well as on All Others.

ONLY CORRECT
PRINCIPLES EMPLOYED.

The Smith Premier Typewriter Co.,
SYRACUSE, N. Y., U. S. A.

Catalogues and Information at Washington Office, No. 1416 F Street.

AN IMPROVED METHOD OF KEEPING THE SCORE IN

DUPLICATE WHIST, COMPASS WHIST, STRAIGHT WHIST AND EUCHRE.

Since Duplicate and Compass Whist have come into fashion there has been an unprecedented revival of interest in the game, due to the fact that mere *luck* is to a large extent eliminated by a comparison of the scores made in the play of the same hands by different players.

The one thing needed to perfect the new method has been a convenient device by means of which the score made on the first round can be concealed until after the replay of the hands, as a knowledge of the first score often enables a good player to make a decisive gain, and matches are lost and won on just such little chances.

A Washington player has at length invented and put upon the market at a very low price a little device which admirably answers the purpose, and at the same time serves as a pretty and useful table ornament, marker, and pencil rest. It is called the "Cosmos Counter," and consists of a little polished wood tablet with a metal keyboard that can be clamped down on the score in such a way as to bring 24 little metal plates over the 24 spaces in the "score" column of the card, for use in concealing each first score as soon as recorded and until the hand is replayed (in duplicate whist) or the entire series finished (in compass whist).

Whist players will at once see the advantage of this new method of keeping the score, as it effectually prevents their opponents at the same or another table from taking advantage, either by accident or design, of a knowledge of what the hand is capable. The trouble with duplicate whist, especially, is that the replay is liable to be influenced by memory of the cards and score, and anything that helps to confuse such recollection is a great gain to fair play.

The "Cosmos Score Card," prepared for use with the counter, shows several new features, such as a heading for both Duplicate and Compass Whist and (on the reverse) for Straight Whist, Euchre, &c., thus enabling the same counter and score to be used for any game of cards.

Cosmos Counters, with tablet of quartered oak, maple, or birch, and metal in either gold or silver finish, 50 cts. apiece; 6 for $2.75; 12 for $5; by mail, 4 cts. apiece extra. Cosmos Score Cards, 25 cts. per package of 50; 12 packages for $2.50; by mail free of postage.

Ask to see samples at any stationer's, or order direct from the General Agents.

Cosmos Duplicate Whist Score

N .... E ....

S .... W ....

HAND	COMPASS WHIST: SCORE	TOTALS	TRUMP	OPPONENTS		HAND
	DUPLICATE WHIST: SCORE	GAIN	TRUMP	GAIN	SCORE	
1						1
2						2
3						3
4						4
5						5
6						6
7						7
8						8
9						9
10						10
11						11
12						12
13						13
14						14
15						15
16						16
17						17
18						18
19						19
20						20
21						21
22						22
23						23
24						24
TOTALS						TOTALS

Copyright, 1895, by Everett Hayden, Washington, D. C. For use with the Cosmos Duplicate Whist Counter, patented July 7, 1896.

...., 189......

E. MORRISON PAPER CO., 1009 Penna. Avenue, Washington, D. C.

NATIONAL GEOGRAPHIC MONOGRAPHS

On the PHYSICAL FEATURES OF THE EARTH'S SURFACE, designed especially to supply to teachers and students of geography fresh and interesting material with which to supplement the regular text-book.

LIST OF MONOGRAPHS COMPRISING VOLUME I:

GENERAL PHYSIOGRAPHIC PROCESSES	J. W. Powell
GENERAL PHYSIOGRAPHIC FEATURES	J. W. Powell
PHYSIOGRAPHIC REGIONS OF THE UNITED STATES	J. W. Powell
BEACHES AND TIDAL MARSHES OF THE ATLANTIC COAST	Prof. N. S. Shaler
PRESENT AND EXTINCT LAKES OF NEVADA	Prof. I. C. Russell
APPALACHIAN MOUNTAINS—NORTHERN SECTION	Bailey Willis
APPALACHIAN MOUNTAINS—SOUTHERN SECTION	C. Willard Hayes
MT. SHASTA—A TYPICAL EXTINCT VOLCANO	J. S. Diller
THE NEW ENGLAND PLATEAU	Prof. W. M. Davis
NIAGARA FALLS AND ITS HISTORY	G. K. Gilbert

Price for one set of ten monographs, **$1.50**. Five sets to one address, **$6.00**. Single monographs, **20c.**

Remit with order to AMERICAN BOOK COMPANY,

New York - Cincinnati . Chicago

Ripans Tabules assist digestion.

TERRESTRIAL MAGNETISM

An International Quarterly Journal

Edited by L. A. BAUER
With the Co-operation of Eminent Magneticians

WITH the March, 1897, issue, this Journal, devoted exclusively to Terrestrial Magnetism and allied subjects, such as Earth Currents, Auroras, Atmospheric Electricity, etc., entered on its second volume. The hearty co-operation extended by the workers in this promising field of investigation, is abundantly shown by the numbers thus far issued, has made this Journal the international organ for making known the latest achievements. The magnetic needle has become such a promising instrument of research, not only in terrestrial, but in cosmical physics, that this Journal appeals to a large class of investigators. The geographer, the geologist, the astronomer, the meteorologist—all are interested in the development of the subject of terrestrial magnetism. It should therefore receive their support.

Among the contributors of the main articles in the past have been Messrs. Barus, Borgen, Chree, Eschenhagen, Littlehales, Rücker, Schmidt, Schuster, and de Tillo.

Future numbers will contain:

"The Earth, a Great Magnet,"
BY DR. J. A. FLEMING.

"The Electrification of the Atmosphere,"
BY PROF. ALEXANDER MCADIE.

"The Height of the Aurora,"
BY PROF. CLEVELAND ABBE.

"The Distribution of Magnetic Observatories,"
(Illustrated),
BY PROF. MAX ESCHENHAGEN,
etc., etc.

The size of the Journal is royal octavo, a volume embracing about 200 pages. Domestic subscription price: **Two dollars**; single numbers, **fifty cents**. Foreign subscription price: **Nine shillings, nine marks, or eleven francs.** Address:

TERRESTRIAL MAGNETISM,
The University of Cincinnati, Cincinnati, Ohio.

PEOPLE like to read about the great and wonderful country of the **Southwest**; of its quaint and curious towns, its ancient civilizations, its natural marvels. They like to get accurate information about **California and the Pacific Coast.** This is because most people want to some day see these things for themselves. . . . .

A charming book covering these facts is issued by the

PASSENGER DEPARTMENT

OF THE

Southern Pacific Railway,

and will be sent to any one, postpaid, on receipt of TEN CENTS.

THE BOOK IS ENTITLED

"Through Storyland to Sunset Seas,"

You can get a copy by writing to

S. F. B. MORSE,
General Passenger Agent,
Southern Pacific,
New Orleans,

and sending 10 cts. to defray postage.

AND IS A WONDERFULLY HANDSOME VOLUME OF 205 PAGES, WITH 160 ILLUSTRATIONS. . . .

The paper used is FINE PLATE PAPER, and every typographical detail is artistic. It is a story of what four people saw on just such a trip as you would like to make. . . . .

THE

National Geographic Magazine

Vol. VIII SEPTEMBER, 1897 No. 9

MODIFICATION OF THE GREAT LAKES BY EARTH MOVEMENT*

By G. K. Gilbert,

U. S. Geological Survey

The history of the Great Lakes practically begins with the melting of the Pleistocene ice-sheet. They may have existed before the invasion of the ice, but if so their drainage system is unknown. The ice came from the north and northeast, and spreading over the whole Laurentian basin invaded the drainage districts of the Mississippi, Ohio, Susquehanna, and Hudson. During its waning there was a long period when the waters were ponded between the ice front and the uplands south of the Laurentian basin, forming a series of glacial lakes whose outlets were southward through various low passes. A great stream from the Erie basin crost the divide at Fort Wayne to the Wabash river. A river of the magnitude of the Niagara afterward flowed from the Michigan basin across the divide at Chicago to the Illinois river; and still later the chief outlet was from the Ontario basin across the divide at Rome to the Mohawk valley.

The positions of the glacial lakes are also markt by shore-lines, consisting of terraces, cliffs, and ridges, the strands and spits formed by their waves. Several of these shore-lines have been traced for hundreds of miles, and wherever they are thoroughly studied it is found that they no longer lie level but have gentle slopes toward the south and southwest. Formed at the edges of

*Publisht by permission of the Director of the United States Geological Survey. A more extended paper, of similar scope, entitled "Recent earth movement in the Great Lakes region," will appear in the Eighteenth Annual Report of the Survey.

water surfaces, they must originally have been level, and their present lack of horizontality is due to unequal uplift of the land. The region has been tilted toward the south-southwest. The different shore-lines are not strictly parallel, and their gradients vary from place to place, ranging from a few inches to three or four feet to the mile.

The epoch of glacial lakes, or lakes partly bounded by ice, ended with the disappearance of the ice-field, and there remained only lakes of the modern type, wholly surrounded by land. These were formed one at a time, and the first to appear was in the Erie basin. It was much smaller than the modern lake, because the basin was then comparatively low at the northeast. Its outline is approximately shown by the inner dotted line of the accompanying map. Instead of reaching from the site

FIG. I—ANCIENT AND MODERN OUTLINES OF LAKE ERIE
The broken lines show the positions of the shores at two epochs of the lake's history

of Buffalo to the site of Toledo, it extended only to a point opposite the present city of Erie, and it was but one-sixth as large as the modern lake. Since that time the land has gradually risen at the north, canting the basin toward the south, and the lake has gradually encroacht upon the lowlands of its valley. At a date to be presently mentioned as the Nipissing, the western end of the lake was opposite the site of Cleveland, as indicated by another dotted line.

The next great lake to be releast from the domination of the ice was probably Ontario, though the order of precedence is here not equally clear. Before the Ontario valley held a land-bound lake it was occupied by a gulf of the ocean. Owing to the different attitude of the land, the water surface of this gulf was not parallel to the present lake surface but inclined at an angle. In the extreme northeast, in the vicinity of the Thousand Islands, the marine shores are nearly 200 feet above the present water level, but they descend southward and westward, passing beneath the lake level near Oswego, and toward the western end of the lake must be submerged several hundred feet. This condition was of short duration, and the rising land soon divided the waters, establishing Lake Ontario as an independent water body. The same peculiarity of land attitude which made the original Erie a small lake served to limit the extent of Ontario, but the restriction was less in amount because of the steeper slopes of the Ontario basin. Here again the southward tilting of the land had the effect of lifting the point of outlet and enlarging the expanse of the lake.

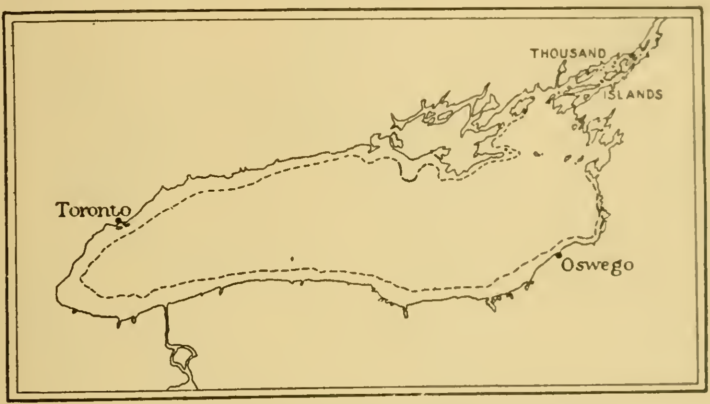


FIG. 2—ANCIENT AND MODERN OUTLINES OF LAKE ONTARIO
The broken line shows the original extent of the lake

There is some reason to think that the upper lakes, Huron, Michigan, and Superior, were at first open to the sea, so as to constitute a gulf, but the evidence is not so full as could be desired. When the normal lacustrine condition was establisht they were at first a single lake instead of three, and the outlet, instead of being southward from Lake Huron, was northeastward from Georgian bay, the outlet river following the valleys of the Mattawa and Ottawa to the St Lawrence. The triple lake is known to us chiefly through the labors of F. B. Taylor, who has made extensive studies of its shore-line. This line, called the Nipissing shore-line, is not wholly submerged, like the old shores of lakes Erie and Ontario, but lies chiefly above the present water surfaces. It has been recognized at many points about Lake Superior and the northern parts of lakes Huron and Michigan, and measurements of its height show that its plane has a remarkably uniform dip, at 7 inches per mile, in a south-southwest direction, or, more exactly, S. 27° W. As will be seen by the accompanying map, reproduced from Taylor, it crosses the modern shore-line of Lake Superior near its western end, thereby passing beneath the water surface; and it similarly passes below the surface of Lake Michigan near Green bay, and below the

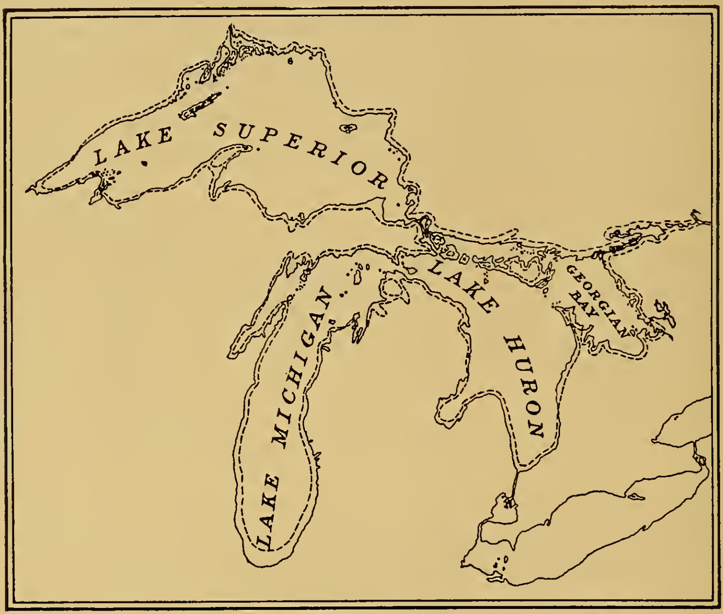


FIG. 3—THE NIPISSING GREAT LAKE (AFTER TAYLOR)
Its boundaries are shown by the broken line

surface of Lake Huron just north of Saginaw bay. The southward tilting of the land, involving the uplift of the point of outlet, increast the capacity of the basin and the volume of the lake, gradually carrying the coast-line southward in Lake Huron and Lake Michigan until finally it reacht the low pass at Port Huron and the water overflowed via the St Clair and Detroit channels to Lake Erie. The outlet by way of the Ottawa was then abandoned, and a continuance of the uplift caused the water to slowly recede from its northern shores. This change after a time separated Lake Superior from the other lakes, bringing the St Marys river into existence, and eventually the present condition was reacht.

These various changes are so intimately related to the history of the Niagara river that the Niagara time estimates, based on the erosion of the gorge by the cataract, can be applied to them. Lake Erie has existed approximately as long as the Niagara river, and its age should probably be reckoned in tens of thousands or hundreds of thousands of years. Lake Ontario is much younger. All that can be said of the beginning of Great Lake Nipissing is that it came long after the beginning of Lake Erie, but the date of its ending, through the transfer of outlet from the Mattawa to the St Clair, is more definitely known. That event is estimated by Taylor to have occurred between 5,000 and 10,000 years ago.*

The lake history thus briefly sketcht is characterized by a progressive change in the attitude of the land, the northern and northeastern portions of the region becoming higher, so as to turn the waters more and more toward the southwest. The latest change, from Great Lake Nipissing to Great Lakes Superior, Michigan, and Huron, involving an uplift at the north of more than 100 feet, has taken place within so short a period that we are naturally led to inquire whether it has yet ceast. Is it not probable that the land is still rising at the north and the lakes are still encroaching on their southern shores? J. W. Spencer, who has been an active explorer of the shore-lines of the glacial lakes and has given much study to related problems, is of opinion that the movements are not complete, and predicts that they will result in the restoration of the Chicago outlet of Lake Michigan and the drying of Niagara.†

The importance of testing this question by actual measurements was imprest upon me several years ago, and I endeavored to secure the institution of an elaborate set of observations to that end. Failing in this, I undertook a less expensive investigation, which began with the examination of existing records of lake height as recorded by gage readings, and was continued by the establishment of a number of gage stations in 1896. To understand fully the nature of this investigation it is necessary to consider the difficulties that arise from the multifarious motions to which the lake water is subject.

*Studies in Indiana Geography, X. A short history of the Great Lakes. Terre Haute, 1897.

† Proc. Am. Ass. Adv. Sci., vol LIII, 1894, p. 246.

If the volume of a lake were invariable, and if its water were in perfect equilibrium under gravity, its surface would be constant and level, and any variation due to changes in the height of the land could be directly determined by observations on the position of the water surface with reference to the land; but these conditions are never realized in the case of the Great Lakes, where the volume continually changes and the water is always in motion. The investigator therefore has to arrange his measurements so as to eliminate the effect of such changes.

Consider first the influence of wind. The friction of the wind on the water produces waves. These are temporary and practically cease in periods of calm; the perpetual ground-swell of the ocean is not known on the lakes. The friction of the wind on the water also drives the water forward, producing currents. The water thus driven against the lee shores returns in undercurrents, but the internal friction of the water resists and delays the return, and there is consequently a heaping of the water against lee shores and a corresponding lowering of its level on other shores. During great storms these differences amount to several feet, reaching a maximum in Lake Erie; in October, 1886, a westerly gale is reported to have raised the water 8 feet at Buffalo and deprest it 8 feet at Toledo.* For light winds the changes of level are much smaller, but they are nevertheless appreciable, and they have even been detected in the case of the gentle "land and sea" breezes which in calm weather are created by the diurnal cycle of temperature change on the land.

The water is also sensitive to atmospheric pressure. If the air prest equally on all parts of the lake surface the equilibrium of the water would not be disturbed; but its pressure is never uniform. As shown by the isobars on the daily weather map, there are notable differences of pressure from point to point, and within the length of one of the Great Lakes these often amount to several tenths of a barometric inch. A column of mercury 0.1 inch high weighs as much as a column of water 1.3 inches high; and whenever the atmospheric pressure at one point on a lake exceeds the pressure at another point by the tenth of a barometric inch, the water level at the first point is, in consequence, 1.3 inches lower than the water level at the second point. When a cumulus cloud forms over the water there is a reaction on the

*Science, vol. VIII, pp. 34, 391. The effect of a storm in October, 1893, is ably discust by Wm. T. Blount, in Ann. Rept. Chief of Engineers, U. S. A., for 1894, part 6, pp. 3431–3435.

water, disturbing its equilibrium, and the passage of a thunder-storm often produces oscillations attracting the attention of even the casual observer. Such sudden and temporary variations of pressure give rise to waves analogous to those caused by a falling pebble, except that they are broad and low, and these waves not only travel to all parts of a lake but are continued by reflection, so that a local storm at one point is felt in the water surface at all points and for a considerable period. The passage of the greater atmospheric waves associated with ordinary cyclonic storms and the impulses given by winds are also able to set the whole body of the lake in motion, so that it sways from side to side or end to end like the swaying water in a tub or basin, and these swaying motions are of indefinite continuance. In the deeper lakes, and probably in all the lakes, they are so enduring as to bridge over the intervals from impulse to impulse. Such oscillations, which appear at any point on the coast as alternate risings and fallings of the water, with periods ranging from a few minutes to several hours, are called *seiches*. Their amplitude is usually a few inches, but at the ends of lakes is sometimes a foot or more.

The lakes, like the ocean, are swayed by the attractions of the sun and moon. Their tides are much smaller than those of the ocean, and are even small as compared to the seiches, but they are still measurable. At Milwaukee the lunar tide rises and falls more than an inch and the solar tide a half inch. At Chicago and Duluth each tide amounts to an inch and a half, and their combination at new and full moon to three inches.

Water is continually added to each lake by rivers and creeks, but the rate is not uniform. Usually a few freshets, occurring within two or three weeks, contribute more water than comes during all the remainder of the year. Water is also added in an irregular way by rain and snow falling directly on the lake. It is subtracted by evaporation, the rate of which varies greatly, and by overflow, which varies within moderate limits. The volume of water contained in the lake, being subject to these variable gains and losses, is itself inconstant, and the general height of the water surface therefore oscillates. In average years the range of variation for Lake Superior is 12 inches; for lakes Michigan and Huron, 12 inches; for Lake Erie, 14 inches, and for Lake Ontario, 17 inches. Low water occurs normally in January or February for all the lakes except Superior, where it occurs in March. High water is reacht sooner in the lower lakes, June being the usual month for Ontario, June or July for Erie, July for Michigan and Huron, and August or September for Superior. Fig. 4 shows the character of the annual oscillations, as given by averages of long series of years.

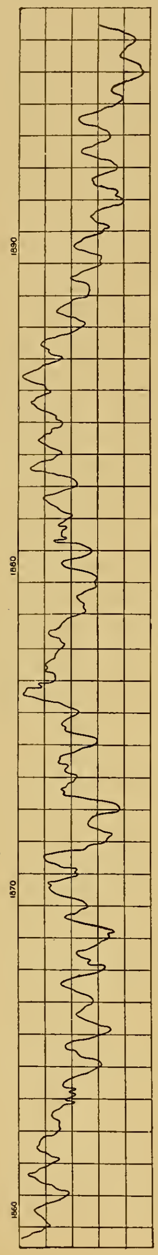


FIG. 4—ANNUAL OSCILLATIONS OF THE SURFACES OF THE LAURENTIAN LAKES

Compiled from monthly means publisht by the Chief of Engineers, U. S. A. Each vertical space represents six inches. The observations for Lake Superior cover the period 1862–1895; for Michigan-Huron, 1860–1895; for Erie, 1855–1895; for Ontario, 1860–1895.

In a wet year more water enters the lake than leaves it, and there is a net rise of the surface; in a dry year there is a net fall. A series of wet years produce exceptionally high water, and a series of dry years exceptionally low, so that the entire range of water height is considerably greater than the annual range. The recorded range for lakes Superior, Michigan, and Huron is between 5 and 6 feet; for Erie and Ontario, between 4 and 5 feet.

The accompanying diagram (Fig. 5) of the oscillations of Lake Michigan illustrates the annual cycle and also the progressive changes from year to year. Being compiled from monthly means of gage readings, it does not show tides and seiches nor the oscillations of short period.

These various oscillations of the water, though differing widely in amplitude, rate, and cause, yet coexist, and they make the actual movement of the water surface highly complex. The complexity of movement seriously interferes with the use of the water plane as a datum level for the measurement of earth movements, and a system of observations for that purpose needs to be planned with much care. The main principles of such a system are, however, simple, and may readily be stated. The most important is that the direct measurement of the heights of individual points should not be attempted, but comparison should always be made between two points, their relative height being measured by means of the water surface used as a leveling instrument.

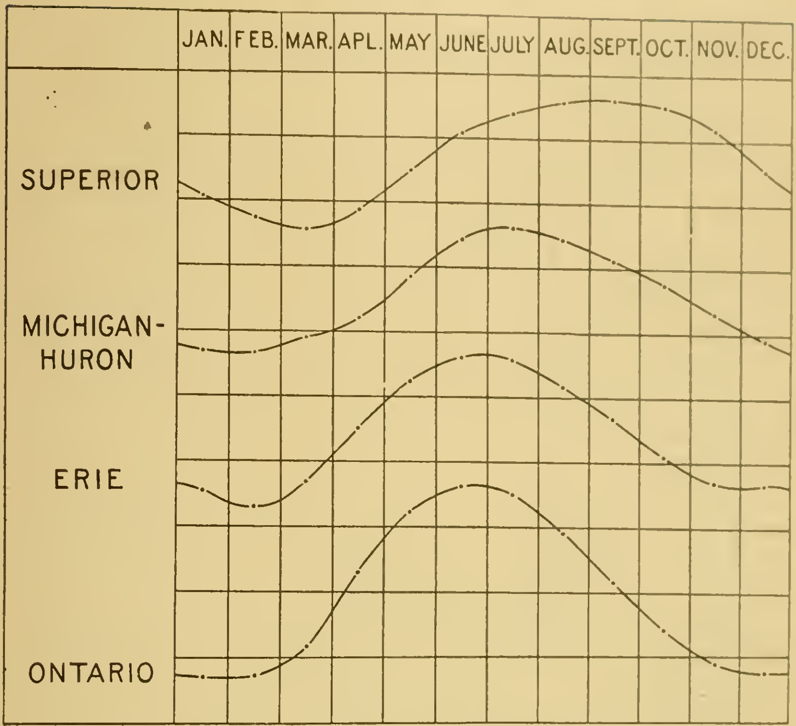


FIG. 5—OSCILLATIONS OF THE SURFACE OF LAKE MICHIGAN, DUE TO CHANGES IN THE VOLUME OF THE LAKE

Compiled under the direction of the Chief of Engineers, U. S. A., from gage readings at Milwaukee, Wisconsin, from August, 1859, to June, 1897. Each horizontal space represents a calendar year; each vertical space one foot

In the diagram, Fig. 6, A C B is the profile of a lake basin. A and B are fixt objects on opposite shores, and we will suppose the water surface to have the position X X′. Assuming the water in equilibrium, all parts of this surface have the same height. If the height of A above the water at X be accurately measured by the surveyor's level, and the height of B above the water at X′ be similarly measured, then the difference between these two measurements gives the difference in height between A and B. After an interval of some years or decades the work

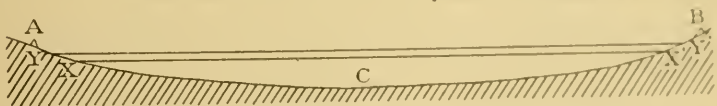


FIG. 6—DIAGRAM ILLUSTRATING THE METHOD OF USING A LAKE SURFACE FOR THE DISCOVERY AND MEASUREMENT OF EARTH MOVEMENTS

is repeated. The water surface then has some different position, Y Y′, and the heights measured are of A above Y and of B above Y′. The difference between the two heights gives again the relative height of A and B; and if earth movement has tilted the basin toward A or B, the change in their relative height may be shown by the difference in the two results of measurement.

As the water is in fact not still, but in continual motion, the mere running of lines of level from A and B to the water does not suffice, and it is necessary to determine from observations on the oscillating water surface what would be its position if still. Such observations are made by means of gages. These are of various forms, but each consists essentially of a fixt point, or zero, close by the water, and a graduated scale by means of which the vertical distance of the water surface from the zero is measured.

Changes in the volume of the lake influence all parts of its surface equally and at the same time. To eliminate their effects from the measurements it is only necessary that the gage observations at the two stations be simultaneous. The effects of wind waves can be prevented by breakwaters. Disturbances due to currents propelled by strong winds can be avoided by choosing times when there is little wind. The effects of light winds can be approximately eliminated by taking the average of many observations, and so can the effects of seiches and tides. The effects of differences of atmospheric pressure can be computed from barometric measurements of air pressure, and the proper corrections applied. It is also possible, by the discussion of long series of observations at each station, to determine the local tidal effects and afterward apply corrections; and the land and sea breeze effect may be treated in the same way.

In the investigation I was able to make, consideration was given to these various sources of error, but it was not practicable to take all desirable measures for avoidance or correction, because the reading of gages was only partly under my control. Gage stations have been establisht on the Great Lakes at various times and at various places, and the records of readings have been preserved. In some cases the zeros of gages were connected by leveling with bench marks of a permanent character, and in a few instances the gages themselves are stable and enduring structures. The most important body of information of this character is contained in the archives of the United States Lake Survey, which were placed at my service by the Chief of Engineers, U. S. A. By searching the records I was able to select certain pairs of stations at which the relative heights of permanent points on the shore (equivalent to A and B of the diagram) had been practically determined twenty or more years ago. At some of these stations gages are still read; at others I establisht gages and ran the leveling lines necessary to connect them with the old benches. At all of them observations were maintained from July to October, 1896, and these observations, in combination with the levelings, afforded measurements that could be compared with those made earlier so as to discover changes due to earth movement.

It will not be necessary to give here the details of observation and computation, as they are fully set forth in a paper soon to

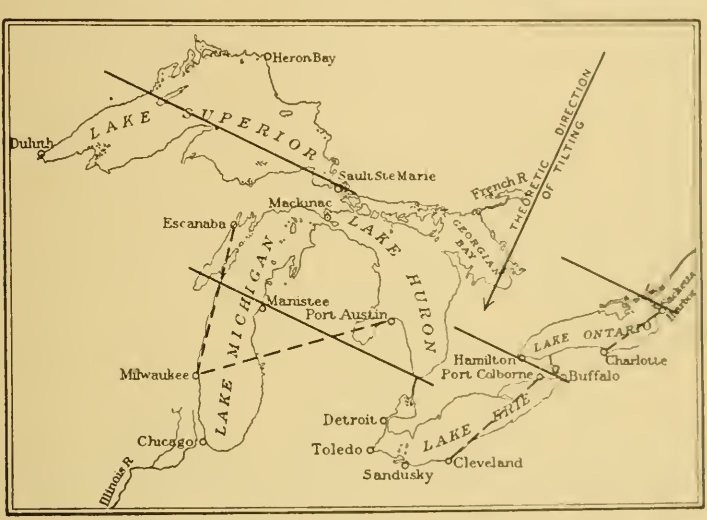


FIG. 7—MAP OF THE GREAT LAKES, SHOWING PAIRS OF GAGING STATIONS AND ISOBASES OF OUTLETS

The isobases are markt by full lines. Broken lines show the pairs of stations

be printed by the Geological Survey, but the general scope of the work may be briefly outlined. As the tilting shown by the geologic data was toward the south-southwest, stations were, so far as possible, selected to test the question of motion in that direction. The most easterly pair were Sacketts Harbor and Charlotte, New York, connected by the water surface of Lake Ontario (see map, Fig. 7). From observations by the U. S. Lake Survey in 1874, it appeared that a bench mark on the old light-house in Charlotte was then 18.531 feet above a certain point on the Masonic Temple in Sacketts Harbor. In 1896 the measurement was repeated, and the difference found to be 18.470 feet, the point at Sacketts Harbor having gone up, as compared to the point at Charlotte, 0.061 foot, or about three-fourths of an inch. Similarly it was found that between 1858 and 1895 a point in Port Colborne, at the head of the Welland canal, as compared to a point in Cleveland, Ohio, rose 0.239 foot, or nearly three inches. Between 1876 and 1896 a point at Port Austin, Michigan, on the shore of Lake Huron, as compared to a point in Milwaukee, on the shore of Lake Michigan, rose 0.137 foot, or one and one-half inches; and in the same period a point in Escanaba, at the north end of Lake Michigan, as compared to the same point in Milwaukee, rose 0.161 foot, or about two inches.

There is no one of these determinations that is free from doubt; buildings and other structures on which the benches were markt may have settled, mistakes may have been made in the earlier leveling, when there was no thought of subjecting the results to so delicate a test, and there are various other possible sources of error to which no checks can be applied; but the fact that all the measurements indicate tilting in the direction predicted by theory inspires confidence in their verdict. This confidence is materially strengthened when the numerical results are reduced to a common unit and compared.

Summary of Distances, Time Intervals, and Measurements of Differential Earth Movements

Pairs of stations.	Direct distance.	Distance in direction S. 27° W.	Interval between dates of measurement.	Change in relative height.	Change per 100 miles per century.	Probable errors of quantities in last column.
	Miles.	*Miles.*	*Years.*	*Feet.*	*Feet.*	*Feet.*
Sacketts Harbor and Charlotte...	86	76	22	.061	.37	.18
Port Colborne and Cleveland.......	158	141	37	.239	.46	.11
Port Austin and Milwaukee	259	176	20	.137	.39	.09
Escanaba and Milwaukee.........	192	186	20	.161	.43	.06
				Mean......	.41	
				Weighted mean......	.42	± .05

The stations of the several pairs are at different distances apart, the directions of the lines connecting them make various angles with the theoretic direction of tilting, and the time intervals separating the measurements are different. To reduce the results to common terms I have computed from each the rate of tilting it implies in the theoretic direction, S. 27° W. In the sixth column of the preceding table the rate is exprest as the change in relative height of the ends of a line 100 miles long during a century.

Compared in this way, the results are remarkably harmonious, the computed rates of tilting ranging only from 0.37 foot to 0.46 foot per 100 miles per century; and in view of this harmony it is not easy to avoid the conviction that the buildings are firm and stable, that the engineers ran their level lines with accuracy, that all the various possible accidents were escaped, and that we have here a veritable record of the slow tilting of the broad lake-bearing plain.

The computed mean rate of tilting, 0.42 foot per 100 miles per century, is not entitled to the same confidence as the fact of tilting. Its probable error, the mathematical measure of precision derived from the discordance of the observational data, is rather large, being one-ninth of the whole quantity measured. Perhaps it would be safe to say that the general rate of tilting, which may or may not be uniform for the whole region, falls between 0.30 and 0.55 foot.

While the credit of formulating the working hypothesis or geologic prediction which has thus been verified by measurement belongs to Spencer, it is proper to note that the fundamental idea of modern differential earth movement in the Great Lakes region was announced much earlier by G. R. Stuntz, a Wisconsin surveyor. In a paper communicated to the American Association for the Advancement of Science in 1869, he cites observations tending to show that in 1852–'53 the water of Lake Superior stood abnormally high at the west end while it was unusually low at the east, and he infers that the land is not stable.

The geographic effects of the tilting are of scientific and economic importance. Evidently the height of lake water at a lake's outlet is regulated by the discharge and is not affected by slow changes in the attitude of the basin; but at other points of the shore the water advances or retreats as the basin is tipt. Consider, for example, Lake Superior. On the map (Fig. 7) a line has been drawn through the outlet at the head of St Marys river in a direction at right angles to the direction of tilting. All points on this line, called the *isobase* of the outlet, are raised or lowered equally by the tilting and are unchanged with reference to one another. All points southwest of it are lowered, the amount varying with their distances from the line, and all points to the northeast are raised. The water, always holding its surface level and always regulated in volume by the discharge at the outlet, retreats from the rising northeast coasts and encroaches on the sinking southwest coasts. Assuming the rate of tilting to be 0.42 foot per 100 miles per century, the mean lake level is rising at Duluth 6 inches per century and falling at Heron bay 5 inches. Where the isobase intersects the northwestern shore, which happens to be at the international boundary, there is no change.

Lake Ontario lies altogether southwest of the isobase of its outlet, and the water is encroaching on all its shores. The same tilting that enlarged it from the area markt by the dotted line of figure 2 is still increasing its extent. The estimated vertical rise at Hamilton is 6 inches per century. The whole coast of Lake Erie also is being submerged, the estimated rate at Toledo and Sandusky being 8 or 9 inches per century.

The isobase of the double Lake Huron-Michigan passes southwest of Lake Huron and crosses Lake Michigan. All coasts of Lake Huron are therefore rising as compared to the outlet, and the consequent apparent lowering of the mean water surface is estimated at 6 inches per century for Mackinac and at 10 inches for the mouth of the French river on Georgian bay. In Lake Michigan the line of no change passes near Manistee, Michigan. At Escanaba the estimated fall of the water is 4 inches per century; at Milwaukee the estimated rise is 5 or 6 inches, and at Chicago between 9 and 10 inches.

These slow changes of mean water level are concealed from ordinary observation by the more rapid and impressive changes due to variations of volume, but they are worthy of consideration in the planning of engineering works of a permanent character, and there is at least one place where their influence is of moment to a large community. The city of Chicago is built on a smooth plain little above the high-water level of Lake Michigan. Every decade the mean level of the water is an inch higher, and the margin of safety is so narrow that inches are valuable. Already the older part of the city has lifted itself several feet to secure better drainage, and the time will surely come when other measures of protection are imperatively demanded.

Looking to the more distant future, we may estimate the date at which the geographic revolution prophesied by Spencer will occur. Near Chicago, as already mentioned, is an old channel made by the outlet of a glacial lake. The bed of the channel at the summit of the pass is about 8 feet above the mean level of Lake Michigan and 5 feet above the highest level. In 500 or 600 years (assuming the estimated rate of tilting) high stages of the lake will reach the pass, and the artificial discharge by canal will be supplemented by an intermittent natural discharge. In 1,000 years the discharge will occur at ordinary lake stages, and after 1,500 years it will be continuous. In about 2,000 years the discharge from Lake Michigan-Huron-Erie, which will then have substantially the same level, will be equally divided between the western outlet at Chicago and the eastern at Buffalo. In 2,500 years the Niagara river will have become an intermittent stream, and in 3,000 years all its water will have been diverted to the Chicago outlet, the Illinois river, the Mississippi river, and the Gulf of Mexico.

THE TORONTO MEETING OF THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

If the British Association for the Advancement of Science has never yet done itself the honor of electing a geographer as its President, it at least is not open to the reproach of neglecting so important a department of knowledge as that which is concerned with the distribution of the human race and the manifold conditions of its environment. Throughout its entire history of 67 years the Association has given geography a prominent place in its proceedings, and there have been few distinguished explorers who have not reserved some of their most interesting and important utterances for the Geographical Section of this great scientific body. Just 40 years ago, in the city of Dublin, it was to see and hear Livingstone that people crowded into the hall assigned to Section E. Fifteen years later, at Brighton, before an equally large and brilliant assemblage, Mr Stanley narrated the thrilling story of his search for the great missionary-traveler in the wilds of equatorial Africa, and almost every Arctic explorer and every seeker for the mysterious sources of the Nile and every daring adventurer who has penetrated the recesses of the great Asiatic plateau has modestly narrated the story of his travels and his discoveries before the British Association.

If the recent Toronto meeting will not be remembered for any dramatic incidents or other highly sensational features, it was in many respects a notable gathering and by no means lacking in important contributions to geographic science. The address of the President of the Geographical Section, Mr J. Scott Keltie, LL. D., Joint Secretary of the Royal Geographical Society and Editor of the Geographical Journal and of the Statesman's Year-Book, dealt with the geographic problems of the future and set forth in admirable and most instructive array the various regions of the globe that are still wholly or in large part unexplored. This address is published, with but very slight abridgment, in the following pages, as a matter not merely of general interest, but of especial value to teachers and geographic students who find it difficult to keep abreast of geographic research in the more remote parts of the world.

Dr Keltie's address was delivered on August 19, and in the afternoon of the same day Sir George Scott Robertson, the Hero of Chitral, described Kafiristan and the Kafirs; Mr E. G. Ravenstein, of London, presented the sixth report of the Committee on the Climatology of Africa, a subject of great interest in view of the recent extension of European territory on that continent; Mr E. Delmar Morgan, of London, read a paper on Nova Zembla and its Physical Geography, summarizing the results of recent Russian investigations and presenting the conclusion that the country is now undergoing a new process of glaciation that will convert it into an icy wilderness; Mr B. Leigh Smith, also of London, spoke on Recent Temperature Observations off Spitzbergen, and a voluminous report was presented on The Position of Geography in the Educational System of Great Britain.

On the following day the proceedings of the Geographic Section included a paper by Prof. Richard E. Dodge, of the Teachers College, New York, on Scientific Geography for Schools, which was a plea for the more scientific teaching of geography in the public schools and for systematic coöperation in the bringing about of a much-needed improvement; a paper by Col. F. Bailey, of Edinburgh, on Forestry in India, showing the serious results of forest denudation in that country and the measures that have been adopted to remedy the evil; a Scheme of Geographical Classification, by Dr Hugh Robert Mill, of London; a paper by Mr Vaughn Cornish, on The Distribution of Detritus by the Sea;

a paper by Mr E. G. Ravenstein, on The Kongo and the Cape of Good Hope, 1482 to 1488, a narrative of one of the most interesting periods in the history of geographic exploration, and a communication by Prof. John Milne, of the Isle of Wight, on Certain Submarine Geological Changes, which was mainly an epitome of the article on Suboceanic Changes, published in the July and August numbers of the Geographical Journal.

On August 23 Mr Marcus Baker, of the U. S. Geological Survey, read a paper, the joint production of himself and Mr Gardiner G. Hubbard, President of the National Geographic Society, on the Geography of the United States and the Agencies employed in its Exploitation; General A. W. Greely presented a paper by Prof. F. H. Newell, Chief Hydrographer of the U. S. Geological Survey, on the Hydrography of the United States; Dr T. C. Mendenhall, President of the Worcester Polytechnic Institute and formerly Superintendent of the U. S. Coast and Geodetic Survey, and Mr Otto H. Tittmann, Assistant in charge of the Office of the Survey, discussed the geographic work of that important government bureau; Mr J. B. Tyrrell, of Ottawa, read a paper on the Barren Lands of Canada, by which title he designated the plains and prairies which stretch from Hudson bay to the Mackenzie river and from the coastline of the Arctic ocean southward to the region of civilization; Mr W. J. White read a paper on the Topographic Work of the Geological Survey of Canada; Prof. Charles D. Walcott, Director of the Geological Survey of the United States, presented a valuable communication on the geographical work of the institution over which he so ably presides, and Prof. Willis L. Moore, Chief of the U. S. Weather Bureau, discussed entertainingly and instructively the Climatology of the United States.

The proceedings of August 24 opened with an address by Mr F. C. Selous on the Economic Geography of Rhodesia, a region in which he has spent twenty-five years in elephant and lion hunting, but in which the ultimate destiny of a large part of the African continent is now being wrought out. This was followed by a Journey in Tripoli, by Mr J. T. Myers; Potamology as a Branch of Geography, by Prof. Albrecht Penck, of the University of Vienna; the Geographical Development of the Lower Mississippi, by Dr E. L. Corthell, of New York; Southeastern Alaska, by Mr Otto J. Klotz, of Ottawa; The First Ascent of Mt. Lefroy and Mt. Aberdeen, by Prof. H. B. Dixon, of Manchester; Mexico Felix and Mexico Deserta, by Mr O. H. Howarth.

of London, and The Direction of Lines of Structure in Eurasia, by Prince Kropotkin, an important paper written in a Russian prison and saved from destruction by the Russian Geographical Society after the escape of its author.

On August 25, the closing day of the meeting, Prof. W. M. Davis, of Harvard, spoke on the importance of geography as a university subject; General A. W. Greely read a paper by Mr Henry Gannett, Chief Geographer of the U. S. Geological Survey, on the Growth and Material Conditions of the United States, and Dr Mill and Prof. Penck exhibited a large number of views illustrative of geographic scenes and conditions.

While the foregoing represents the work of the Geographical Section, it by no means exhausts the list of subjects of interest to the student of geography that were discussed at the Toronto meeting. In the Section of Mathematics and Physics, on August 19, Prof. John Milne presented a report from the Committee on Seismological Observations, and exhibited, for the purpose of illustrating the nature of certain recent discoveries, the wonderfully delicate instruments that are used in locating breakages in submarine cables. On the same day, in the Section of Geology, Prof. J. C. Branner, of Stanford University, discussed The Former Extension of the Appalachians across Mississippi, Louisiana, and Texas, and Dr F. D. Adams demonstrated the plasticity of rocks. Again, in the Section of Mathematics and Physics, on August 20, Mr Alexander Johnson, of McGill University, discussed the project of an Imperial Hydrographic Survey, and at the Horticultural Pavilion Prof. H. O. Forbes, of Liverpool, lectured on British New Guinea, its People, and the Problems which the Region offers to Geologists and Naturalists.

In the Section of Meteorology, on August 23, Mr F. Napier Denison, of the Toronto Observatory, discussed the Great Lakes as a Sensitive Thermometer; Mr John Hopkinson read a paper on The Monthly and Annual Rainfall in the British Empire during the last Twenty Years, Dr Van Rijckevorsel, of Rotterdam, discussed the Temperature of Europe, laying stress on the influences originating in western Asia on the east and in or beyond the Atlantic ocean on the west; Mr R. F. Stupart, of the Toronto Meteorological Department, read a paper on The Climatology of Canada, and Mr R. G. Haliburton, a learned member of the Canadian Bar, discussed November Meteors and November Flood Traditions. In the evening Prof. John Milne lectured before the Association in general session on Earthquakes and

Volcanoes, an exceptionally large and distinguished audience being attracted by the fame of the man who announced in England on the day of its occurrence the terrible earthquake which visited Japan in June, 1896.

The Anthropological Section also presented many attractions to the geographer, especially on August 23, when the proceedings included a paper by Mr B. Sulte on the Origin and Characteristics of the French-Canadians, an account of the Seri Indians, by Prof. W J McGee, Acting President of the American Association, and a long discussion on the Evidences of American-Asiatic Contact, opened by Prof. F. W. Putnam, of Harvard.

It will readily be seen from the foregoing that the Toronto meeting of the British Association was the occasion of many notable contributions to geographic science, and no apology will be offered for the presentation in forthcoming numbers of The National Geographic Magazine of abridgments of such of them as are of greatest value and are available for the purpose.

J. H.

THE GREAT UNMAPPED AREAS ON THE EARTH'S SURFACE AWAITING THE EXPLORER AND GEOGRAPHER*

By J. Scott Keltie, LL. D.,

Secretary to the Royal Geographical Society, Editor of the Geographical Journal and of the Statesman's Year-Book, etc., etc.

We meet this year in exceptional circumstances. Thirteen years ago the British Association met for the first time in a portion of the empire beyond the limits of the British islands. During these thirteen years much has happened of the greatest interest to geographers, and if I attempted to review the progress which has been made during these years—progress in the exploration of the globe, progress in geographical research, progress in geographical education—I could not hope to do it to any purpose in the short time during which it would be right for a president to monopolize the attention of the Section.

But we have, at the same time, reached another stage in our history which naturally leads us to take stock of our progress in

* Presidential address delivered before the Geographical Section of the British Association for the Advancement of Science, at Toronto, August 19, 1897.

the past. We have all of us been celebrating the sixtieth year of the glorious reign of the Sovereign of whose vast dominions Canada and the United Kingdom form integral parts. The progress made during that period in our own department of science has been immense; it would take volumes to tell what has been done for the exploration of the globe.

The great continent of Africa has practically been discovered, for sixty years ago almost all but its rim was a blank. In 1837 enormous areas in North America were unexplored and much of the interior of South America was unknown. In all parts of Asia vast additions have been made to our knowledge; the maps of the interior of that continent were sixty years ago of the most diagrammatic character. The Australian interior was nearly as great a blank as that of Africa; New Zealand had not even been annexed. Need I remind you of the great progress which has been made during the period both in the North and South Polar areas, culminating in the magnificent achievement of Dr Nansen? It was just sixty years ago that the great Antarctic expedition under Sir James Ross was being organized; since that, alas! little or nothing has been done to follow up his work. Sixty years ago the science of oceanography, even the term, did not exist. It is the creation of the Victorian era, and may be said almost to have had its origin in the voyage of the *Challenger*, which added a new domain to our science and opened up inexhaustible fields of research.

* * * * * * *

I have thought, then, that the most useful and most manageable thing to do on the present occasion will be to indicate briefly what, in my estimation, are some of the problems which geography has to attack in the future, only taking such glances at the past as will enable us to do this intelligibly.

ASIA

Turning to the continent of Asia, we find that immense progress has been made during the past sixty years. In the presidential address given sixty years ago Mr Hamilton says of Asia: "We have only a general knowledge of the geographical character of the Burman, Chinese, and Japan empires; the innumerable islands of the latter are still, except occasionally, inaccessible to European navigators. Geographers hardly venture on the most loose description of Tibet, Mongolia, or Chinese Tartary, Siam, and Cochin China." Since then the survey of India, one of the greatest enterprises undertaken by any State, has been completed, and is being rapidly extended over Burma. But I need not remind you in detail of the vast changes that have taken place in Asia during these years and the immense additions that have been made to our knowledge of its geography. Exploring activity in Asia is not likely to cease, though it is not to be expected that its inhospitable center will ever be so carefully mapped as have been the mountains of Switzerland.

The most important desiderata, so far as pioneer exploration in Asia is concerned, may be said to be confined to two regions. In southern and central Arabia there are tracts which are entirely unexplored. It is probable that this unexplored region is in main a sandy desert. At the same time it is, in the south at least, fringed by a border of mountains whose slopes are capable of rich cultivation and whose summits the late Mr Theodore Bent found, on his last and fatal journey, to be covered with snow. In exploration, as in other directions, it is the unexpected that happens; and if any traveler cared to face the difficulties—physical, political, and religious—which might be met with in southern and central Arabia, he might be able to tell the world a surprising story.

The other region in Asia where real pioneer work still remains to be done is Tibet and the mountainous districts bordering it on the north and east. Lines of exploration have in recent years been run across Tibet by Russian explorers like Prjevalsky, by Rockhill, Prince Henry of Orleans, and Bonvalot, by Bower, Littledale, Wellby, and Malcolm. From the results obtained by these explorers we have formed a fair idea of this, the most extensive, the highest, and the most inhospitable plateau in the world. A few more lines run in well-selected directions would probably supply geography with nearly all she wants to learn about such a region, though more minute exploration would probably furnish interesting details as to its geological history.

THE FORBIDDEN CITY

The region lying to the north of the Himalayan range and to the south of the parallel of Lhasa is almost a blank on the map, and there is ample room here for the enterprising pioneer. The forbidden city of Lhasa is at present the goal of several adventurers, though as a matter of fact we cannot have much to learn in addition to what has been revealed in the interesting narrative of the native Indian traveler, Chandra Das. The magnificent mountain region on the north and east of Tibet furnishes a splendid field for the enterprising explorer. Mrs Bishop recently approached it from the east, through Sze-chuen, and her description of the romantic scenery and the interesting non-Mongolian inhabitants leaves us with a strong desire to learn more. On the southeast of Tibet is the remarkable mountainous region, consisting of a series of lofty parallel chains, through which run the upper waters of the Yangtse, the Mekong, the Salwin, and the Irrawaddy. This last-named river, recent exploration has shown, probably does not reach far into the range. But it will be seen by a glance at a map that the upper waters of the other rivers are carried far into the heart of the mountains. But these upper-river courses are entirely conjectural and have given rise to much controversy. There is plenty of work here for the explorer, though the difficulties, physical and political, are great.

But besides these great unexplored regions there are many blanks to be filled up in other parts of Asia, and regions which, though known in a general way, would well repay careful examination. There is the mountain track between the Zarafshan river and the middle course of the Sarkhab, tributary of the Oxus, and the country lying between that and the Oxus. There is the great Takla-Makan desert in Chinese or Eastern Turkistan, part of which has recently been explored by Russian expeditions and by that young and indefatigable Swedish traveler, Dr Sven Hedin. It is now one of the most forbidding deserts to be found anywhere, but it deserves careful examination, as there are evidences of its once having been inhabited, and that at no very remote period. It is almost surrounded by the Tarim, and on its eastern edge lies Lob-nor, the remarkable changes in which have been the subject of recent investigation. As readers of Dr Nansen's Voyage of the *Fram* will remember, the Siberian coast is most imperfectly mapped. Of course it is a difficult task, but it is one to which the Russian government ought to be equal. China has on paper the appearance of being fairly well mapped; but as a matter of fact our knowledge of its mountain ranges and of its great river courses is to a large extent extremely vague. All this awaits careful survey. In northeastern Manchuria and in many parts of Mongolia there are still blanks to be filled up and mountain and river systems to be surveyed. In the Malay peninsula and in the great array of islands in the east and southeast of Asia—Sumatra, Borneo, the Philippines—much work still remains to be done. Thus for the coming century there will be abundance of work for explorers in Asia and plenty of material to occupy the attention of our geographical societies.

DARKEST AFRICA

Coming to the map of Africa, we find the most marvelous transformation during the last sixty years, and mainly during the last forty years, dating from Livingstone's memorable journey across the continent. Though the north of Africa was the home of one of the oldest civilizations, and though on the shores of the Mediterranean Phœnicians, Carthaginians, Greeks, and Romans were at work for centuries, it has only been within the memory of many of us that the center of the continent, from the Sahara to the confines of Cape Colony, has ceased to be an unexplored blank. This blank has been filled up with bewildering rapidity. Great rivers and lakes and mountains have been laid down in their main features, and the whole continent, with a few unimportant exceptions, has been parceled out among the powers of Europe; but much still remains to be done ere we can form an adequate conception of what is in some respects the most interesting and the most intractable of the continents. Many curious problems still remain to be solved. The pioneer work of exploration has to a large extent been accomplished; lines have been run in all directions; the main features have been blocked out; but between these lines the broad meshes remain to be filled in, and to do this will require many years of careful exploration. However, there still remain one or two regions that afford scope for the adventurous pioneer.

To the south of Abyssinia and to the west and northwest of Lake Rudolf, on to the Upper Nile, is a region of considerable extent, which is still practically unknown. Again, in the western Sahara there is an extensive area, inhabited mainly by the intractable Tuaregs, into which no one has been able to penetrate, and of which our knowledge is extremely scanty. Even in the central Sahara there are great areas which have not been traversed, while in the Libyan desert much remains to be done. These regions are of interest almost solely from the geographical and geological standpoints; but they deserve careful investigation, not only that we may ascertain their actual present condition, but in order, also, that we may try to discover some clues to the past history of this interesting continent. Still, it must be said that the great features of the continent have been so fully mapped during the last half century that what is required now is mainly the filling-in of the details. This is a process that requires many hands and special qualifications. All over the continent there are regions which will repay special investigation. Quite recently an English traveler, Mr Cowper, found not far from the Tripoli coast miles of magnificent ruins and much to correct on our maps. If only the obstructiveness of the Turkish officials could be overcome, there is a rich harvest for any one who will go to work with patience and intelligence. Even the interior of Morocco, and especially the Atlas mountains, are but little known. The French, in both Tunis and Algeria, are extending our knowledge southward.

EFFORTS OF THE POWERS

All the powers who have taken part in the scramble for Africa are doing much to acquire a knowledge of their territories. Germany especially deserves praise for the persistent zeal with which she has carried out the exploration of her immense territories in East and West Africa. The men she sends out are unusually well qualified for the work, capable not simply of making a running survey as they proceed and taking notes on country and people, but of rendering a substantial account of the geology, the fauna, the flora, and the economic conditions. Both in the French and the British spheres good work is also being done, and the map of Africa is being gradually filled up. But what we especially want now are men of the type of Dr J. W. Gregory, whose book on the Great Rift valley is one of the most valuable contributions to African geography ever made. If men of this stamp would settle down in regions like that of Mount Ruwenzori or Lake Rudolf or the region about lakes Bangweolo and Tanganyika, or in the Atlas or in many other regions that could be named, the gains to scientific geography, as well as to the economic interests of Africa, would be great. An example of work of this kind is seen in the discoveries made by a young biologist trained in geographical observation, Mr Moore, on Lake Tanganyika. There he found a fauna which seems to afford a key to the past history of the center of the continent, a fauna which, Mr Moore maintains, is essentially of a salt-water type. Mr Moore, I believe, is inclined to maintain that the ancient connection of this part of Africa with the ocean was not by the west, as Joseph Thomson surmised, but by the north, through the Great Rift valley of Dr Gregory, and he strongly advocates the careful examination of Lake Rudolf as the crucial test of his theory. It is to be hoped that he or some one equally competent will have an opportunity of carrying out an investigation likely to provide results of the highest importance.

CLIMATE OF THE COUNTRY

But there are other special problems connected with this, the most backward and the most repellent of continents, which demand serious investigation—problems essentially geographical. One of the most important of these, from the point of view of the development of Africa, is the problem of acclimatization. The matter is of such prime importance that a committee of the Association has been at work for some years collecting data as to the climate of tropical Africa. In a general way we know that that climate is hot and the rainfall scanty; indeed, even the geographers of the ancient world believed that Central Africa was uninhabitable on account of its heat; but science requires more than generalities, and therefore we look forward to the exact results which are being collected by the committee referred to with much hope. We can only go to work experimentally until we know precisely what we have to deal with. It will help us greatly to solve the problem of acclimatization when we have the exact factors that go to constitute the climate of tropical Africa. At present there is no doubt that the weight of competent opinion—that is, opinion of those who have had actual experience of African climate and of those who have made a special study of the effects of that climate on the human constitution—is that, though white men, if they take due precautions, may live and do certain kinds of work in tropical Africa, it will never be possible to colonize that part of the world with people from the temperate zone. This is the lesson taught by generations of experience of Europeans in India.

So far, also, sad experience has shown that white people cannot hope to settle in Central Africa as they have settled in Canada and the United States and in Australia, and make it a nursery and a home for new generations. Even in such favorable situations as Blantyre, a lofty region on the south of Lake Nyasa, children cannot be reared beyond a certain age; they must be sent home to England, otherwise they will degenerate physically and morally. No country can ever become the true home of a people if the children have to be sent away to be reared. Still, it is true our experience in Africa is limited. It has been maintained that it might be possible to adapt Europeans to tropical

Africa by a gradual process of migration: Transplant southern Europeans to north Africa; after a generation or two remove their progeny further south, and so on, edging the succeeding generation further and further into the heart of the continent. The experiment—a long one it would be—might be tried; but it is to be feared that the ultimate result would be a race deprived of all those characteristics which have made Europe what it is.

HIDDEN ENEMIES

An able young Italian physician, Dr Sambon, has recently faced this important problem, and has not hesitated to come to conclusions quite opposed to those generally accepted. His position is that it has taken us centuries in Europe to discover our hidden enemies, the microbes of the various diseases to which northern humanity is a prey, and to meet them and conquer them. In Africa we have a totally different set of enemies to meet, from lions and snakes down to the invisible organisms that produce those forms of malaria, anæmia, and other diseases characteristic of tropical countries. He admits that these are more or less due to heat, to the nature of the soil, and other tropical conditions, but that if once we knew their precise nature and modes of working we should be in a position to meet them and conquer them. It may be so, but this is a result that could only be reached after generations of experience and investigation, and even Dr Sambon admits that the ultimate product of European acclimatization in Africa would be something quite different from the European progenitors. What is wanted is a series of carefully conducted experiments.

I have referred to the Blantyre highlands. In British East Africa there are plateaus of much greater altitude, and in other parts of Central Africa there are large areas of 4,000 feet and over above sea level. The world may become so full that we may be forced to try to utilize these lofty tropical regions as homes for white people when Canada and Australia and the United States become over populated. As one of my predecessors in this chair (Mr Ravenstein) tried to show at the Leeds meeting some years ago, the population of the world will have more than doubled in a century, and about 180 years hence will have quadrupled. At any rate, here is a problem of prime importance for the geographer of the coming century to attack. With so many energetic and intelligent white men all over Africa, it should not be difficult to obtain the data which might help toward its solution.

NORTH AMERICA

I have dwelt thus long on Africa, because it will really be one of the great geographical problems of the coming century. Had it been as suitable as America or Australia, we may be sure it would not have remained so long neglected and despised by the European peoples as it has done. Unfortunately for Africa, just as it had been circumnavigated, and just as Europeans were beginning to settle upon its central portion and trying to make their way into the interior, Columbus and Cabot discovered a new world—a world as well adapted as Europe for the energies of the white races. That discovery postponed the legitimate development of Africa for four centuries. Nothing could be more marked than the progress which America has made since its rediscovery 400 years ago, and the stagnation of Africa, which has been known to Europe since long before the beginning of history. During these 400 years North America at least has been very thoroughly explored. The two great nations which divide North America between them have their Government surveys, which are rapidly mapping the whole continent and investigating its geology, physical geography, and natural resources.

I need hardly tell an audience like this of the admirable work done by the survey of Canada under Sir William Logan, Dr Selwyn, and his successor, Dr George Dawson; nor should it be forgotten that under the lands department much excellent topographical work has been carried out by Captain Deville and his predecessors. Still, though much has been done, much remains to be done. There are large areas which have not as yet been roughly mapped. Within quite recent years we have had new regions opened up to us by the work of Dawson and Ogilvie on the Yukon, Dr Bell in the region to the south of Hudson bay, by the brothers Tyrrell in the barren lands on the west of the same bay, by O'Sullivan beyond the sources of the Ottawa, and by Low in Labrador.

But it is not so long since that Dr Dawson, in reviewing what remains to be done in the Dominion in the way of even pioneer exploration, pointed out that something like a million square miles still remained to be mapped. Apart from the uninhabitable regions in the north, there are, as Dr Dawson pointed out, considerable areas which might be turned to profitable agricultural and mining account of which we know little, such areas as these which have been recently mapped out on the south of Hudson bay by Dr Bell and beyond the Ottawa by Mr O'Sullivan. Although the eastern and western provinces have been very fully surveyed, there is a considerable area between the two lying between Lake Superior and Hudson bay which seems to have been so far almost untouched. A very great deal has been done for the survey of the rivers and lakes of Canada. I need hardly say that in Canada, as elsewhere in America, there is ample scope for the study of many problems in physical geography—past and present glaciation and the work of glaciers, the origin and régime of lake basins, the erosion of river beds, the oscillation of coast lines. Happily, both in Canada and the United States there are many men competent and eager to work out problems of this class, and in the reports of the various surveys, in the transactions of American learned societies, in scientific periodicals, and in separate publications, a wealth of data has already been accumulated of immense value to the geographer.

UNITED STATES

Every geologist and geographer knows the important work which has been accomplished by the various surveys of the United States, as well as by the various State surveys. The United States Coast Survey has been at work for more than half a century, mapping not only the coast but all the navigable rivers. The Lake Survey has been doing a similar service for the shores of the Great Lakes of North America. But it is the work of the Geological Survey which is best known to geographers—a survey which is really topographical as well as geological, and which, under such men as Hayden, King, and Powell, has produced a series of magnificent maps, diagrams, and memoirs of the highest scientific value and interest. Recently this survey has been placed on a more systematic basis, so that now a scheme for the topographical survey of the whole of the territory of the United States is being carried out. Extensive areas in various parts of the States have been already surveyed on different scales. It is to be hoped that in the future, as in the past, the able men who are employed on this survey work will have opportunities of working out the physiography of particular districts, the past and present geography of which is of advancing scientific interest. Of the complete exploration and mapping of the North American continent we need have no apprehension; it is only a question of time, and it is to be hoped that neither of the governments responsible will allow political exigencies to interfere with what is really a work of national importance.

CENTRAL AND SOUTH AMERICA

It is when we come to Central and South America that we find ample room for the unofficial explorer. In Mexico and the Central American States there are considerable areas of which we have little or only the vaguest knowledge. In South America there is really more room now for the pioneer explorer than there is in Central Africa. In recent years the Argentine Republic has shown laudable zeal in exploring and mapping its immense territories, while a certain amount of good work has also been done by Brazil and Chile. Most of our knowledge of South America is due to the enterprise of Europeans and of North American explorers. Along the great river courses our knowledge is fairly satisfactory, but the immense areas, often densely clad with forests, lying between the rivers are almost unknown. In Patagonia, though a good deal has recently been done by the Argentine government, still in the country between Punta Arenas and the Rio Negro we have much to learn, while on the West Coast range, with its innumerable fjord-like inlets, its islands and peninsulas, there is a fine field for the geologist and physical geographer. Indeed, throughout the whole range of the Andes systematic exploration is wanted, exploration of the character of the excellent work accomplished by Whymper in the region around Chimborazo.

There is an enormous area lying to the east of the northern Andes and including their eastern slopes, embracing the eastern half of Ecuador and Colombia, southern Venezuela, and much of the country lying between that and northern Bolivia, including many of the upper tributaries of the Amazon and Orinoco, of which our knowledge is of the scantiest. Even the country lying between the Rio Negro and the Atlantic is but little known. There are other great areas in Brazil and in the northern Chaco which have only been partially described, such as the region whence the streams forming the Tapajos and the Paraguay take their rise, in Mato Grosso. A survey and detailed geographical and topographical description of the whole basin of Lake Titicaca is a desideratum.

In short, in South America there is a wider and richer field for exploration than in any other continent. But no mere rush through these little-known regions will suffice. The explorer must be able not only to use his sextant and his theodolite, his compass, and his chronometer. Any expeditions entering these regions ought to be able to bring back satisfactory information on the geology of the country traversed, and of its fauna and flora, past and present. Already the revelations which have been made of the past geography of South America and of the life that flourished there in former epochs are of the highest interest. Moreover, we have here the remains of extinct civilizations to deal with, and although much has been done in this direction, much remains to be done, and in the extensive region already referred to the physique, the traditions, and the customs of the natives will repay careful investigation.

AUSTRALIA

The southern continent of Australia is in the hands of men of the same origin as those who have developed to such a wonderful extent the resources of Canada and the United States, and therefore we look for equally satisfactory results so far as the characteristics of that continent permit. The five colonies which divide among them the three million square miles of the continent have each of them efficient government surveys, which are rapidly mapping their features and investigating their geology; but Australia has a trying economic problem to solve. In none of the colonies is the water supply quite adequate; in all are stretches of desert country of greater or less extent. The center and western half of the continent are covered by a desert more waterless and more repellent than even the Sahara; so far as our present knowledge goes, one-third of the continent is uninhabitable. This desert area has been crossed by explorers, at the expense of great sufferings, in various directions, each with the same dreary tale of almost featureless sandy desert, covered here and there with spinifex and scrub, worse than useless. There are hundreds of thousands of square miles still unknown, but there is no reason to believe that these areas possess any features that differ essentially from those which have been found along the routes that have been explored.

There have been one or two well-equipped scientific expeditions in recent years that have collected valuable data with regard to the physical characteristics, the geology and biology of the continent; and it is in this direction that geography should look for the richest results in the future. There remains much to be done before we can arrive at satisfactory conclusions as to the physical history of what is in some respects the most remarkable land area on the globe. Though the surface water supply is so scanty, there is reason to believe that underneath the surface there is an immense store of water. In one or two places in Australia, especially in western Queensland and in New South Wales, this supply has been tapped with satisfactory results; millions of gallons a day have been obtained by sinking wells. Whether irrigation can ever be introduced on an extensive scale into Australia depends upon the extent and accessibility of the underground water supply, and that is one of the geographical problems of the future in Australia. New Zealand has been fairly well surveyed, though a good deal remains to be done before its magnificent mountain and glacier system is completely known. In the great island of New Guinea both the British and the Germans are opening up the interiors of their territories to our knowledge, but the western and much larger portion of the island presents a large field for any explorer who cares to venture into its interior.

POLAR EXPLORATION

The marvelous success which has attended Dr Nansen's daring adventure into the Arctic seas has revived a widespread interest in polar exploration. Nansen may be said to have almost solved the North Pole problem—so far, at least, as the Old World side of the Pole is concerned. That some one will reach the Pole at no distant date is certain; Nansen has shown the way, and the legitimate curiosity of humanity will not rest satisfied till the goal be reached. But Arctic exploration does not end with the attainment of the Pole. Europe has done her share on her own side of the Pole; what about the side which forms the hinterland of North America, and especially of Canada? To the north of Europe and Asia we have the scattered groups of islands, Spitsbergen, Franz Josef Land, Nova Zembla, and the New Siberian islands. To the north of America we have an immense archipelago, the actual extent of which is unknown. Nansen and other Arctic authorities maintain that the next thing to be done is to complete exploration on the American side—to attempt to do for that half of the North Polar region what Nansen has done for the other half. It may be that the islands which fringe the northern shores of the new world are continued far to the north; if so, they would form convenient stages for the work of a well-equipped expedition. It may be that they do not go much farther than we find them on our maps. Whatever be the case, it is important, in the interests of science, that this section of the polar area be examined; that as high a latitude as possible be attained; that soundings be made to discover whether the deep ocean extends all round the Pole.

It is stated that the gallant Lieutenant Peary has organized a scheme of exploring this area which would take several years to accomplish. Let us hope that he will be able to carry out his scheme. Meantime, should Canada look on with indifference? She has attained the standing of a great and prosperous nation. She has shown the most commendable zeal in the exploration of her own immense territory. She has her educational, scientific, and literary institutions which will compare favorably with those of other countries; her press is of a high order, and she has made the beginnings of a literature and an art of her own. In these respects she is walking in the steps of the mother country. But has Canada not reached a stage when she is in a position to follow the maternal example still further? What has more contributed to render the name of Great Britain illustrious than those enterprises which for centuries she has sent out from her own shores, not a few of them solely in the interests of science? Such enterprises elevate a nation and form its glory and its pride. Surely Canada has ambitions beyond mere material prosperity; and what better beginning could be made than the equipment of an expedition for the exploration of the seas that lie between her and the Pole? I venture to throw out these suggestions for the consideration of those who have at heart the honor and glory of the great Canadian Dominion.

THE ANTARCTIC REGIONS

Not only has an interest in Arctic exploration been revived, but in Europe at least an even greater interest has grown up in the exploration of the region around the opposite Pole of the earth of which our knowledge is so scanty. Since Sir James C. Ross' expedition, which was sent out in the year 1839, almost nothing has been done for Antarctic research. We have here to deal with conditions different from those which surround the North Pole. Instead of an almost landless ocean, it is believed by those who have given special attention to the subject that a continent about the size of Australia covers the South Polar region. But we do not know for certain, and surely, in the interests of our science, it is time we had a fairly adequate idea of what are the real conditions. We want to know what is the extent of that land, what are its glacial conditions, what is the character of its geology, what evidence exists as to its physical and biological conditions in past ages? We know there is one lofty, active volcano. Are there any others? Moreover, the science of terrestrial magnetism is seriously impeded in its progress because the data in this department from the Antarctic are so scanty. The seas around this continent require to be investigated both as to their depth, their temperature, and their life. We have here, in short, the most extensive unexplored area on the surface of the globe.

For the last three or four years the Royal Geographical Society, backed by other British societies, has been attempting to move the home government to equip an adequate expedition to complete the work begun by Ross sixty years ago, and to supplement the great work of the *Challenger;* but though sympathy has been expressed for Antarctic exploration, and though vague promises have been given of support, the government is afraid to enter upon an enterprise which might involve the services of a few naval officers and men. We need not criticise this attitude; but the Royal Geographical Society has determined not to let the matter rest here. It is now seeking to obtain the support of public-spirited men for an Antarctic expedition under its own auspices. It is felt that Antarctic exploration is peculiarly the work of England, and that if an expedition is undertaken it will receive substantial support from the great Australasian colonies, which have so much to gain from a knowledge of the physical condition of a region lying at their own doors and probably having a serious influence on their climatological conditions. Here, then, is one of the greatest geographical problems of the future, the solution of which should be entered upon without further delay. It may be mentioned that a small and well-equipped Belgian expedition has already started, mainly to carry out deep-sea search around the South Pole area, and that strenuous efforts are being made in Germany to obtain the funds for an expedition on a much larger scale.

OCEANOGRAPHY

But our science has to deal not only with the lands of the globe; its sphere is the whole of the surface of the earth and all that is thereon, so far at least as distribution is concerned. The department of oceanography is a comparatively new creation; indeed, it may be said to have come definitely into being with the famous voyage of the *Challenger*. There had been expeditions for ocean investigation before that, but on a very limited scale. It has only been through the results obtained by the *Challenger*, supplemented by those of expeditions that have examined more limited areas, that we have been able to obtain an approximate conception of the conditions which prevail throughout the various ocean depths—conditions of movement, of temperature, of salinity, of life. We have only a general idea of the contours of the ocean bed, and of the composition of the sediment which covers that bed. The extent of the knowledge thus acquired may be gauged from the fact that it occupies a considerable space in the fifty quarto volumes—the *Challenger* publications—which it took Dr John Murray twenty years to bring out.

What islands are to the ocean, lakes are to the land. It is only recently that these interesting geographical features have received the attention they deserve.

Rivers are of not less geographical interest than lakes, and these have also recently been the subject of special investigation by physical geographers. I have already referred to Professor Davis' study of a special English river system. The work in the English lake district by Mr Marr, spoken of in connection with Dr Mill's investigations, was mainly on the hydrology of the region. Both in Germany and in Russia special attention is being given to this subject, while in America there is an enormous literature on the Mississippi alone, mainly, no doubt, from the practical standpoint, while the result of much valuable work on the St Lawrence is buried in Canadian official publications.

THE COMPASS IN MODERN NAVIGATION

By G. W. Littlehales,

U. S. Hydrographic Office

Transoceanic navigation, with all that it has been to the commerce of the world and the development of the civilization of the nineteenth century, rests upon the magnetic needle of the mariner's compass. None but those who may estimate the effect of the sudden loss of the earth's magnetism will ever fully know the extent of the influence of the compass in human affairs.

Throughout the history of ocean navigation it has remained pre-eminent among nautical instruments; and today, by the side of the chronometer and sextant, it is scarcely less important than it was when it constituted the navigator's sole equipment. The later instruments have contributed to precision in the use of the compass and to precise navigation in general, but they have in no sense supplanted it or greatly affected the degree of its fundamental importance.

Up to the era of iron ships the management of the mariner's compass was as simple as the surveyor's, being influenced by the earth's magnetism alone; but with the growth of the application of steam propulsion to modern ships and the employment of iron and steel in their construction it was found that every ship herself becomes a great magnet like the earth is, although of lesser intensity.

It has long been known that the earth acts upon the magnetic needle somewhat as a bar magnet does, and that it has definite poles of magnetic strength and a magnetic field surrounding it which may be represented in general by lines of magnetic intensity issuing from one pole and proceeding to the other by curved paths to which a freely suspended magnetic needle will everywhere set itself tangent. For more than a century it has been customary among geomagneticians to represent the elements of the direction and intensity of the earth's magnetism as manifested at its surface by lines conceived to be drawn upon the surface of the globe. The lines passing through all places where the angle between the plane of the astronomical meridian and the vertical plane passing through a freely suspended magnetic needle is the same are called lines of equal magnetic declination or, among mariners and surveyors, lines of equal variation of the compass. These lines issue from one magnetic pole and pass by curved paths to the other and through the geographical poles of the earth. The lines which are conceived to be drawn through all places where the angle between the direction of a freely suspended needle and the plane of the horizon is the same are called lines of equal magnetic inclination or dip. They gird the earth in circumferences parallel to the magnetic equator, somewhat the same as the parallels of latitude with reference to the geographical equator. The magnetic equator is the line passing through every point at which the freely suspended needle lies in a horizontal plane. As we travel from the magnetic equator toward the northern magnetic pole the needle inclines more and more, the north end tending downwards until the pole is reached, when the needle assumes a vertical direction. As we travel toward the southern magnetic pole the same takes place with the south end of the needle.

Similar results may be obtained by carrying a small needle through the magnetic field of a bar-magnet. At the neutral band it will be parallel to the bar, while, as either end is approached, the dip toward the Pole becomes more and more; and as with the bar-magnet, which has a magnetic field that varies in intensity from point to point, so with the earth, whose magnetic field is powerful near the Poles and steadily moderates in strength as the magnetic equator is approached. There is thus a third set of lines passing through all points where the magnetic intensity is the same. These are known as isodynamic lines or lines of equal magnetic intensity. In general contour they follow the lines of equal inclination or dip.

These different systems of lines representing the magnetic elements have not on the earth that symmetry and regularity which they would present around a steel bar; but, on the contrary, they often pursue serpentine courses with many a bend and loop; and since the values of the magnetic elements are not fixed either as to time or locality, they shift their positions hourly, daily, monthly, yearly, and through centuries. These changes are all believed to be periodic and, with the exception of the secular change, are of such small amplitude that they do not affect the use of the compass on the seas where commerce is carried on. So that for purposes of navigation, the terrestrial magnetic lines may be drawn so as to hold good for several years from a given epoch.

A freely suspended magnetic needle dipping, as it does, everywhere except on the magnetic equator, is of no value to guide a ship. The compass needle must be horizontal. This condition is attained in practice by putting a small sliding counterpoise on the needle to overcome the downward pull of the earth's magnetism, or by floating the compass-card in a mixture of water and alcohol. It is, therefore, only the horizontal component of the earth's magnetism that gives steadiness to the needle of the compass and influences its direction.

If a wooden ship, with no metal other than the copper in her frame, were to sail around the world, her compass would experience only those magnetic phases that result from the influence of the earth's magnetism—more or less steadiness, according to the varying amount of the horizontal component of the intensity of the terrestrial magnetic field, and a variation of the compass of larger or smaller amount according to geographical position — the ship herself would exert no influence whatever. But, in modern navigation, instead of guiding a vessel having no magnetic influence whatever over the globe—a great magnet whose magnetic elements are known—the mariner's compass is employed in guiding a steel vessel, which is a great magnet, whose magnetic elements are ever varying and capricious, over the globe, a greater magnet.

If a bar-magnet be brought into a horizontal position under a compass-needle that has assumed a steady position under the influence of the earth's magnetism, the compass-needle will immediately move and assume a position which is the resultant of the joint action of the earth and the bar-magnet; and with every change in the azimuth or inclination of the bar-magnet the compass-needle will assume a new resultant position. This is analogous to the joint action of the magnetism of the earth and the iron ship on the mariner's compass, only the influence of the ship is vastly complicated by the existence, along with her permanent magnetic elements, of the ever-varying magnetic effects resulting from the inductive action upon the "soft" iron of the ship, of the fields of the earth's magnetism, and the ship's permanent magnetism.

If a cylinder of pure wrought iron that has not been hammered and is entirely free from magnetism be held vertically in our latitude the upper end instantly becomes a south and the lower a north pole. If it be reversed, the magnetism also reverses, so that the upper and lower ends are still as they were before—a south and a north pole, respectively. When it is held horizontally in the meridian the end toward the north becomes a north pole, while that toward the south becomes a south pole; and when it is revolved slowly or rapidly in azimuth, the foci of magnetic polarity move with the fidelity of a shadow, until when the cylinder points east and west, all the side facing the north is pervaded by north magnetism, and all facing the south by south magnetism. Again, let us conceive the hull of a ship to be like the cylinder of pure wrought-iron and as susceptible of magnetic induction in being steered over its ever-changing courses as the cylinder is when turned into different positions. Then, as the ship steers north, in the northern magnetic hemisphere, the bow will become the center of north polarity and the stern that of south polarity. As she gradually changes course to the eastward, so will the north focus shift to the port bow, the south focus to the starboard quarter, and the neutral line dividing them, which while the ship headed north was athwartship, will now become a diagonal from starboard bow to port quarter. When the ship heads east all the starboard side is pervaded with south polarity, the port with north, and the neutral line takes a general fore-and-aft direction. Continuing to change course to the southward, the poles and neutral line continue their motion in the opposite direction, until at the south the conditions at north are repeated, but this time it is the stern that is a north pole, while the bow is a south pole. At west the conditions at east prevail, only that it is now the starboard side that has north polarity and the port side south polarity. And this transient induction in both the cylinder and the ideal ship is solely due to the effect of the earth's magnetic field in which they move.

Leaving now the *ideal* or "soft" iron ship and passing to the consideration of the *actual* ship, which is built of many beams and frames that have been bent, hammered, and twisted in fashioning them for the construction, we find that the structure, although still containing many "soft" iron pieces that become magnets when lying in the magnetic meridian and lose their magnetic qualities when turned at right angles to that plane, has acquired characteristics that make it as permanent and well defined a magnet as the steel bar, with poles and neutral line as in the bar, but located according to the direction, with reference to the magnetic meridian, in which the ship's keel lay during the course of her construction.

An iron ship, with her frames, plating, decks, beams, stanchions, shafts, engines, smoke-pipes, yards, and masts, is not a simple magnet like a steel bar, but a network of magnets having the characteristics of a simple magnet growing out of many and diverse and reactionary influences within the hull. However complex the network of magnets may be, yet, for purposes of analytical investigation to reach results to enable the mariner to allow for the influence of the ship's magnetism upon the compass, its effect may be considered as taking place in three cöordinate axes, namely, fore-and-aft, athwartship, and vertically downward, with the pivot of the compass needle as the origin.

Almost all the structural iron of a ship is symmetrically arranged with reference to the vertical plane through the keel, so that for any piece on the starboard side another is generally found similarly disposed on the port side; and the problem is simplified to pairs of parallel forces, each pair having its resultant parallel to one of the cöordinate axes. The effect of every magnetic particle, whether of permanent or induced magnetism, may be reduced to this condition. If the sum total of all the magnetic forces parallel to each cöordinate axis be transferred to it, and the whole be conceived to be concentrated upon the north point of the compass-needle, the entire magnetic power of the ship may be compared to that of three imaginary compound-magnets—one laid horizontally in the axis of X; the second, also horizontally, in the axis of Y, and the third, vertically, in the axis of Z. By steaming around a circle in the open sea and observing the compass bearing of the sun with the ship's head on equidistant compass courses, and also, at the same times, the astronomical bearings of the sun, the magnetic effect of the ship—that is, of the three imaginary compound-magnets in the axes of X, Y, and Z—which causes the needle to deflect from the magnetic meridian by different angles at the different headings, can be immediately found, if the variation of the compass due to the geographical locality is known. As the ship makes a complete circle in azimuth, the north end of the needle is drawn sometimes to the right hand of the magnetic meridian and sometimes to the left hand; in the former case the deflection is called east deviation and in the latter west deviation. A table of these deflections, serially arranged, is called a table of deviations of the compass. The harmonic analysis of such a table of deviations consists in representing each of the elementary magnets, whose effects contribute to make up the imaginary compound-magnets, as a separate disturbing cause whose effect upon the compass needle may be represented by a constant multiplied by a simple harmonic function of the compass-azimuth of the ship's head. Adding together the effects of the different disturbing causes, thus represented, and placing them equal to the deviation observed on a certain heading of the ship, a conditional equation may be formed for each of the headings upon which the deviation was observed.

From such a series of conditional equations normal equations may be found by the method of least squares, and from them the harmonic constants which represent the elementary disturbing magnets. Thus it is that from the effect an intelligent comprehension of the cause may be gained.

With these coefficients a navigator may compute beforehand the value of the deviation to which his compass will be subject on any heading of the ship; but in making long cruises and passing into different magnetic latitudes they require unceasing attention, because some of them represent the effects of the induction of the earth's magnetic field upon the "soft" iron of the ship, and as the ship sails the ocean she passes through ever-varying fields of terrestrial magnetism. Her own magnetism is also undergoing continual, though small, changes due to the wrenching and straining of the ship by the action of the sea. Yet, by examining thoroughly into the harmonic coefficients and by considering the known values of the elements of the earth's magnetism, a careful navigator may predict a table of deviations for his ship and compass in any part of the world.

He will then understand and be prepared for such changes in the ship's magnetism as arise from the heeling of the ship, from change in geographical position, and from alteration in the course after the ship has remained for a long time on one heading, and he may navigate his vessel with the confidence and security that he would have in a wooden ship, for he can at any time correct the course steered by the compass so that the magnetic course actually made good may be laid down upon the chart or used in the calculation of the ship's reckoning, he can correct bearings of the land by the amount of deviation due to the direction of the ship's head at the time they were taken, and if he wishes to shape a course for a port, having found by calculation or from the chart the correct magnetic course to be made good, he can so apply the deviation as to obtain the compass course to be steered.

In many modern ships the deviations are largely reduced by introducing magnets into positions near the compass to compensate for the effects of the ship's magnetism. The analysis of the table of deviations shows that the polar forces acting in the ship may be represented by imaginary magnets, and it is, therefore, certain from well known laws of magnetic action that the effects of these disturbing forces may be neutralized by introducing real magnets whose forces have the same magnitudes but act in the opposite directions.

The proceedings of the British Association at Toronto were admirably reported by the local press, the daily reports of the *Globe*, together with a finely illustrated supplement, aggregating nearly 150 columns, or the equivalent of an octavo volume of 550 pages of long primer.

SEPTEMBER

SEPTEMBER

IS

A GOOD MONTH

—AND THE LAST ONE THIS YEAR—

IN WHICH

TO VISIT

YELLOWSTONE

PARK.

A Mighty Throng has been there—swell the number.

Send to the undersigned for the

NORTHERN PACIFIC'S

WONDERLAND '97.

Send SIX CENTS.

CHAS. S. FEE, General Passenger Agent, St. Paul, Minn.

Among the Contents of Forthcoming Numbers of

THE NATIONAL GEOGRAPHIC MAGAZINE

WILL BE THE FOLLOWING:

THE ENCHANTED MESA,

By F. W. HODGE,

Bureau of American Ethnology;

Down the Volga, from Nijni Novgorod to Kazan,

By PROF. FREDERIC W. TAYLOR,

—— AND ——

Abridgments of the principal geographical papers presented at the Toronto Meeting of the British Association for the Advancement of Science.

JUDD & DETWEILER, PRINTERS, WASHINGTON, D. C.

[illegible] VIII [illegible]

The National Geographic Magazine

AN ILLUSTRATED MONTHLY

Editor: JOHN HYDE

Associate Editors

A. W. GREELY W J McGEE HENRY GANNETT
C. HART MERRIAM ELIZA RUHAMAH SCIDMORE

CONTENTS

WASHINGTON
PUBLISHED BY THE NATIONAL GEOGRAPHIC SOCIETY

AGENTS IN THE [illegible]
THE AMERICAN NEWS COMPANY, [illegible]
PARIS: BRENTANO'S, [illegible]

Price 25 Cents $2.50 a Year

Entered at the [illegible]

THE

National Geographic Society

ORGANIZED, JANUARY, 1888

PRESIDENT

GARDINER G. HUBBARD

VICE-PRESIDENTS

MARCUS BAKER
WILLIAM H. DALL
G. K. GILBERT
A. W. GREELY
C. HART MERRIAM
HERBERT G. OGDEN

TREASURER

CHARLES J. BELL

RECORDING SECRETARY

EVERETT HAYDEN

CORRESPONDING SECRETARY

HENRY GANNETT

MANAGERS

H. F. BLOUNT
F. V. COVILLE
C. W. DABNEY, JR.
DAVID T. DAY
JOHN HYDE
W J McGEE
F. H. NEWELL
W. B. POWELL

SECRETARY'S OFFICE, 1517 H STREET N. W., WASHINGTON

The National Geographic Society, the object of which is the increase and diffusion of geographic knowledge, has a paying membership of 1,400. Its membership is not restricted to practical geographers, but is open to any person in good standing who may be sufficiently interested in its work to seek admission. The annual subscription is: for active members, $5.00 per annum; for corresponding members, $2.00 per annum. Active members pay also an entrance fee of $2.00 on election. THE NATIONAL GEOGRAPHIC MAGAZINE is sent regularly to all members, both active and corresponding.

Donations for the founding of Prize Medals and Scholarships are respectfully solicited.

THE ENCHANTED MESA — THE GREAT SOUTHWESTERN CLEFT AND TALUS HEAP

THE

National Geographic Magazine

Vol. VIII — OCTOBER, 1897 — No. 10

THE ENCHANTED MESA

By F. W. Hodge,

Bureau of American Ethnology

The pueblo of Acoma, in western central New Mexico, is the oldest settlement within the limits of our domain. Many of the walls that still stand on that beetling peñol were seen by Coronado during his marvelous journey in 1540, and even then they were centuries old.

The valley of Acoma has been described as "the Garden of the Gods multiplied by ten, and with ten equal but other wonders thrown in; plus a human interest, an archeological value, an atmosphere of romance and mystery;" and the comparison has not been overdrawn. Stretching away for miles lies a beautiful level plain clothed in grama and bound on every side by mesas of variegated sandstone rising precipitously from 300 to 400 feet, and relieved by minarets and pinnacles and domes and many other features of nature's architecture. About their bases miniature forests of piñon and cedar are found, pruned of their dead limbs by native wood-gatherers. Northwestward, Mount Taylor, the loftiest peak in New Mexico, rears its verdant head, and 20 miles away to the westward the great frowning pine-fringed Mesa Prieta, with the beautiful vale of Cebollita at its feet, forms a fitting foreground to every dying sun.

But none of these great rock-tables is so precipitous, so awe-inspiring, and seemingly so out of place as the majestic isolated Katzímo or Enchanted Mesa, which rises 430 feet from the middle of the plain as if too proud to keep company with its fellows; and this was one of the many wonderful homesites of the

Acomas during their wanderings from the mystic Shípäpu in the far north to their present lofty dwelling place.

Native tradition, as distinguished from myth, when uninfluenced by Caucasian contact, may usually be relied on even to the extent of disproving or verifying that which purports to be historical testimony. The Acoma Indians have handed down from shaman to novitiate, from father to son, in true prescriptorial fashion for many generations, the story that Katzímo was once the home of their ancestors, but during a great convulsion of nature, at a time when most of the inhabitants were at work in their fields below, an immense rocky mass became freed from the friable wall of the cliff, destroying the only trail to the summit and leaving a few old women to perish on the inaccessible height. What more, then, could be necessary to enwrap the place forever after in the mystery of enchantment?

This tradition was recorded in its native purity some twelve years ago by Mr Charles F. Lummis, who has done so much to stimulate popular interest in this most interesting corner of our country, and the same story was repeated by Acoma lips to the present writer while conducting a reconnaissance of the pueblos in the autumn of 1895. During this visit, desiring to test the verity of the tradition, a trip was made to the base of Katzímo, where a careful examination of the talus (especially where it is piled high about the foot of the great southwestern cleft (Pl. 32, 33) up which the ancient pathway was reputed to have wound its course) was rewarded by the finding of numerous fragments of pottery of very ancient type, some of which were decorated in a vitreous glaze, an art now lost to Pueblo potters. The talus at this point rises to a height of 224 feet above the plain, and therefore slightly more than half-way up the mesa side. It is composed largely of earth, which could have been deposited there in no other way whatsoever than by washing from the summit during periods of storm through many centuries. An examination of the trail to a point within 60 feet of the top exhibited traces of what were evidently the hand and foot holes that had once aided in the ascent of the ancient trail, as at Acoma today. Even then the indications of the former occupancy of the Enchanted Mesa were regarded as sufficient and that another one of many native traditions had been verified by archeologic proof.

Enchanted Mesa has become celebrated during the last summer through the reports of the expedition of Prof. William Libbey, of Princeton, who, after several days of effort, succeeded in scal-

THE GREAT SANDSTONE CLEFT OF THE MESA

Through this cleft the traditional trail passed, and distinct traces of it are to be seen on each side of the vertical fissure to the right of the upper ladder

ing the height, in the latter part of July, by means of a life-saving equipment. It would seem that Professor Libbey neglected to search for relics in the talus, that he devoted no attention to the great southwestern cleft or cove up which the trail was reputed to have passed, and that after spending some three hours on the narrow southern extension of the mesa top, awaiting the arrival of a ladder from Acoma to conduct him across a fissure, he employed the remaining two hours in a reconnaissance of the wider and more interesting part of the height, finding nothing that would indicate even a former visit by human beings.*

While engaged in archeologic work in Arizona and later in Cebollita valley in western central New Mexico, some 20 miles westward from Acoma pueblo, I was directed to visit Katzímo once more in order to determine what additional data of an archeological nature might be gathered by an examination of the summit. The knowledge gained by the previous visit made it apparent that a light equipment only would be necessary to accomplish the task. Procuring an extension ladder, comprising six 6-foot sections, some 300 feet of half-inch rope, and a pole-pick, together with a number of bolts, drills, etc., which afterward were found to be needless, I proceeded to Laguna, the newest, yet the most rapidly decaying, of all the pueblos, on the Santa Fé Pacific railroad. Here I was fortunate in enlisting the services of Major George H. Pradt, who has served as a United States deputy surveyor in that section for nearly 30 years; Mr A. C. Vroman, of Pasadena, California, a few of whose excellent photographs are here reproduced, and Mr H. C. Hayt, of Chicago. Much of the success of the little expedition is due to the untiring aid of these gentlemen, and for many creature comforts I am indebted to the Messrs Marmon, whose beautiful little home at Laguna has delighted the heart of many a weary wayfarer in that sunny land.

Leaving the railroad September 1, we proceeded with two farm wagons, each drawn by a very small black mule and a large white horse, driven by two sturdy Laguna boys. The road trends westward for about seven miles, then turns southward through a rather wide valley scarred with arroyas and lined with

*Had the explorer crossed to the northern part of the mesa by means of a bench a few feet below the summit of the rocky southern tongue, it would not have been necessary for him to spend most of his time so fruitlessly in awaiting the arrival of means to cross the fissure. The ladder was found as Professor Libbey had left it, but was taken down by one of the Indians, who followed the bench mentioned, in order to secure the rope for his own use. The ladder is the short one shown in Pl. 33, the photograph having been made during the descent.

fantastically carved sandstone cliffs. The summit of Mesa Encantada is visible for several miles ere the vale of Acoma is reached, and as one enters the valley proper he cannot fail to appreciate the wisdom displayed by the natives in the selection of the beautiful, grassy, mesa-dotted plain that has been their home for so many generations.

The next day was spent in the village witnessing that curious anomaly of paganism intermixed with christianity, known as the Fiesta de San Estevan. On the morning of the 3d an early start was made for Mesa Encantada, which lies three miles northeastward from the pueblo, just within the eastern boundary of the Acoma grant, in latitude 34° 54′ N., longitude 107° 34′ W.

The remainder of the forenoon was employed in making camp in the little grove of cedars at the base of the cleft near the southwestern corner of the height, in unpacking apparatus, and in determining the altitude of the mesa above the western plain. The observations of Major Pradt show that the elevation of the foot of the great talus slope above the plain is at this point 33 feet, the apex of the talus 224 feet above the plain, and the top of the highest pinnacle on the summit of the mesa overlooking the cleft 431 feet* above the same datum. (Pl. 32.)

The start from camp was made at noon. The ascent of the talus, in which the potsherds had been observed in such considerable quantities two years previously, was made in a few minutes, the ladders, ropes, and photographic and surveying instruments being carried with some effort, since climbing, heavily laden, at an altitude of 6,000 feet, in a broiling sun, is no trifling labor; but the real work began when the beginning of the rocky slope of the cleft was reached. One member of the party, taking the lead, dragged the end of a rope to a convenient landing place, where a dwarf piñon finds sufficient nourishment from the storm-water and sand from above to eke out a precarious existence. Fastening the rope to the tree, the outfit was hauled up, and the other members of the party found a ready means of ascent. The next landing was several feet above, at the base of a rather steep pitch of about twelve feet. This wall, although somewhat difficult to scale, may be climbed with greater or less safety by the aid of several small holes in its face. These holes were doubtless made artificially, but as the narrow pathway at this point is now a drain-

*These elevations were determined trigonometrically by means of an engineers' transit, using a base-line of 660 feet measured opposite the cleft, the observations from the northern end of the line giving 430 feet and from the southern end 432 feet; mean, 431 feet.

age course during periods of storm, the soft sandstone has become so much eroded that they have apparently lost their former shape. The cliff at this point was readily surmounted with the aid of two sections of the ladder, a rope being carried over the slope above and secured to a large bowlder in the corner of a convenient terrace some 60 feet below the summit.

This was the point which I reached during the 1895 visit. At that time I spent several minutes on this ledge, making diligent

FIG. I—ENCHANTED MESA FROM THE SOUTH

search on the walls of the cove for evidences of pictographs, but finding none. This does not signify that none ever existed, for both here and elsewhere about the cliffs great blocks of stone have fallen away so recently that their edges have not yet had time to round by erosion, and the now exposed faces of their former abiding places on the cliff wall are yet unstained by weathering. (See Fig. 1.)

The bowlder previously alluded to rests in a corner of the terrace below a long crack that extends the entire height of the 30 feet of wall (Pl. 33), just as it had appeared to me before, and I well remember viewing the chasm while seated on it. I note these circumstances, since one of the first things that met my gaze on reaching this point during our late climb was a collection of four oak sticks, lying beside the bowlder, that I am sure were not there during my previous climb. They were about 2½ feet in length, an inch thick, and had been freshly pointed at each end with a sharp tool, evidently a hatchet. Their occurrence here suggested a careful investigation of the fissure above, which resulted in the finding of a regular series of pecked holes, apparently very ancient, for their edges had been so eroded that they are now visible only on close examination. So shallow, indeed, had the holes been worn that I at once saw that while the pointed sticks afforded an indication of the former use of the holes, it would have been impossible for the latter to have been employed as a means of scaling the wall in modern times. I therefore concluded that the sticks had recently been left there by one who desired to gain access to the summit, but had failed in the attempt. This conclusion was confirmed immediately afterward when I found, almost beneath the bowlder, a sherd of typical modern Acoma pottery and an unfeathered prayer-stick, and a few moments later Mr Hayt dug from the moist sand in the corner other fragments of the same vessel, evidently the remains of a sacrifice, which, had it been accessible, would doubtless have been deposited on the summit. It should here be said that the difference in ancient and modern Acoma ceramics is far greater than between modern Acoma and Zuñi ware, for example, and it requires no very intimate acquaintance to enable anybody to readily distinguish the one variety from the other in the latter types.

After making this interesting find we proceeded to fit together the entire ladder in order to scale the 30 feet of sheer wall now before us. Selecting the middle of the eastern face of the cove as the most convenient and least hazardous point of ascent, the ladder was adjusted and carefully raised, section by section, until it reached the lower part of the sloping terrace above. Two holes were then pecked in the soft sandstone floor to prevent the now almost vertical ladder from slipping forward down the chasm. Again a member of the party went forward, drawing with him a rope fastened about the waist, the remaining three

THE FLATTEST PART OF THE SUMMIT, LOOKING SOUTH

The slope east and west is readily discernible, and several dead cedars may be seen on the bare rock, the earth having been washed over the precipice. The film of surface soil barely covers the rocky floor (the Indians stayed below) holding the ladder as rigidly as possible; yet it swayed and creaked and bent like a reed until the top was reached, and it required no little care to step from an upper rung to the dizzy sloping ledge without forcing the ladder from its insecure bearing. The shelf was gained in safety, however; the rope was tied to a rung and made fast around a large block of stone on the terrace to the left. The others ascended, one by one, each with the rope tied around his chest and drawn about the rock by the leader as a measure of precaution. Then the equipage, wrapped in blankets, was fastened to the end of a rope thrown to the two Indians below and drawn up, piece by piece. The remainder of the ascent was made without difficulty. The time consumed by the entire climb was somewhat over two hours.

If the view from the valley at Acoma is beautiful, that from the summit of Katzímo is sublime. Mesa Prieta was sullen still, and the pink mesas, haughty in their grandeur from the plain, now seemed to realize their insignificance in the light of the glories beyond. Placid little pools, born of the storm the day before, lay glinting like diamonds on an emerald field, while old Mount Taylor tried in vain to lift his lofty head above the clouds that festooned the northern horizon.

The summit of Encantada has been swept and carved and swept again by the winds and rains of centuries since the ancestors of the simple Acomas climbed the ladder-trail of which we found the traces. The pinnacled floor has not always appeared as it is today, for it was once thickly mantled by the sherd-strewn soil that now forms a goodly part of the great talus heaps below. The walls of the dwellings, undoubtedly of the sun-baked mud-balls that Castañeda describes, must have been erected on this soil stratum, for the native finds in earth, when he has it, a better footing for his walls than he does on bare rock, and one may readily see that the film of soil that still remains occurs in places that would have afforded the best sites for dwellings. (Pl. 34.)

The day before was a day of storm; it even rained hard enough to drive an Indian from his religion, and yet not a cupful of water found a resting place on the entire mesa surface save in a few "potholes" eroded in the sandstone. The water had poured over the brink in a hundred cataracts, each contributing of the summit's substance to the detritus round about the base as in every storm for untold ages.

There is little wonder, then, that I despaired of finding even a single relic when we had reached the top of the trail and looked about at the destruction wrought; and yet we had been on the summit only a few minutes when Major Pradt found a sherd of pottery of very ancient type, much crackled by weathering. This fragment is of plain gray ware, quite coarse in texture, with a dégraissant of white sand.

Beginning at the eastern side we immediately began to explore the rim of the escarpment, in a short time encountering the rude monument which had been observed by Professor Libbey, who

FIG. 2—AN ARTIFICIAL MONUMENT ON THE SUMMIT

expresses the opinion that it may have found its origin in erosion; but it seems to me, as I think it will appear to any one who will examine the accompanying illustration (Fig. 2), that only a glance is necessary to determine beyond all doubt that the pile could not have been erected save by the hand of man. The structure stands on a natural floor of sandstone at the edge of the eastern cliff, and consists of a narrow slab some 30 inches in length held erect by smaller slabs and bowlders about the base, the stratification of the upright slab being vertical, that of the supporting stones horizontal. It would have been impossible for the structure to have originated by any but artificial means.

The reconnaissance of the eastern rim was continued northward and of the western edge southward, but no further evidences of aboriginal occupancy were observed. The sun was lowering, so that we were compelled to suspend the investigation in order to make preparation for our night's camp. After supper, Mr Vroman and Mr Hayt built a huge fire, for the evening air at this altitude is very chilly. We passed the night in questionable comfort and were out of our blankets at dawn. After a hasty breakfast, we immediately began a survey of the mesa

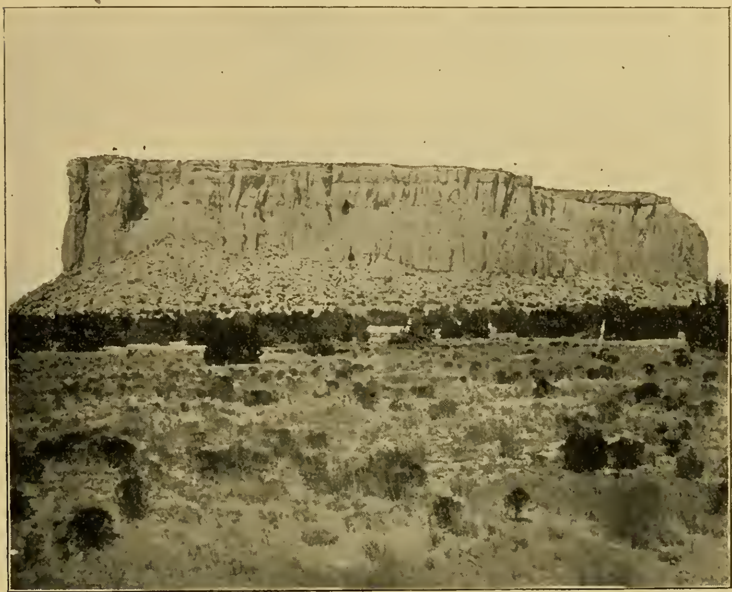


FIG. 3—THE ENCHANTED MESA FROM THE SOUTHEAST

rim, and while thus engaged were somewhat surprised to find three Acomas among us. They were scarcely friendly at first; indeed, according to the story of our two Lagunas, who had spent the night in the camp below, they had seen our fire and had come with the avowed intention of compelling us to descend, even if they had to threaten to cut down our ladder. A little explanation, however, coupled with the information that we kept our coffee and sugar in a crevice beyond the camp fire, soon appeased any wrath that may have been concealed in their bosoms and induced communicativeness.

These three natives were Luciano Cristoval, teniente of the tribe and a medicine priest; Luis Pino and Santiago Savaró, principales. After careful inquiry in regard to the tradition of the former occupancy of Katzímo, Luciano informed us that "the elders" had lived there so long ago and the storms in his country were so destructive that we could now hardly expect to find any remains on the surface of the mesa. When we told him and his companions that a potsherd had already been found, they became deeply interested and manifested no little anxiety to find other evidences of the lofty homesite of their ancestors. I think there can be no doubt that this was the first visit of any of the present Acomas to the mesa top. They evinced much curiosity in the place, and were greatly surprised when we took them to the stone monument, of which they could give no satisfactory explanation. It is needless to say that the natives did not intimate that the pile was due to natural causes.

As already stated, the Indians were deeply interested in finding further evidence of occupancy, and I encouraged them to search for relics. They had proceeded only a few yards, accompanied by Major Pradt, when the teniente found a fragment of ancient pottery quite similar to the sherd picked up the evening before. A few moments later several more fragments were found (two of them of different kinds of indented ware), as well as a portion of a shell bracelet still bearing evidence of considerable wear, and a large arrowpoint. Soon after the keen-eyed Luciano discovered near the northern rim of the mesa the blade end of a white stone ax, on the edge of which several small notches had been made. The exposed side of this implement was thoroughly bleached and crackled, while the side in contact with the ground was stained and still damp when the finder handed it to me. After descending the mesa the same Indian exhibited the blade end of another ax which showed a portion of the groove and which was notched similarly to the other. He had found it on the summit, or rather on a ledge a few feet below the summit. Both Mr Hayt and myself tried to purchase it, but the Indian refused to part with the specimen, as he was a medicine priest and desired to keep it for ceremonial use. Like the other implement, this ax was thoroughly bleached on one side by weathering, the unexposed side being stained through contact with the lichen-covered ground.

We descended the mesa about noon of the second day (September 4), having spent about 20 hours on the summit. During this time I employed every opportunity in making a critical

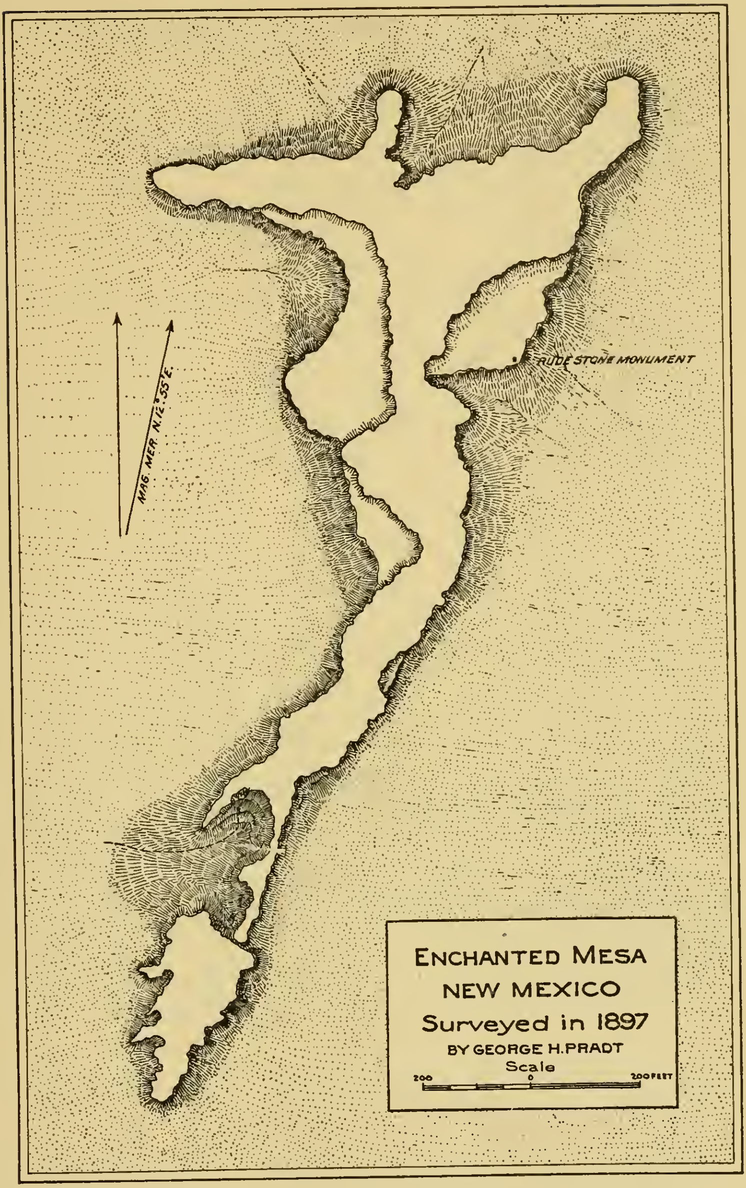


FIG. 4—MAP OF THE MESA SUMMIT

study of the general features of the top of Katzímo throughout the 2,500 feet of its length (see Fig. 4), devoting special consideration to the topography of the site, the erosion, the earthy deposits, the drainage, and the great cedars that stand gaunt and bare or lie prone and decaying because their means of subsistence have been so long washed away, and I was forced to the conclusion that had house-walls, whether of stone or adobe, ever existed on the summit at a reasonably remote period, there is no possibility that any trace of them could have remained to this day. The abundance of ancient relics in the talus, the distinct remains of the ladder-trail, the specimens found on the summit coupled with the destruction wrought by nature, the tradition itself—all testify to the former habitation of the site.

To the Acomas Katzímo is still enchanted, and as a subject in the study of mysticism the man of science must yet regard it. The lore of a millennium is not undone by a few hours of iconoclasm.

ELECTRIC STREET RAILWAYS

According to the *Western Electrician*, there were, on January 1, 1897, 15,250 miles of street-car track in the United States, of which 13,580 miles, or 89 per cent, were operated by electricity, 1,010 miles, or 6.6 per cent, by horses, 515 miles, or 3.4 per cent, by cable, and 145 miles, or 1 per cent, by steam dummy. The adoption of electricity as a motive power has completely revolutionized the methods of city and suburban transportation. Between January 1, 1888, and January 1, 1897, the number of horse cars in use decreased from 21,736 to 3,664, while the number of electric cars increased from 172 to 37,097. In 1888 horse cars represented 86 per cent and electric cars seven-tenths of one per cent of the total car equipment. At the beginning of the present year 79 street cars out of every 100 were propelled by electricity and only seven out of 100 by horses. J. H.

MODIFICATION OF THE GREAT LAKES BY EARTH MOVEMENT—AN ERRATUM

We regret to state that two of the figures illustrating Mr Gilbert's article in the September number are transposed. The narrow figure on page 240 belongs on page 241, and the square figure at the top of page 241 belongs on page 240. As the figures stand, they are associated with the wrong titles.

GEOGRAPHICAL RESEARCH IN THE UNITED STATES*

By Gardiner G. Hubbard, LL. D.,

President of the National Geographic Society,

and

Marcus Baker,

U. S. Geological Survey

The United States, now a little more than a century old, comprises an area of 3,600,000 square miles, an area a little greater than that of Canada and a little less than that of Europe. From easternmost Maine to westernmost Alaska it stretches through 120 degrees of longitude, or about one-third of the earth's circumference. Thus, in midsummer, sunrise in eastern Maine occurs 20 minutes before sunset in westernmost Alaska. From southernmost Florida, reaching to the verge of the torrid zone, it stretches northward to northernmost Alaska, more than 300 miles within the Arctic circle, while in altitude it ranges from 200 or more feet below sea level in the deserts of southern California to heights of more than 18,000 feet in Alaska.

Beginning with the close of the war for independence, 114 years ago, as 13 distinct and independent states stretching along the Atlantic seaboard from New Hampshire to Georgia, we have first a loose confederation of states which, speedily breaking down, was replaced by the present constitutional union of the people, bound together in 45 sovereign states and 5 territories. In 1790 the 13 states had an area of about 350,000 square miles and a population of a little less than 4,000,000. A century later its area was nearly eleven times as great and its population about seventeen times as great, or between 65 and 70 millions.

Discovery of what is now the United States began just four centuries ago this very year, when the Bristol merchant Cabot, the first white man (after the Norsemen) to set foot on the American continent, antedating Columbus by fourteen months, landed on the bleak coast of Labrador, and then cruised southward as far as Virginia. This, like all discoveries, was only a beginning,

*An address before the Geographical Section of the British Association for the Advancement of Science, at Toronto, August 23, 1897.

which pointed the way to and stimulated other discoveries. These are still unfinished, and within the limits of the United States some tracts still exist which have never been seen by the white man. Of other tracts, though seen and long vaguely known, our knowledge is still dim and shadowy.

For a century after Cabot small advance was made in our knowledge of the continent formally taken possession of by him in the name of his sovereign lord, King Henry VII. The outline of the Atlantic and Gulf coasts were crudely delineated, but of the Pacific coast north of California our maps until about 1750 were either blank or filled with fabled lands or monsters. Bering's voyage of 1741 yielded the first definite knowledge of northwestern America, but it was not until nearly 40 years later, in 1778, that Cook, the great English navigator, gave to the world the general outlines of Alaska as we now know them. The general features of the coast of western North America obtained by Cook were some 16 years later vastly improved, from southern California to Kadiak, by another English navigator, the equal if not the superior of Cook, whom every American student delights to honor, Capt. George Vancouver.

The period of the war for independence in the last quarter of the last century was one of great geographic activity and stimulated the production of maps of the revolted colonies. The numerous and excellent, for their time, maps by the English geographer, Jefferys, may be taken as the best exponent of American geography one hundred years ago. They show fairly well the Atlantic coast line from the maritime provinces of Canada to Georgia, and so much of the interior as was the scene of hostilities; but west of the Appalachian mountain chain the delineation was conjectural. The existence of the Great Lakes, of the mighty Mississippi, and of the fertile valley drained by it were barely known.

Such was the world's geographic knowledge of what is now the United States when those states united in 1789. The knowledge subsequently acquired is the work of the United States, the individual states, private persons, and corporations.

The General Land Office.—One of the earliest agencies by which geographic knowledge was increased was the General Land Office.

The general government found itself in 1783 possessed of a region called the Northwest Territory, lying beyond the mountains. Into this region settlers came about the beginning of the century. That they might acquire title to land for their homes, the government early devised a system of land partition. Surveyors were sent into the wilderness to subdivide the land for purposes of record and sale or gift. The land was divided into square tracts six miles on each side, called towns or townships, and their corners marked, sometimes by ax marks on trees called *blazes*, and sometimes by artificial marks. A row of such towns running north and south is called a *range*, and numbered E. and W. from some arbitrary meridian. Similarly a row of towns running east and west is called *town*; and is numbered north or south from an arbitrary base line. Each town was further subdivided into 36 squares, each containing one square mile, or 640 acres, called a section. The sections are similarly numbered from 1 to 36 in every town. Each corner of each section was marked by the surveyors, who were thus required actually to chain over every mile, to keep a record of their measures, to note all streams and lakes, and the character of soil and timber; to note the magnetic declination, and to submit to the General Land Office a skeleton map of each town subdivided, together with their field-notes. These maps, called town plats, now constitute a vast body of original records in the General Land Office in Washington, and are the sole dependence of map-makers for hundreds of thousands of square miles of our territory. Every state and territory in the Union except the original thirteen, Maine, Vermont, Kentucky, Tennessee, Texas, and Alaska, has been thus in whole or in part surveyed and subdivided. This work, now far advanced toward completion, has always been under the control of the General Land Office, now a part of the Department of the Interior.

For geographic purposes the results are shown in a series of state maps and a general map of the United States. The work was for about a century done by contract, but within the past two or three years a part has been done by the U. S. Geological Survey in connection with its topographic surveys.

Thus indirectly the General Land Office has for a century been and still continues to be one of the important geographic agencies of the United States.

Coast and Geodetic Survey.—Another old and important geographic agency is the Coast and Geodetic Survey, under the Treasury Department. The primary purpose of this bureau was to accurately chart the coast for purposes of commerce and defense. Its field of work is tidewater with a fringe of topography landwards and a somewhat extensive border of sea bottom seawards. Created in 1807, it made little progress till 1832. In that year it was revived and has continued uninterruptedly till the present day.

From the beginning its ideals were high. Great accuracy has ever been and is its motto. It has been a leader and not a follower. It has developed its own methods and instruments, and to its officers, civil, military, and naval, we are indebted, among other things, for the zenith telescope for the most accurate determination of latitudes; for the application of the telegraph to longitude determinations; for the invention, construction, and use of a machine for predicting tides, and for great improvements in apparatus for measuring the force of gravity. The polyconic projection now so extensively used was developed and applied by officers of this bureau, as also were appliances for deep-sea sounding and the study of the ocean deeps.

Its field of work was extended in 1871 to include geodetic work in the interior, and in 1876 it received the name of Coast and Geodetic Survey, by which it is officially designated, though often referred to as the Coast Survey. It is one of the active geographic agencies of the United States, and is not only making charts, coast pilots, and tide tables, but is contributing to our knowledge of ocean physics, terrestrial magnetism, and of the size, shape, and structure of our planet.

Engineer Corps, U. S. A.—The U. S. Engineers, though not now actively prosecuting geographic research, have in the past made notable contributions to geography. Prior to and even since the war of the rebellion, 1861–'65, numerous expeditions in the far west were made by army officers, and each of these added something to our geographic knowledge. Aside from these various military reconnaissances two noteworthy surveys have been carried on in the past by the U. S. Engineers. One was a survey of the northern and northwestern lakes, which, after an existence of forty years, was concluded in 1881. It made a series of detailed and accurate charts of all the Great Lakes, and a valuable collection of data. Its series of lake levels has very recently been put to use in determining certain secular changes in the crust of the earth forming the great basin in which those lakes lie. If the slow tilting of this basin southward which these levels show, when compared with recent ones, continues for a period of about 6,000 years, then it is calculated that Niagara will have vanished, and all the lakes except Ontario will drain to the Mississippi by way of the Chicago outlet. These highly interesting and somewhat startling conclusions have just been presented at the Detroit meeting of the American Association for the Advancement of Science by Mr G. K. Gilbert, of the U. S. Geological Survey.

Another noteworthy geographic work by the U. S. Engineers was a general map-making survey in the far west under the direction of Capt. George M. Wheeler, U. S. E., and usually referred to as the Wheeler survey. A considerable tract of country was mapped by it on a scale of 8 miles to 1 inch. This survey with two others, the so-called Hayden and Powell surveys, were merged in the present Geological Survey in 1879.

The work of improving rivers and harbors in the interest of commerce is now carried on by the United States engineers, and their geographic work consists in special surveys for these improvements and of a new survey of the Great Lakes.

Geological Survey.—The chief agency for increasing geographic knowledge of the United States at the present time is the United States Geological Survey, now eighteen years old. Nearly or quite one-half of its energies and funds are expended in the production of topographic maps, and thus it is in fact, though not in name, the United States Topographic and Geologic Survey. The conditions confronting this survey at its creation differed in one important particular from those similarly confronting European geological surveys. Those surveys had, in almost if not quite every case, been preceded by topographic surveys, and the geologists found maps, adequate to their needs, ready made. But in the United States topographic maps were not available, as there had been no topographic survey. Thus progress in geologic mapping was impeded at the outset by the lack of suitable maps. Accordingly in 1882 authority was given to make topographic maps, and since then about one-half of the energies of the Survey have been given to their production. Since 1882 the Survey has surveyed and mapped on scales of one, two, and four miles to the inch an area of 760,000 square miles, almost equal to the combined areas of Great Britain, France, Germany, Spain, and Portugal. The results are contained on 980 atlas sheets, 460 on the one-mile scale, 460 on the two-mile scale, and 60 on the four-mile scale. These surveys have been made in nearly every state and territory. Following these came the geological surveys. But before much progress was possible a large amount of preliminary investigation was needful to determine the great features whose details were to be wrought out and mapped. A system of rock classification uniformly applicable to so great and complex an area as the United States required much careful preliminary work. That has been accomplished and systematic geologic mapping has been in progress for some years.

The aspect of the country and its utility for man's use is largely dependent on the annual rainfall. This ranges from a very few inches in the driest part of the arid or desert regions of the southwest to nearly or quite 8 feet per year on the coast of Southern Alaska. As the humid regions were settled up population gradually pushed into the semi-arid and desert regions of the far west, where agriculture without artificial irrigation is impossible, but *with* irrigation marvelously successful. Thus came a demand for knowledge as to water supply, and to this work one division of the Geological Survey is wholly devoted.

Intimately associated with water supply is the forestry problem. The proper administration of the forests—their preservation from destruction by carelessness or greed—is a question now attracting serious attention. A number of large forest tracts in the west have been recently set apart as reservations, and these, with the Yellowstone National Park, the Yosemite, and others previously reserved, comprise a total area estimated at 38,880,000 acres, or more than 60,000 square miles. In the budget for this year Congress has included an item of $150,000 for the survey of these forest reserves. This work is under the direction of the United States Geological Survey.

The output of the mines and quarries of the United States has grown in value from $369,000,000 in 1880 to $622,000,000 in 1896. That authentic information on this subject might be promptly available a division of mineral statistics has existed in the Geological Survey from the beginning, charged with the duty of gathering and publishing statistics. This it does in an annual volume devoted to mineral statistics, and the state of the mining industry from year to year finds permanent record in these volumes.

Navy Department.—The Hydrographic Office of the Bureau of Navigation has for a primary aim the securing and publication of information useful to those who go down to the sea in ships. This includes surveys and chart-making of all coasts (except those of the United States), ocean meteorology, terrestial magnetism, and ocean physics. The charting of the coasts of the United States is done exclusively by the Coast Survey, which has nearly completed the Atlantic and Gulf coasts and about three-fifths of the Pacific coast, except Alaska, of which only a small part is as yet surveyed. Of foreign coasts, the Hydrographic Office has recently surveyed and charted the western coast of the peninsula of Lower California, one of the Mexican states, about 1,000 miles in extent. It has extended our knowledge of the sea abysses by various lines of soundings in the interest of projected cable lines, and it lessens the perils of ocean travel by the monthly issue of pilot charts of the North Pacific and North Atlantic oceans, containing data as to derelicts, ice-fields, storm tracks, and other information useful to the mariner. The systematic collection of data for these pilot charts results in a constant increase in our knowledge of the geography of the sea.

Weather Bureau.—To investigate the history, structure, and contents of the crust of the earth is the peculiar province of the Geological Survey; to study the currents, movements, and characteristics of the earth's salt-water envelope is the province of the Coast Survey and the Hydrographic Office; to investigate the character, amount, habits, and migrations of its contained life is the province of the Fish Commission. The study of the all-enveloping gaseous ocean in which we live and move—that invisible sea of air with its ever-varying moods of restful calm and fierce storm, now delightfully transparent and now somber or menacing with storm-cloud, sometimes scorching and sometimes freezing—the study of this gaseous envelope, of the laws which govern its behavior and the daily deduction from these laws which foretell to the sailor, the farmer, the traveler what he may expect—is the peculiar province of the Weather Bureau. May we not properly call this field of study the geography of the air? And has it not ever formed a large chapter in our physical geographies? The weather service in the United States is 27 years old, dating from 1870. At first it was a military organization called the Signal Service, and its purpose was to give "notice on the northern lakes and on the seacoast, by magnetic telegraph and marine signals, of the approach and force of storms." Its primary object was, therefore, not the study of climate, but the prediction of storms. It seeks to tell the weather of tomorrow rather than that of the last year or the last century. But, as we are forced to judge the future by the past, the study of meteorological records is not neglected, and within the bureau there has ever been a corps of scientific experts at work upon such lines as gave promise of producing something new or useful for the forecaster. The bureau is now a civilian one, having been transferred from the War Department to the Department of Agriculture. Its present field of activity is far wider than we have indicated—so wide, indeed, that time will not permit even a mention of details.

Thus have we briefly summarized and characterized the work carried on by the greater geographic agencies of the government of the United States; and yet such summary would be incomplete without mention at least of several other agencies still at work and actively contributing to a fuller and better knowledge of our geography.

The total railroad mileage of the United States, not counting second or third tracks or sidings, is in round numbers 180,000 miles, or about 45 per cent of the world's mileage. To locate and construct these thousands of miles of road, much of it running through districts little or quite unknown when preliminary surveys began, has involved a vast expenditure of money by which geographic knowledge has been increased. It has been estimated, perhaps it would be more exact to say guessed, that the sums expended on these railroad surveys is enough to have produced a topographic map of the entire country. The chief geographic contribution from these surveys is a knowledge of altitudes. Over all these railroads lines of level have been run, and by collecting and platting those levels and adding to them those obtained from other sources, it has been possible for the Geological Survey to produce a fairly approximate contour map of the United States.

The Mississippi river, with its tributaries in the great central valley of the United States, drains an area of about 1,200,000 square miles, or about one-third of the United States. From the sources of the Missouri to the passes at the mouth of the Mississippi in the Gulf of Mexico is 4,200 miles. These two great rivers, with their affluents, afford thousands of miles of navigable water through the great central valley. So important is this artery of commerce that two distinct commissions, one for the Mississippi and one for the Missouri, have existed for some years for the purpose of surveying, mapping, studying, and improving them. Detailed maps of the rivers and a fringe of topography on either side have been made over a considerable part of the navigable parts of these rivers, and the results are shown on 240 atlas sheets. Much precise leveling has also been carried on in connection with these surveys.

Independent of the Federal government, various states, to the number of 20 or more, particularly those known to possess mineral wealth, have conducted geological surveys, or perhaps it should be said geological reconnaissances. Two have conducted topographic surveys and four have coöperated with the general government in making topographic surveys. These four, Massachusetts, Rhode Island, Connecticut, and New Jersey, as also the District of Columbia, are now completely mapped on a scale of one mile to the inch and in contours with a vertical interval of 20 feet.

The Post Office Department, for its own purposes in administering the 70,000 post-offices under its control, compiles state maps showing post-routes and political divisions. The boundary lines shown on these maps are compiled from the laws and by correspondence, and constitute an authentic source of information as to minor boundaries.

Allusion has been made to the work of the Fish Commission in studying the character, habits, and migrations of marine life, and by its side should be mentioned the similar work on land carried on by the Biological Survey in the Department of Agriculture.

Of the great advances in geographic knowledge resulting from the explorations of Lewis and Clarke near the beginning of the century; from the work of Fremont, the Pathfinder; from the Pacific Railroad surveys of 50 years ago, and from numerous military expeditions, time fails for more than a bare mention.

These, then, are the greater geographic agencies of the United States. Some of them will be presented to you more at large by the gentlemen actually conducting the works outlined.

As to the future, it will easily appear that the amount already achieved is but a small part of what remains to be done. Geographic research and progress in the United States has never been swifter or more active than it is today, and knowledge of environment and resources is gathered in large installments each year. To discover and develop its resources the United States is now employing about 5,000 persons and expending nearly $8,000,000 annually. Just as the Royal Geographical Society of London began sixty-seven years ago its work of fostering and promoting geographic research, so the National Geographic Society of Washington nine years ago entered upon similar work. Great and lasting good has resulted from each undertaking. May their efforts continue till dark continents and unexplored regions shall have vanished from our maps.

A BRIEF ACCOUNT OF THE GEOGRAPHIC WORK OF THE U. S. COAST AND GEODETIC SURVEY *

By T. C. Mendenhall, LL. D., Ph. D., etc.,

President of the Worcester Polytechnic Institute, and formerly Superintendent of the Coast and Geodetic Survey, Washington, D. C.,

AND

Otto H. Tittmann,

Assistant in Charge of the Office of the Survey

While a relatively small part of the energies of the United States Coast and Geodetic Survey has been devoted, since the creation of the Bureau in 1807, to geographic exploration, it is, perhaps, only just to say that in the character and amount of its precision work it is second to no similar organization in the world. From the very start the standard of work has been the highest attainable in the existing condition of the arts and sciences on which such work must depend, and often, not content with that condition, the Survey has made it its business to better it by original investigations of the first class, leading to improvements in the instruments and methods of the highest importance. It thus became the principal and for many years almost the only bureau of the Government in which exact science was cultivated. In its outward activities it was essentially an organization for the practical application of science to the solution of certain problems and the issue of certain publications which were of the utmost value to commerce.

The duties to be performed by it were to sound the depths of the ocean along the coasts of the United States, to define the shallows which barred the ways of commerce, to delineate with great accuracy the shores and physical condition of the thousand harbors and estuaries with which a benign Providence has blessed our coasts, to investigate the tides and currents of the waters which bear their precious burden of human lives and property to and fro, and to study the mysterious variations and uncertainties of the magnetic needle by which the course of the navigator was largely directed.

* Read before the Geographical Section of the British Association for the Advancement of Science, Toronto, August 23, 1897.

To these immediate problems the Survey addressed itself with vigor and foresight under the guiding hands of Hassler and his eminent successors. Hassler, the friend of Jefferson and Gallatin, enjoyed the confidence and support of these eminent statesmen, but he had before him difficulties as great as his field was wide. Inert public opinion as to the utility of the proposed Survey had to be vitalized and molded, men had to be trained to carry out the technical parts of the work, instruments had to be constructed, and correct methods had to be prescribed. How these difficulties presented themselves and how they were overcome will form a proper chapter not only in the history of the great Survey which yet remains to be written, but also in the history of the progress of science in this country.

It may be said that Hassler, in 1844, saw the fruition of his hopes when a general plan of operations prescribed by him was adopted by a scientific commission composed of Army and Navy officers and civilians. Its adoption marks the official recognition of the necessity for precise and systematic work in the mapping of our domain. Its simple and correct outline of the operations to be followed in making a survey of great extent has permitted the extension of the work in a manner commensurate with the enlargement of our national domain by acquisitions of territory from France, Spain, and Mexico. With the expansion of territory came the extension of the scope of the survey, and finally, when the advantages of a transcontinental triangulation became apparent, its geodetic function was recognized by law.

In accordance with its primary duties the Survey has developed and charted the depth of the waters along our coasts with extreme minuteness and accuracy, not only in the rivers, bays, and harbors, but off shore as far as the needs of commerce demanded it. Going beyond the immediate requirements of the mariner, it has devoted itself to discovering the depths of the sea over large areas, as is shown by the complete survey of the Gulf of Mexico. Its depths were sounded and charted, its salinity tested, and the temperatures of its waters were recorded. Much earlier than these successful surveys of the Gulf were the explorations of the Gulf Stream, important not alone in their geographic results, but in developing methods, often by failures, which rendered subsequent success possible. The hydrographic results achieved are shown on between five hundred and six hundred charts, many of them of such exquisite perfection as to form a standard of excellence for all cartographers.

Its researches in physical hydrography include not only the study of the tides and currents and incidentally the establishment of planes of reference from which the constancy of the relation between the ocean level and the land is to be inferred, but it has studied for future comparison the movements of sandy shores, as, for instance, those of Cape Cod and of the exposed islands of Nantucket and Marthas Vineyard, to discover the relationship between the outlying shoals and the changes of the shores. Here, again, precision of work alone is of any avail, for correct conclusions can be drawn only after the lapse of time and after a standard of comparison has been created by an accurate survey. Want of space forbids the enumeration of many special results, but the discovery of the value of the tidal circulation through the East river as a factor in maintaining the depth of the bar at Sandy Hook and the discovery of the underrun of the Hudson and its bearing on the feasibility of obtaining a water supply for the towns along that river may be mentioned as contributions in a special field of geography.

As properly belonging to the subject of the hydrographic surveys, the literature of the several and successive volumes of the Coast Pilots, published by the Survey, must be mentioned. The Coast Pilots of Alaska, compiled by Davidson and later by Dall, are invaluable historical records of the geography of that coast, and the same may be said of the volumes covering the remainder of the Pacific coast and those which describe in detail our Atlantic shores. They are not intended to deal in generalities, but they describe with rigid particularity geographic landmarks which are to guide ships by day and by night.

The maps of the Survey are embellished by accurate representation of the topography which borders our shores. For thousands of miles a narrow fringe of topography has been mapped with minute and necessary accuracy. It is based on local and detailed triangulation, which in turn rests on a larger network of triangles which coördinates all the surveys along the coasts.

The introduction of precise methods for the determination of latitudes and longitudes went hand in hand with all the other operations of the Survey. Thus the success of Morse in the spring of 1844 was followed in the autumn of the following year by formal instructions given by Bache to Walker to prepare for telegraphic longitude determinations; but it was not until October 10, 1846, that the method was successfully put into practice by the exchange of signals between Philadelphia and Washington, and thereafter the precise determination of longitudes had merely to await the extension of the telegraph system from point to point within our own borders and throughout the world. As soon as the Atlantic cable had been laid in 1866, the Survey successfully undertook to determine our longitude from Greenwich by the telegraphic method. Up to that time the longitude adopted for Cambridge, Massachusetts, in 1851, was used. The adopted value (4 h. 44 m. 39.5 s.) had been derived from many years of laborious observations of moon culminations, eclipses, occultations, and chronometer determinations, but this value was increased (in 1869) by 1.35 s., as the result of comparatively brief cable determinations. Similarly, the longitude adopted for San Francisco in 1855, as the result of 206 moon culminations, was increased in 1869 by 3.1 s., in linear measure about ¾ of a mile, by the telegraphic determination.

Within the past year the Survey has completed and adjusted its primary longitude net covering the whole United States and fixing for all time the astronomical longitudes of the points included in it, not only in their relation to each other, but, in all probability, their final relation to the initial meridian of Greenwich, since in this adjustment three transatlantic determinations by the Coast Survey and one by the Canadians have been used. Less need be said of the many latitude determinations, since the methods adopted, though admirable in their precision, involved no such radical improvement as that which the telegraph brought about in the determination of longitudes. On the other hand, however, the zenith telescope, as developed by the Survey, has in the hands of its observers contributed materially to our knowledge of the variation of latitude.

Reference has been made to the geodetic function of the Survey. It has measured an oblique arc, the last triangles in which have but just now been observed, extending from the northeastern boundary to the Gulf of Mexico. To join this with the primary chain, as yet incomplete, of triangles along the Pacific coast, a great arc has been measured along the 39th parallel of latitude, the completion of which has been but recently announced.

The adjustment of the triangulation along this great arc and the adoption of a homogeneous system of geographic coördinates will furnish the fundamental data for the coördination of all Government or State surveys for all time to come, if it be permitted to fallible human wisdom to make such an assertion.

Grand in its inception, splendid in its execution, this monumental work may be reckoned as the most important contribution to the geography of our country, on account of its present and prospective value. The measurement of a great meridional arc along the 98th meridian is in contemplation, and our sister Republic of Mexico, which has just established a Geodetic Survey, it is hoped will take a hand in its extension southward, while to our cousins across the northern border a similar opportunity for its prolongation northward may be offered in the course of time.

The Survey has been especially called upon for assistance in defining the boundaries of eleven States, and aid has been extended to fifteen others by the determination of geographical positions within their borders. In the determination of the national boundaries it has coöperated in retracing the line between Mexico and the United States, has made topographic surveys along the northeastern boundary, and in the far north it has determined the crossing of the 141st meridian on the Porcupine and Yukon rivers in regions to which all adventurous eyes are now turned, and in southeast Alaska it has made exploratory surveys, as well as precise geographic determinations, for the ultimate delineation of the boundary between Alaska and the British possessions.

The enormous extent of the country included in the operations of the Survey, and especially its nearness to the principal north magnetic pole, offered a rare opportunity for the investigation of the problem of terrestrial magnetism. Observations began at an early date, and have been continued up to the present time at a constantly increasing number of stations. In addition to a regular, periodic study of the magnetic elements at a large number of specially selected points by the most approved methods and the best of instrumental appliances, the Survey has maintained a photographic registering magnetic observatory, which it has moved from time to time from one part of the country to another. It has made extensive publication of the data thus obtained, including a series of magnetic charts which are of the greatest value to navigators at sea and surveyors on the land. Its archives contain a mass of reliable information concerning terrestrial magnetism unequaled in extent and importance.

In common with several similar organizations in Europe, it has devoted much attention, mostly during the past twenty-five years, to the study of terrestrial gravity. Beginning with methods long in use, its observers were quick to detect and point out certain serious and hitherto unsuspected faults, necessitating considerable corrections in nearly all accumulated data relating to that subject. Instruments were also improved and methods greatly changed, increasing at once the precision and rapidity of gravity measurements. Expeditions have been sent to various quarters of the globe for the purpose of gravity observations, and Coast Survey pendulums have swung in all continents except Australia, in most important cities, on several of the highest mountains, and on many islands in the several oceans. No others have been vibrated so near the pole as these and none over so wide a range in longitude. The results of these operations, together with the measurement of the great arc of unrivaled length, form a contribution of no ordinary interest to the more precise solution of the great problems of dimensional geography.

UNITED STATES DAILY ATMOSPHERIC SURVEY*

By Prof. WILLIS L. MOORE,

Chief of the U. S. Weather Bureau

The United States Weather Service has been in existence twenty-seven years. During the past twenty-five years the daily synoptic charts of the service have shown the most comprehensive atmospheric survey ever presented to the forecaster or to the broad investigator of the fundamental principles of storms. The vast region now brought under the dominion of bi-daily synchronous observations embraces an area extending 2,000 miles north and south, 3,000 miles east and west, and so fortunately located in the interest of the meteorologist as to cut an important arc from the circumpolar thoroughfare of storms of the northern hemisphere. The extreme points of observation are Edmonton, in the Canadian Province of Alberta, on the northwest; St Johns, on the northeast; Key West, on the southeast, and San Diego, on the southwest; and arrangements are now complete for a coöperation with Mexico similar to that in operation with Canada, which will in a few months extend the area of observation southward over Mexico and Yucatan.

It is a wonderful panoramic picture of atmospheric condi-

*Read before the Geographical Section of the British Association for the Advancement of Science, Toronto, August 23, 1897.

tions, which by the aid of simultaneous measurements and the electro-magnetic telegraph joining the places of observation by a magic touch is presented to the trained eye of the forecaster. Each twelve hours the kaleidoscope changes and a new graphic picture of actual conditions is shown. Where else can the meteorologist find such opportunity to study storms and atmospheric changes?

In the middle of the eighteenth century Franklin detected the rotary and progressive motions of storms; early in the nineteenth century Redfield and Espy contended over rival theories as to the mechanical principle involved in the formation of storms, and a little later Maury studied the storms of the Atlantic ocean; still later Loomis, Dove, and Ferrell reviewed these theories and added much to our knowledge; but at this late date no one has been able to satisfactorily coördinate the forces operative in cyclones or to assign quantitative values to the horizontal temperature and pressure gradients, to the surface and internal frictions of convection, to centrifugence, to the latent heat of condensation, and to the effect of hemispherical circulation. Probably the only component of cyclonic force that is well understood and accurately computed is the deflection due to the earth's rotation.

Our early investigators studied only the storms of low levels and humid airs, where convection was only needed to carry the moist air currents to but a slightly higher elevation before cooling by expansion would produce condensation and an immediate acceleration of the cyclone by the liberation of latent heat. They had never seen the whirling cyclones of the arid northern Rocky Mountain plateau dash down upon our Great Lakes with rapidly increasing energy, notwithstanding the fact that there was little or no condensation, and hence no addition of the latent heat which Espy supposed was absolutely essential to a continuation of storms.

The widely differing elevation, topography, temperature, and aridity of the broad region under observation give conditions which are unequaled anywhere in the world for the advantages which they present to the physicist to study the mechanical phases of storm development and progression, or at least such as can be profitably studied with observations taken only at the bottom of the great aerial ocean surrounding the earth.

Here we see summer cyclones formed under the intense insolation which beats down through a diathermanous atmosphere upon the arid waste of the Rocky Mountain plateau; cyclones which, if they form in the northern part of the plateau region, move eastward to our lakes and thence to the St Lawrence with scant rainfall; cyclones which, if they have their origin farther south on the warmer plains of Colorado, move into the Ohio valley and thence into New England with considerably more precipitation; and cyclones which, if they have their inception on the hot and high plains of Arizona and New Mexico, can always be expected to give abundant rainfall when they reach the lower Mississippi valley, and later as they pass over the Middle Atlantic states. All these can be studied during their inception at an average altitude of 5,000 feet above sea level and under conditions of extreme aridity; they can be viewed later as they come down nearly to sea level in the Mississippi valley and reach a more humid atmosphere 1,000 miles from the place of their birth; and, finally, they are seen as they reach the extremely humid air of the Atlantic ocean, 1,500 miles farther east.

The great winter cyclones which originate south of the Japanese islands and cross the Pacific ocean come under our vision as they successfully surmount the formidable Rocky Mountain barriers with but little diminution of energy, sweep across our continent with increasing force and heavy precipitation, and within three days pass beyond our meteorological horizon at the Atlantic seaboard only to be heard from three days later as borean ravagers of northern Europe.

The great anti-cyclones or high-pressure eddies, which constitute the American cold waves, drift into our territory from the Canadian Northwest provinces and are studied under rapidly changing conditions during 3,000 miles of their course. The high-pressure eddy, with all the convectional principles of the cyclone reversed, may be said not to depend upon the land of its birth for the cold it brings, for a strong vortical and anti-cyclonic motion at the center is continually drawing down the cold air from above. In the cold wave it must be conceded that the loss of heat by radiation to a cloudless sky is much greater than that gained by compression, or else it must be assumed that the atmosphere possesses such intense cold at the elevation from which the air is drawn that, notwithstanding the heat gained by compression in its descent, it is still far below the normal temperature at the surface of the earth.

The West Indian hurricanes, always at sea level and in humid air, which are the most violent of all American storms, intrude themselves into the domain of the United States weather map at the bend of their parabolic course, at about latitude thirty. They have for years furnished a fruitful theme for the thoughts of the investigator.

For twenty-seven years the forecasters of the Weather Bureau have studied the inception, development, and progression of these different classes of atmospheric disturbances. From a knowledge personally gained by many years' service as an official forecaster, I do not hesitate to express the opinion that we long since reached the highest degree of accuracy in the making of forecasts possible to be attained with surface readings. It is patent that we are extremely ignorant of the mechanics of the storm, of the operations of those vast yet subtle forces in free air which give inception to the disturbance and which supply the energy necessary to continue the same.

Having long realized this, I determined at once, on coming to the control of the United States Weather Bureau, to systematically attack the problem of upper-air exploration, with the hope ultimately of being able to construct a daily synoptic weather chart from simultaneous readings taken in free air at an altitude of not less than one mile above the earth, as it appeared to me that previous plans for investigating the upper air by means of free and uncontrollable balloons, by observers in balloons, or by independent kite stations were of little value in getting the information absolutely necessary to improve our methods of forecasting. Simultaneous observations at a uniformly high level from many kite stations was the plan I inaugurated for the prosecution of this important investigation. Professor Marvin was assigned to the difficult task of devising appliances and making instruments, and I am pleased to say that we have improved on kite-flying to such an extent that apparatus is now easily sent up to a height of one mile in only a moderate wind. We have made an automatic instrument that, while weighing less than two pounds, will record temperature, pressure, humidity, and wind velocity. Before next spring we expect to have not less than twenty stations placed between the Rocky mountains and the Atlantic ocean taking daily readings at an elevation of one mile or more.

We shall then construct a chart from the high-level readings obtained at these twenty stations and study the same in connection with the surface chart made at the same moment. Being thus able to map out not only the vertical gradients of temperature, humidity, pressure, and wind velocity, but the horizontal distribution of these forces on two levels, it is hoped to better understand the development of storms and cold waves and eventually improve the forecasts of their future course, extent, and rate of movement.

In exceptional cases we have flown the kites to a height of nearly two miles. From daily readings at only one kite station, at Washington, we have derived information as to the direction and force of the wind above the one-mile level, which has greatly assisted us in estimating the future direction of a storm center when our surface chart gave but negative indications. It will be a fascinating study to note the progress of cold waves at this high level and to determine if the changes in temperature do not first begin above. The readings at Washington indicate that contending equatorial and polar winds may be more potent in the formation of storm eddies than heated and ascending convectional currents.

I am anxious to know the difference in temperature between the surface and the upper stratum in the four quadrants of the cyclone and in the four quadrants of the anti-cyclone, especially when the storm and cold-wave conditions are intense. At an elevation of five miles but little effect remains of diurnal temperature variation. At this altitude the atmosphere is free from the disturbing influence of immediate surface radiation, and consequently there is but little change between the temperature of midday and midnight. The vertical distribution of temperature in the several quadrants of the cold-wave or rainstorm areas may give a clue to the future direction of the storm. When we are able to construct isobaric gradients at the one-mile level it may be discovered that the storm center at that elevation will not always coincide with the geographical location of the storm center at the surface of the earth. The displacement of this center may possibly give some indication of the future direction of the storm. There are many interesting problems to be solved by this investigation.

The Eleventh International Congress of Orientalists was opened at Paris on September 5, with 800 members in attendance. One of the most interesting discussions had reference to the proposed dictionary of hieroglyphics, which is to be compiled under the auspices of the German government by members of the academies of Berlin, Göttingen, Leipzig, and Munich. It is expected that the actual publication will begin in 1908 and be completed by the end of 1913.

GEOGRAPHIC NOTES

AFRICA

Sierra Leone. The first section of the first railroad in British West Africa is now being operated between Freetown and Wellington.

British South Africa. A company has been formed to construct and operate a line of railway from Umtali to Salisbury, a distance of about 160 miles. Umtali is the terminus of the existing Beira railway system.

Abyssinia. A recent report on the trade of Adis Abbata states that ivory, which could once be obtained at the rate of a tusk for a percussion musket, is now sold at from $80 to $100 for 40 pounds. Coffee of good quality grows wild in many parts of the country.

CENTRAL AMERICA

British Honduras. The report of the government surveyors on the practicability of the proposed railroad from Belize to the western frontier of the colony (a distance of 72 miles) estimates the cost of construction at $3,575,237, or nearly $50,000 per mile. It is considered doubtful if the road would pay interest on so large an investment unless it were continued into Guatemala, and negotiations looking to that end are now in progress.

Nicaragua. Mr Thomas O'Hara, U. S. consul at San Juan del Norte, states in a recent report that there is neither a cellar nor a chimney in that city. All the buildings are of wood, although lumber is expensive and short-lived, the climate and wood ants combining to play havoc with it. The exclusive use of wood (except in a very few cases for foundation purposes) is not due to fear of earthquakes, but to the fact that there is neither stone nor brick-clay in the vicinity. There is, however, no market for imported brick.

SOUTH AMERICA

Venezuela. The government of Venezuela has ceded to Messrs Rutgers de Beaufort, bankers, of Amsterdam, the monopoly of all the salt mines in the country, in consideration of the establishment of a new bank in Caracas with a capital of $3,860,000. The bank will have the right to establish branches and to issue notes to double the amount of its capital. The concession is reported to have created great dissatisfaction among the people.

British Guiana. A recent writer on the gold industry of British Guiana says that whether the colony has a future as a gold-producing country is a question not yet removed from the region of doubt. There is no denying the fact that the central areas are richly auriferous, but the difficulties and dangers attending the navigation of the rivers constitute an enormous obstacle to the working of the deposits. The total gold production of the colony for the year ending June 30, 1897, was 128,334 ounces, as against 119,422 ounces in 1895-'96, and 138,279 ounces in 1892-'93.

J. H.

C&O ROUTE

F.F.V. LIMITED

CHESAPEAKE & OHIO RY.

THE F. F. V. LIMITED is one of the finest trains hauled over any railway track in America. It runs solid between Cincinnati and New York, the route from Washington being over the Pennsylvania system. It has every modern convenience and appliance, and the dining-car service has no superior if it has an equal. The road-bed is literally hewed out of the eternal rocks; it is ballasted with stone from one end to the other; the greater portion is laid with one-hundred-pound steel rails, and although curves are numerous in the mountain section, the ride is as smooth as over a Western prairie.

One of the most delightful rides in all the route is that through the New River valley. The mountains are just low enough to be clad with verdure to the very top, and in the early spring every variety of green known to the mixer of colors can be seen, while the tones in autumn take on all the range from brown to scarlet.

These facts should be borne in mind by the traveler between the East and the West.

H. W. FULLER, *Genl. Pass. Agent, Washington, D. C.*

HUNTER'S HOT SPRINGS

THESE SPRINGS

form a series of links between the INVALID and HEALTH.

Located in Montana and Washington, amidst fine scenery, having a pure, bracing atmosphere and glorious climate — they are pleasant stopping-points on the overland trip. *Six* Cents for Tourist Literature.

CHAS. S. FEE,
Gen. Pass. Agent,
ST. PAUL, MINN.

A CHAIN OF SPRINGS ON OUR NORTHERN PACIFIC YELLOWSTONE PARK LINE LINE

BROADWATER SPRINGS

PIPESTONE SPRINGS

WASHINGTON HOT SPRINGS

SOUTHERN RAILWAY

GREATEST SOUTHERN SYSTEM.

Penetrates with its main line or branches eight States South of the Ohio and Mississippi Rivers, and in conjunction with its friendly allied connections reaches all the commercial centers of the South and Southwest . . .

DOUBLE DAILY VESTIBULED LIMITED TRAINS

. . . BETWEEN . . .

Washington and Nashville via Salisbury, Asheville, Knoxville and Chattanooga.
Washington and Tampa via Columbia, Savannah and Jacksonville.
Washington and Memphis via Atlanta, Birmingham and K. C. M. & B.
Washington and New Orleans via Atlanta, Montgomery and Mobile.
Norfolk and Chattanooga via Salisbury, Asheville and Knoxville.

Pullman Sleeping Cars—Dining Cars—Day Coaches.
Additional Trains for local travelers . . . .

The direct line to the Winter Resorts of { FLORIDA, GULF COAST and TEXAS, ... MEXICO and CALIFORNIA,

—AND THE BEST—

Through Car Line to and from Asheville and Hot Springs—"The Land of the Sky."

Write for Map Folders.

R. W. POLLOCK, General Agent, 271 Broadway, New York City.
J. C. HORTON, Passenger Agent, 106 E. German Street, Baltimore, Md.
L. S. BROWN, General Agent Passenger Department, Washington, D. C.
J. H. WINGFIELD, Passenger Agent, Norfolk, Va.

S. H. HARDWICK, Assistant General Passenger Agent, Atlanta, Ga.
C. A. BENSCOTER, Assistant General Passenger Agent, Chattanooga, Tenn.
W. H. TAYLOE, Assistant General Passenger Agent, Louisville, Ky.

J. M. CULP, Traffic Manager. **W. A. TURK**, General Passenger Agent.

The Mutual Life Insurance Co.

OF NEW YORK,

RICHARD A. McCURDY, President,

Is the Largest Insurance Company in the World.

The Records of the Insurance Department of the State of New York SHOW THAT The Mutual Life

Has a Larger Premium Income - - -	($39,000,000)
More Insurance in Force - - - - -	($918,000,000)
A Greater Amount of Assets - - - -	($235,000,000)
A Larger Annual Interest Income - - -	($9,000,000)
Writes More New Business - - - -	($136,000,000)
And Pays More to Policy-holders - -	($25,000,000 in 1896)

THAN ANY OTHER COMPANY.

It has paid to Policy-holders since its organization, in 1843, - - $437,005,195.29

ROBERT A. GRANNISS, Vice-President.

WALTER R. GILLETTE, General Manager. FREDERIC CROMWELL, Treasurer.
ISAAC F. LLOYD, Second Vice-President. EMORY McCLINTOCK, Actuary.
WILLIAM J. EASTON, Secretary.

Burlington Route

TO

ST. PAUL
MINNEAPOLIS

BEST LINE
CHICAGO OR ST. LOUIS

Ripans Tabules cure headache.

The Fastest and Finest Train in the West . . . .

IS

UNION PACIFIC
THE OVERLAND ROUTE
WORLD'S PICTORIAL LINE

The Overland Limited

......TO......

UTAH and CALIFORNIA.

FROM 16 TO 20 HOURS
SAVED BY USING

"THE OVERLAND ROUTE."

Double Drawing-Room Pullman Sleepers.
Free Reclining Chair Cars.
Pullman Dining Cars.
Buffet Smoking and Library Cars.

Send for Descriptive Pamphlet "49-96,"
Folders and other Advertising Matter.
(Mention this publication.)

E. L. LOMAX,
General Passenger and Ticket Agent,
OMAHA, NEB.

THE CHICAGO, MILWAUKEE AND ST. PAUL RAILWAY

. . RUNS . .

Electric Lighted and Steam Heated Vestibuled Trains between **Chicago, Milwaukee, St. Paul and Minneapolis** daily.

Through Parlor Cars on day trains between **Chicago, St. Paul and Minneapolis.**

Electric Lighted and Steam Heated Vestibuled Trains between **Chicago and Omaha and Sioux City** daily.

Through Sleeping Cars, Free Reclining Chair Cars and Coaches between **Chicago and Kansas City, Mo.**

Only two hours from Chicago to Milwaukee. Seven fast trains each way, daily, with Parlor Car Service.

Solid trains between **Chicago** and principal points in **Northern Wisconsin** and the **Peninsula of Michigan.**

Through Trains with Palace Sleeping Cars, Free Reclining Chair Cars and Coaches between **Chicago** and points in **Iowa, Minnesota, Southern and Central Dakota.**

The **finest Dining Cars** in the World.

The **best Sleeping Cars. Electric Reading Lamps in Berths.**

The best and latest type of **private Compartment Cars, Free Reclining Chair Cars, and buffet Library Smoking Cars.**

Everything First=class. First-class People patronize First-class Lines.

Ticket Agents everywhere sell tickets over the Chicago, Milwaukee and St. Paul Ry.

GEO. H. HEAFFORD,
General Passenger Agent, Chicago, Ill.

WHENEVER YOU VISIT WASHINGTON . . .

YOU ARE INVITED TO INSPECT THE

* MAMMOTH DRY GOODS ESTABLISHMENT *

OF

WOODWARD & LOTHROP

Where the **LATEST PARIS NOVELTIES** are always on Exhibition.
The attention of those who anticipate purchasing . . . .

BRIDAL TROUSSEAUX

Is invited especially to extreme PARIS NOVELTIES in matched sets of French Hand-made Lingerie, including Gowns, Skirts, Chemises, Drawers, Corset Covers, &c. These can be furnished in any number of pieces desired. . . . .

HAND-MADE BRIDAL TROUSSEAUX, personally selected in Paris and exclusive in style and design: Three or more pieces . . . . **$10 to $250.**

CORRESPONDENCE SOLICITED. MAIL ORDERS RECEIVE PROMPT AND CAREFUL ATTENTION.

TENTH, ELEVENTH, AND F STREETS N. W. . . . . WASHINGTON, D. C.

Shortest Line
TO
St. Paul and Minneapolis
and the Northwest

CHICAGO
GREAT
WESTERN
RAILWAY

"Maple
Leaf
Route"

For tickets, rates or any detailed information apply to your home agent or write to

F. H. LORD,
Gen'l Pass'r and Ticket Agent,
CHICAGO.

A VITAL POINT

"IMPROVEMENT THE ORDER OF THE AGE."

A TYPEWRITER'S PRINTING MECHANISM

MUST BE SCIENTIFICALLY CONSTRUCTED. THIS POINT IS OF UTMOST IMPORT FOR

EASY OPERATION AND PERFECT EXECUTION.

The Smith.. Premier Typewriters

Superior on This Point as Well as on All Others.

ONLY CORRECT PRINCIPLES EMPLOYED.

The Smith Premier Typewriter Co.,
SYRACUSE, N. Y., U. S. A.

Catalogues and Information at Washington Office, No. 1416 F Street.

AN IMPROVED METHOD OF KEEPING THE SCORE IN

DUPLICATE WHIST, COMPASS WHIST, STRAIGHT WHIST AND EUCHRE.

Since Duplicate and Compass Whist have come into fashion there has been an unprecedented revival of interest in the game, due to the fact that mere *luck* is to a large extent eliminated by a comparison of the scores made in the play of the same hands by different players.

The one thing needed to perfect the new method has been a convenient device by means of which the score made on the first round can be concealed until after the replay of the hands, as a knowledge of the first score often enables a good player to make a decisive gain, and matches are lost and won on just such little chances.

A Washington player has at length invented and put upon the market at a very low price a little device which admirably answers the purpose, and at the same time serves as a pretty and useful table ornament, marker, and pencil rest. It is called the "COSMOS COUNTER," and consists of a little polished wood tablet with a metal keyboard that can be clamped down on the score in such a way as to bring 24 little metal plates over the 24 spaces in the "score" column of the card, for use in concealing each first score as soon as recorded and until the hand is replayed (in duplicate whist) or the entire series finished (in compass whist).

Whist players will at once see the advantage of this new method of keeping the score, as it effectually prevents their opponents at the same or another table from taking advantage, either by accident or design, of a knowledge of what the hand is capable. The trouble with duplicate whist, especially, is that the replay is liable to be influenced by memory of the cards and score, and anything that helps to confuse such recollection is a great gain to fair play.

The "Cosmos Score Card," prepared for use with the counter, shows several new features, such as a heading for both Duplicate and Compass Whist and (on the reverse) for Straight Whist, Euchre, &c., thus enabling the same counter and score to be used for any game of cards.

Cosmos Counters, with tablet of quartered oak, maple, or birch, and metal in either gold or silver finish, 50 cts. apiece; 6 for $2.75; 12 for $5; by mail, 4 cts. apiece extra. Cosmos Score Cards, 25 cts. per package of 50; 12 packages for $2.50; by mail free of postage.

Ask to see samples at any stationer's, or order direct from the General Agents.

Cosmos Duplicate Whist Score

N .... E ....

S .... W ....

HAND	COMPASS WHIST					HAND
	SCORE	TOTALS	TRUMP	OPPONENTS		
	DUPLICATE WHIST					
	SCORE	GAIN	TRUMP	GAIN	SCORE	
1						1
2						2
3						3
4						4
5						5
6						6
7						7
8						8
9						9
10						10
11						11
12						12
13						13
14						14
15						15
16						16
17						17
18						18
19						19
20						20
21						21
22						22
23						23
24						24
TOTALS						TOTALS

Copyright, 1895, by Everett Hayden, Washington, D. C. For use with the Cosmos Duplicate Whist Counter, patented July 7, 1896.

...., 189......

E. MORRISON PAPER CO., 1009 Penna. Avenue, Washington, D. C.

NATIONAL GEOGRAPHIC MONOGRAPHS

On the Physical Features of the Earth's Surface, designed especially to supply to teachers and students of geography fresh and interesting material with which to supplement the regular text-book.

LIST OF MONOGRAPHS COMPRISING VOLUME I:

General Physiographic Processes	J. W. Powell
General Physiographic Features	J. W. Powell
Physiographic Regions of the United States	J. W. Powell
Beaches and Tidal Marshes of the Atlantic Coast	Prof. N. S. Shaler
Present and Extinct Lakes of Nevada	Prof. I. C. Russell
Appalachian Mountains—Northern Section	Bailey Willis
Appalachian Mountains—Southern Section	C. Willard Hayes
Mt. Shasta—A Typical Extinct Volcano	J. S. Diller
The New England Plateau	Prof. W. M. Davis
Niagara Falls and Its History	G. K. Gilbert

Price for one set of ten monographs, **$1.50**. Five sets to one address, **$6.00**. Single monographs, **20c.**

Remit with order to AMERICAN BOOK COMPANY,

New York - Cincinnati - Chicago

Ripans Tabules assist digestion.

TERRESTRIAL MAGNETISM

An International Quarterly Journal

Edited by L. A. BAUER
With the Co-operation of Eminent Magneticians

With the March, 1897, issue, this Journal, devoted exclusively to Terrestrial Magnetism and allied subjects, such as Earth Currents, Auroras, Atmospheric Electricity, etc., entered on its second volume. The hearty co-operation extended by the workers in this promising field of investigation, as abundantly shown by the numbers thus far issued, has made this Journal the international organ for making known the latest achievements. The magnetic needle has become such a promising instrument of research, not only in terrestrial, but in cosmical physics, that this Journal appeals to a large class of investigators. The geographer, the geologist, the astronomer, the meteorologist—all are interested in the development of the subject of terrestrial magnetism. It should therefore receive their support.

Among the contributors of the main articles in the past have been Messrs. Barus, Börgen, Chree, Eschenhagen, Littlehales, Rücker, Schmidt, Schuster, and de Tillo.

Future numbers will contain:

"The Earth, a Great Magnet,"
By Dr. J. A. Fleming.

"The Electrification of the Atmosphere,"
By Prof. Alexander McAdie.

"The Height of the Aurora,"
By Prof. Cleveland Abbe.

"The Distribution of Magnetic Observatories,"
(Illustrated),
By Prof. Max Eschenhagen,
etc., etc.

The size of the Journal is royal octavo, a volume embracing about 200 pages. Domestic subscription price: **Two dollars**; single numbers, **fifty cents**. Foreign subscription price: **Nine shillings, nine marks, or eleven francs.** Address:

TERRESTRIAL MAGNETISM,
The University of Cincinnati, Cincinnati, Ohio.

PEOPLE like to read about the great and wonderful country of the **Southwest**; of its quaint and curious towns, its ancient civilizations, its natural marvels. They like to get accurate information about **California and the Pacific Coast.** This is because most people want to some day see these things for themselves. . . . .

A charming book covering these facts is issued by the

PASSENGER DEPARTMENT

OF THE

Southern Pacific Railway,

and will be sent to any one, postpaid, on receipt of **TEN CENTS.**

THE BOOK IS ENTITLED

"Through Storyland to Sunset Seas,"

AND IS A WONDERFULLY HANDSOME VOLUME OF **205** PAGES, WITH **160** ILLUSTRATIONS. . . .

The paper used is FINE PLATE PAPER, and every typographical detail is artistic. It is a story of what four people saw on just such a trip as you would like to make. . . . .

You can get a copy by writing to

S. F. B. MORSE,

General Passenger Agent,

Southern Pacific,

New Orleans,

and sending **10 cts.** to defray postage.

How a Donkey Found a Mine.

THE history of mine discoveries in the West is full of strange and amusing incidents. Many of the most celebrated mines or ledges have been found by accident. Some of these accidental discoveries are laughable in the extreme. One of them occurred in connection with the discovery of one of the richest mines in the Cœur d'Aléne country in Idaho. In this case a common donkey, or jackass, or "burro," as one chooses to term it, was credited with the finding of the mine.

The Northern Pacific Railway's finely illustrated tourist book, **Wonderland '97,** has a chapter on mining in the West, in which the incident alluded to is given. It shows how, from slight or trivial things, great results may flow. There are also articles on **Yellowstone Park, Alaska, Cattle Raising,** etc. By sending Six Cents in postage stamps to CHAS. S. FEE, Gen. Pass. Agent, St. Paul, Minn., any one can obtain a copy of this book. It is full of historical fact and descriptive narrative, and valuable as a school text-book.

SOUTHERN RAILWAY

GREATEST SOUTHERN SYSTEM.

Penetrates with its main line or branches eight States South of the Ohio and Mississippi Rivers, and in conjunction with its friendly allied connections reaches all the commercial centers of the South and Southwest . . .

DOUBLE DAILY VESTIBULED LIMITED TRAINS

. . . BETWEEN . . .

Washington and Nashville via Salisbury, Asheville, Knoxville and Chattanooga.
Washington and Tampa via Columbia, Savannah and Jacksonville.
Washington and Memphis via Atlanta, Birmingham and K. C. M. & B.
Washington and New Orleans via Atlanta, Montgomery and Mobile.
Norfolk and Chattanooga via Salisbury, Asheville and Knoxville.

Pullman Sleeping Cars—Dining Cars—Day Coaches.
Additional Trains for local travelers . . . .

The direct line to the Winter Resorts of { FLORIDA, GULF COAST and TEXAS, ... MEXICO and CALIFORNIA,

—AND THE BEST—

Through Car Line to and from Asheville and Hot Springs—"The Land of the Sky."

Write for Map Folders.

R. W. POLLOCK, General Agent, 271 Broadway, New York City.
J. C. HORTON, Passenger Agent, 106 E. German Street, Baltimore, Md.
L. S. BROWN, General Agent Passenger Department, Washington, D. C.
J. H. WINGFIELD, Passenger Agent, Norfolk, Va.

S. H. HARDWICK, Assistant General Passenger Agent, Atlanta, Ga.
C. A. BENSCOTER, Assistant General Passenger Agent, Chattanooga, Tenn.
W. H. TAYLOE, Assistant General Passenger Agent, Louisville, Ky.

J. M. CULP, Traffic Manager. W. A. TURK, General Passenger Agent

---

The Mutual Life Insurance Co.

OF NEW YORK,

RICHARD A. McCURDY, President,

Is the Largest Insurance Company in the World.

The Records of the Insurance Department of the State of New York SHOW THAT The Mutual Life

Has a Larger Premium Income - - -	($39,000,000)
More Insurance in Force - - - - -	($918,000,000)
A Greater Amount of Assets - - - -	($235,000,000)
A Larger Annual Interest Income - - -	($9,000,000)
Writes More New Business - - - -	($136,000,000)
And Pays More to Policy-holders - -	($25,000,000 in 1896)

THAN ANY OTHER COMPANY.

It has paid to Policy-holders since its organization, in 1843, - - $437,005,195.29

ROBERT A. GRANNISS, Vice-President.

WALTER R. GILLETTE, General Manager. FREDERIC CROMWELL, Treasurer.
ISAAC F. LLOYD, Second Vice-President. EMORY McCLINTOCK, Actuary.
WILLIAM J. EASTON, Secretary.

JUDD & DETWEILER, PRINTERS, WASHINGTON, D. C.

Vol. VIII NOVEMBER, 1897 No. 11

The National Geographic Magazine

AN ILLUSTRATED MONTHLY

Editor: JOHN HYDE

Associate Editors

A. W. GREELY W J McGEE HENRY GANNETT
C. HART MERRIAM ELIZA RUHAMAH SCIDMORE

CONTENTS

WASHINGTON
PUBLISHED BY THE NATIONAL GEOGRAPHIC SOCIETY

Agents in the United States and Canada
The American News Company, 39 and 41 Chambers Street, New York
Paris: Brentano's, 37 Avenue de l'Opera

Price 25 Cents $2.50 a Year

Entered at the Post-office in Washington, D. C., as Second-class Mail Matter.

THE

National Geographic Society

ORGANIZED, JANUARY, 1888

President

GARDINER G. HUBBARD

Vice-Presidents

MARCUS BAKER
WILLIAM H. DALL
G. K. GILBERT
A. W. GREELY
C. HART MERRIAM
HERBERT G. OGDEN

Treasurer

HENRY GANNETT

Recording Secretary

EVERETT HAYDEN

Corresponding Secretary

ELIZA RUHAMAH SCIDMORE

Managers

CHARLES J. BELL
H. F. BLOUNT
F. V. COVILLE
DAVID T. DAY
JOHN HYDE
W J McGEE
F. H. NEWELL
W. B. POWELL

SECRETARY'S OFFICE, 1517 H STREET N. W., WASHINGTON

The National Geographic Society, the object of which is the increase and diffusion of geographic knowledge, has a paying membership of 1,400. Its membership is not restricted to practical geographers, but is open to any person in good standing who may be sufficiently interested in its work to seek admission. The annual subscription is: for active members, $5.00 per annum; for corresponding members, $2.00 per annum. Active members pay also an entrance fee of $2.00 on election. The National Geographic Magazine is sent regularly to all members, both active and corresponding.

Donations for the founding of Prize Medals and Scholarships are respectfully solicited.

MAYER GLACIER, HEAD OF MAYER RIVER, CORDILLERAS, PATAGONIA

From a Photograph by J. B. Hatcher

THE

National Geographic Magazine

Vol. VIII NOVEMBER, 1897 No. 11

PATAGONIA

By J. B. Hatcher,

Of Princeton University

Patagonia (from the Spanish *patagon*, a large or clumsy foot) is the name commonly applied to that portion of South America lying between Rio Negro on the north and the Strait of Magellan on the south, and embraced by the Atlantic and Pacific oceans. It thus has an extent from north to south of about 1,000 miles and a maximum breadth of nearly 500 miles. The name dates from 1520, when Magellan, on his voyage around the world, observing near his winter quarters at San Julian certain large human footsteps (patagones) gave that name to the country.

Although Spanish settlements were founded at San Felipe and at other places in Patagonia as early as 1579, more than forty years before the landing of the Pilgrims at Plymouth Rock, yet it is still a very sparsely settled and little known country, especially throughout the interior of the central region. With the exception of the settlements along Rio Negro and the Welsh colonies on the river Chubut, there are no important settlements in the interior, and in the country lying to the south of the latter stream the entire settlements are confined to a few sheep farms scattered along the eastern coast from Port Desire to Sandy Point (Punta Arenas) in the Strait of Magellan. On the western coast there are a few unimportant settlements at Otway Station and Skiring Water in the extreme south; while on the north most of the settlements are confined to Chiloe and the other larger islands. The western coast of the mainland and most of the interior is inhabited only by roving bands of Indians, which in the former region include closely related tribes of Canoe or Channel Indians who live almost entirely in small open boats of native design, constructed with considerable skill from large pieces of bark, either from the antarctic deciduous beech (*Fagus antarctica*) or from the evergreen beech (*F. betuloides*), sewn together with sinew or flexible whalebone. The latter is thrown up in considerable quantities along the shores of this coast. At present the Indians are usually clothed with bits of cheap calico fashioned into rude garments, that of the women resembling loose skirts suspended from the shoulders and usually extending somewhat below the knees. While for the most part the men and women are at present clothed with some sort of cloth, usually obtained by barter from the whites, yet examples are not entirely wanting of individuals still clinging, through choice or necessity, to that more primitive state in which a narrow girth about the loins is deemed sufficient, with sometimes the addition of a piece of seal skin held above by a single thong passing around the neck and over the shoulders, and below by another about the body, so that it may be readily shifted to any desired position according to the direction of the wind. These Indians feed almost exclusively upon shell-fish which they are able to pick up along the shore, while the remains of an occasional seal or sea-otter cast up by the waves, or the same animals taken alive with their spears, serve to vary their diet. Perhaps in no other people in the world are the actual necessities of life reduced to so few as among the Channel Indians of this region. With no constant habitation, they move about from one sheltered cove to another, so that their occupation of any particular place is entirely dependent upon, first, the abundance of the mollusks upon which they live, and, second (when these are well-nigh exhausted), upon the condition of the weather. On a few earthen sods in the bottom of their canoes they keep constantly burning a small fire, which always seems just on the point of going out; and over this they all bend when not engaged in collecting the animals for food, which they usually eat uncooked and without other preliminary preparation. For their shelter on land, notwithstanding the inclement weather that prevails almost continuously, they erect exceedingly inefficient and primitive structures consisting of only a few branches of trees, the lower ends of which are stuck in the ground in an almost complete circle, while the upper ends are carelessly thatched together, thus forming a sort of low, conical " wickiup " with an opening on one side. These, together with their canoes, two small paddles with which the latter are propelled, one or two spears or harpoons made of bone for the capture of seals, and one or more rather well formed vessels made of rushes and usually of the capacity of about a gallon (used in gathering shell-fish), fulfill all their domestic requirements. Notwithstanding the exceedingly primitive manner in which they live, it is evident from the great accumulation of shell heaps in many places periodically occupied by them that they have inhabited this region for a considerable period, during which little if any alteration has taken place in their habits and customs.

TEHUELCHE BOY OF 16 YEARS

From a Photograph by J. B. Hatcher

The Indian tribes east of the Cordilleras are of Tehuelche or Araucanian stock, and in general appearance, habits, and customs they are quite different from and far superior to those of the western coast. Perhaps as a race no people in the world are better developed physically than are the Tehuelches of southern and eastern Patagonia. While their size has been considerably exaggerated by many of the earlier travelers, yet the fact remains that they are a large and physically well-developed race. The men have an average height of about five feet ten inches and the women of about five feet six inches. In both sexes the body is well formed, and while the features are without doubt far less striking than are those of certain of our tribes of Indians, yet their countenances are usually such as to inspire confidence in their peaceful intentions and to allay feelings of uneasiness in the mind of the traveler who may be unwillingly thrown among them. In the construction of their "toldos" or tents they have advanced one step at least over that shown by many nomadic tribes living in North America or elsewhere, in that while having no permanent residences, they are nevertheless not entirely dependent upon the resources of the immediate vicinity in which they happen to locate for materials with which to construct their shelters, for they always carry with them a covering usually made of skins stitched firmly together in such a manner as to fit more or less precisely a framework of poles also carried for the purpose. With some tribes of North American Indians these easily transportable habitations are known as "tipis," the frame of which consists of a series of long poles arranged in a large circle at the base and meeting above, where they interlock in such manner as to afford mutual support, and on the outside of which the covering, formerly made of skins but now usually made of canvas, is stretched, thus forming a perfect cone when closed. In all such habitations among our North American Indians, so far as I am aware, this entire inclosure is unobstructed by partitions, and no attempt is made to divide the interior into separate compartments so as to afford a certain degree of privacy to individual members of the family.

The toldos or tents of the Tehuelches are each usually composed of the skins of about fifty adult guanacos sewed together in sections, which, when fitted together, are so designed as to form the top, one side, and both ends of a huge box, one side of which is much higher than the other and is left open. The framework of this box consists of three parallel rows of poles, forked above, planted in the ground at a distance of about four feet from each other in the direction of the length of the box and six feet in the opposite direction. The poles forming the first row or that on the open side of the toldo are usually about seven feet in height, in the next row, running through the middle of the interior, they are about five feet high, while three feet suffices for the series at the rear. In the forks of these uprights poles are laid, and over the whole the skin covering is stretched. These toldos are usually about twenty feet long by twelve feet in width. That portion of the interior between the two higher series of uprights may be considered as the living room, while in the rear small partitions extend from each of the posts in the third row to the opposite one in the middle row, thus dividing this space into a series of sleeping compartments from four to six feet in width, and sufficient to accommodate one or two persons. I think this condition of affairs should be regarded as a decided advance over that found in other tribes with transportable habitations, and that it has had a decidedly beneficial influence upon the social relations of the Tehuelches I do not doubt. That we have here represented three stages in that development which has

TEHUELCHE FAMILY AND TOLDO

From a Photograph by J. B. Hatcher

led up to the nineteenth century dwelling with all modern conveniences can hardly be doubted. Most primitive of the three is that of the Channel Indian, who once in each week or two throughout his entire life spends perhaps half an hour in gathering the branches to construct the rude "wickiup" which forms his ideal of a domestic habitation.

The Tehuelches of southern Patagonia are almost entirely unacquainted with the use of firearms, but they have an abundance of horses and dogs, by the aid of which, together with their bolledoros (bolas) they are able to capture guanacos and ostriches more than sufficient to supply them with food. From the skins of these, together with those of other animals, they construct the coverings for their toldos, make their clothing and bedding, and have sufficient left with which to manufacture the beautiful fur "capos" or mantles so highly prized by the Europeans. For the latter they consequently find a ready sale, from the proceeds of which they derive a revenue ample for the purchase of considerable quantities of "wachaki," which those better qualified than myself to judge consider as very bad whisky. Perhaps to some there will be a satisfaction in the reflection that "bad whisky, sooner or later, makes good Indians."

The surface of Patagonia is naturally divided by physiographic features into two regions—an eastern comparatively level plains region and an extremely mountainous western region. The latter extends in a narrow strip throughout the entire length of Patagonia and exhibits everywhere intensely rugged mountains, clad at their bases with luxuriant forests, while their summits are forever covered with great fields of snow and ice, which form glaciers often descending far below timber-line and constituting the sources of many of the numerous mountain torrents emptying into the Pacific, as well as most of the larger rivers of the eastern region, which after emerging from the mountains follow deeply eroded valleys in the plains and discharge their waters into the Atlantic.

Politically Patagonia is divided into essentially the same districts as physiographically. The western or mountainous region belongs to Chile and is mostly included in the territory of Magellan, with the seat of government at Punta Arenas. The eastern or plains region belongs to Argentina and consists of the territories of Santa Cruz, Chubut, Rio Negro, and a part of Neuquen.

To the absence of exact knowledge regarding the real physical features of this region is due the vexatious boundary dispute at present existing between Argentina and Chile. Formerly the loftier ranges of the Cordilleras were supposed to form the natural watershed of this entire region, and in the earlier boundary treaties negotiated between the two countries it was stated that a line connecting the highest peaks which divide the waters of the Pacific from those of the Atlantic should constitute the national boundary line. It has since been ascertained that in many instances, at least, streams flowing into the Pacific cut entirely through the Cordilleras, and in some cases have their

MAP OF PATAGONIA, ILLUSTRATING EXPLORATIONS OF J. B. HATCHER, 1896–'97 sources well out on the plains; so that, were former boundary treaties interpreted literally, much territory supposed to be of considerable value mineralogically and extensive tracts of rich grazing lands, all now held by Argentina, would revert to Chile. Not only has there never been any attempt at a topographic survey of the country, but throughout vast areas over the plains region of central Patagonia the watercourses as located on all the government and current charts are merely conjectural, while in the region between Lake San Martin and the territory of Neuquen no authentic map showing the locations of the principal streams flowing toward either the Atlantic or the Pacific has ever been attempted.

That part of this region which was visited and traversed by the writer and his assistant, Mr O. A. Peterson, during recent explorations in behalf of Princeton University and the Bureau of American Ethnology, and especially noticed in this paper, lies between the headwaters of Rio Chico and Rio Santa Cruz and the Strait of Magellan. The principal overland route will be found located on the map. From different points along this route shorter excursions were made in all directions.

The plains region of Patagonia may be considered as consisting of a series of benches or steps which appear as successive elevations on the surface as one proceeds from the Atlantic coast overland toward the Cordilleras. The precipitous bluffs of the coast, rising in places to a height of nearly five hundred feet, form the first step in the series, and from this the succeeding benches gradually increase in elevation until along the base of the mountains an altitude, according to Darwin, of 3,000 feet is attained. The escarpments constituting the limits of each of these succeeding benches form irregular but somewhat parallel lines, which conform not only to the general direction of the present coast-line, but also to the courses of the great transverse valleys at the bottom of which flow the larger rivers of eastern Patagonia. This series of benches or steps may be seen not only as one proceeds from the coast toward the interior of Patagonia, but also on either the one or the other side, sometimes on both, of all the greater watercourses of this region distant from the coast and near the mountains. They doubtless represent succeeding bluffs formed along the coast, and mark successive stages in the final elevation of this region which took place toward the close of the Pliocene period. The occurrence of this series of benches along the sides of the river valleys of this region is

SIERRA VENTANA, SOUTH SIDE OF RIO CHICO DE SANTA CRUZ, PATAGONIA

From a Photograph by J. B. Hatcher

additional evidence in favor of my view * that the great transverse valleys of Patagonia were in existence prior to the last submergence of this region in the Pliocene, and during which submergence the marine Cape Fairweather beds were deposited. During the elevation that caused the close of this submergence there was distributed over this region the great Bowlder or Shingle formation (Tehuelche formation of Ameghino) of Patagonia. These benches along the watercourses are not merely river terraces formed of alluvial materials, but are composed of the original strata constituting the Santa Cruz, Supra-Patagonian, and Patagonian beds, as shown in numerous exposures. They are often many miles in width, and I think show conclusively that throughout certain periods during the elevation of this region these valleys formed deep embayments into which extended the waters of the Atlantic. Some of the more important of these valleys may even have formed straits connecting the Pacific and Atlantic oceans, as has been claimed by Darwin.

Another prominent feature over the Patagonian plains is the occurrence of numerous volcanic cones, appearing usually in groups and at places remote from the Cordilleras. These craters, although now extinct, have been active during comparatively recent times, as is evidenced by the numerous small lava streams to be found in many places, and which are seen to have flowed directly from some one of these craters down over the sides and into the valleys of the present smaller watercourses, where they have adapted themselves to the curves of the valleys and the inequalities in the surface of the bottoms of the latter, and do not extend into strata forming the sides of the valleys. Such lava streams of comparatively recent origin always present an irregular, hummocky surface, with numerous caverns, and are composed almost always of very vesicular material. A splendid example of such a lava stream may be seen in a small cañon on the southern side of the Rio Chico of the Gallegos river about two miles below Palli Aike, near the point where the present national boundary line crosses the Chico. Probably these small volcanoes were active throughout a considerable period in Tertiary times, and largely furnished the materials of the Santa Cruz beds. That they were active during the depositions of the Santa Cruz beds is evidenced by the occurrence of lavas included between successive strata of those beds, which, owing to the absence of disturbance in the latter, can hardly be considered as intrusive.

* See "On the Geology of Southern Patagonia," Am. Jour. Sci., Nov., 1897, pp. 327-354.

These extinct volcanoes are scattered over the plains in a not entirely irregular manner. As before stated, they occur in groups, there being usually from three or four to as many as a dozen in each group within a radius of perhaps five miles. These crater areas occur at irregular intervals on the plains of Patagonia from near Cape Virgin at the eastern entrance to the Strait of Magellan to as far north as the country visited by us, at least, and most likely for a considerably greater distance. For the most part, they are found over an area extending parallel with the Cordilleras and distant from eighty to one hundred and twenty miles from them. In places they rise but a few feet above the surface of the surrounding country, and some of these may not be craters, but simply elevations in the surface of the lava due to a heaping up of the materials resulting from the intersection of two or more streams while flowing. In many cases they rise several hundred feet above the surrounding country, have immense craters or bowls on their summits, and present unmistakable evidences of having been active volcanoes within comparatively recent times.

Whether these craters should be considered as lateral cones dependent upon the greater volcanoes of the Cordilleras and as having derived their molten materials from the same reservoir, or as an independent system the materials of which were derived from a distinct reservoir, it is difficult to say. From the similarity of the basalts known to occur in the two regions, however, I should be inclined to the former view. Between this series of volcanoes and the Cordilleras, especially in the region lying south of Santa Cruz river, there are wide, open plains, entirely unobstructed by either extinct volcanoes or lava fields.

Another interesting feature prominent in the topography of Patagonia, especially in that part of the country lying east of the crater region, is the occurrence of numerous shallow salt lagoons at the bottoms of great depressions, or rather excavations, from 100 to 300 feet or more in depth, scattered over the surface of the plains. I have described these lakes and discussed their origin in a previous paper already cited on the geology of the region.

At a distance of ten or twenty miles from the Cordilleras the shingle or bowlder formation increases greatly in thickness and is composed of much coarser materials. Near the base of the mountains the materials constituting this formation are not distributed in a uniform manner over the surface, so that the latter loses its level, plain-like appearance, and presents numerous small, rounded hillocks composed of heterogeneous masses of angular stones, rounded bowlders, and finer clays and sands. These materials were evidently deposited as terminal moraines in late Pliocene or early Quaternary times. Such deposits are especially noticeable in all the larger valleys near the Cordilleras, where they are frequently of great thickness, and, left as barriers by the receding glaciers, they now aid in confining considerable bodies of fresh water, which as lakes extend in a more or less continuous chain all along the base of the mountains. Among the more important of these are lakes Argentina, Viedma, San Martin, and Buenos Aires. All these lakes extend far back into

MOUNT LEVIATHAN: SOUTH COAST OF TIERRA DEL FUEGO

From a Photograph by J. B. Hatcher

the otherwise almost inaccessible recesses of the Cordilleras, where they are fed by numerous glaciers. None of the lakes have been thoroughly explored and mapped, and their exact size and shape are as yet undetermined.

There are no more rugged mountains anywhere in the world than are the Cordilleras of Patagonia. They rise directly from the plains on the east and the sea on the west to a height in some places of more than 10,000 feet, and present myriads of inaccessible peaks without so much as a single practicable pass, so far as has yet been discovered, for more than a thousand miles. On the west they are invaded by a labyrinth of bays, channels, sounds, and inland watercourses which for beauty and intricacy are unsurpassed and probably unequaled on any other coast.

The intensely rugged nature of these mountains and of the Pacific coast is doubtless largely due to the comparatively recent age of the former, for from the highly inclined position of the Miocene strata (Supra-Patagonian beds) all along the eastern base of the mountains it is evident that while the actual birth of the latter may have taken place during Mesozoic times, yet their greatest development was not accomplished until the Miocene, and hence they now present numerous sharp peaks, bold lines, and rigid angles, which the eroding elements in nature have not yet had sufficient time to soften; yet it cannot be said that they do not harmonize well with their surroundings, for only that which is rugged in the extreme could comport with the perpetual storms which forever rage about the summits and the terrific onslaughts of waves that constantly attack the bases. Nature always produces most perfect harmony; and as these lofty peaks are lowered and their sharp angles rounded by erosion, just so will the causes of the truly terrible storms that now prevail here be removed and equally harmonious conditions preserved, perhaps even more pleasing, if not so startling, increasing in beauty, like the splendid canvas or mural painting, as the brighter and more vivid colors are gradually softened with age.

According to its flora, Patagonia may be divided into three regions, characterized not so much by differences in species represented (for one of these regions may be fairly considered as furnishing all the species of plants found in the other two) as by the quantity and quality of the vegetation. The first of these may be designated as the eastern coast region, and consists of a narrow belt of fairly good grazing lands, extending along the coast from the Strait of Magellan to Port Desire. All the available land is here taken up by sheep farmers, mostly from the Falkland islands and Scotland, with a few English, Germans, French, Spaniards, and native Argentinians and Chilinos. The second region consists of almost barren high pampas and usually equally barren river valleys. It extends from the western border of the first region to the base of the Cordilleras, and is entirely uninhabited, so that while the vegetation is indeed exceedingly scanty it nevertheless suffices for the support of considerable bands of the guanaco and the rhea, the so-called ostrich of South

GUER AIKE: A PATAGONIAN SHEEP FARM — TYPICAL VIEW OF THE PAMPAS

From a Photograph by J. B. Hatcher

America. The third region is that of the Cordilleras, and is far richer than the other two, both as to species and in the total amount of vegetation.

Throughout the first two regions trees are unknown, the vegetation consisting entirely of grasses, herbs, and a few small shrubs, never attaining a height of more than a few feet. Among the more common of these shrubs are two small resinous evergreens with a decided odor of pitch. They belong to different families, and are distinguished by the inhabitants according to the color of the foliage as "mate verde" and "mate negra;" they form the "South American tea," which is largely used in Patagonia and elsewhere. A species of *Berberis* ("Calafate") with bright yellow flowers and dark-purple, rather tart, edible fruit is common everywhere, while along the watercourses far in the interior the incense bush and a species of leguminous shrub, often attaining a height of five or six feet, are not uncommon. The dead trunks and branches of these shrubs provide sufficient fuel for the traveler in Patagonia.

In the Cordilleras forests abound, consisting for the most part of two species of beech (*Fagus antarctica* and *F. betuloides*), the winter's bark (*Drimys winteri*), and toward the north a few species of conifers. On the eastern slopes of the mountains the vegetation is not nearly so varied as on the western, and in many places over vast areas only one species of tree is to be found, viz., *Fagus antarctica*, the deciduous beech. This condition prevails especially about the headwaters of Rio Chico and Rio Santa Cruz, and on all the upper tributaries of Mayer river, a stream of no mean size which we discovered in this region flowing to the Pacific, and named in honor of General Edelmiro Mayer, the late governor of the territory of Santa Cruz.

Throughout all the forests of the Cordilleras mosses, hepaticas, ferns, and lichens occur in the greatest profusion. The stones, trunks of fallen trees, the bases of those still standing, and even the ground itself, are often covered to a depth of several inches with these plants, forming a soft carpet of rich colors exceedingly pleasing to the eye, and surpassing in beauty any exhibition of foliage plants, if I may so call them, that I have ever seen.

The faunas of the plains and mountain regions differ more widely than do the floras, for in each are found species wanting in the other. The most striking and most abundant mammals met with over the plains are the guanaco (*Auchenia huanacus*) and two species of dogs, sometimes erroneously called foxes

(*Canis azaræ* and *C. magellanicus*). The former speciés is much the smaller, is of a light gray color with a black spot at the base of the tail, and is quite tame and exceedingly common everywhere on the plains. The second and much larger species is rather shy, and is found only in the mountains. The puma or mountain lion (*Felis concolor*) is abundant, while a smaller cat, perhaps some species of lynx, is not uncommon. A small skunk (*Mephitis patagonica*) was formerly abundant, but a few years since they were almost exterminated in one winter over a large area along the southern coast by some disease, apparently contagious, among them. Their skulls and skeletons are now to be picked up in great numbers, and occasionally a live specimen is still met with. Only one species of armadillo is at all common in the region visited by us, and it does not extend south of Santa Cruz river. Deer are absent on the plains, but one species is fairly abundant in the mountains. It is about the size of our Virginia deer, of a rich dark-gold color, the males armed with a pair of two-pronged horns. I killed about fifteen of these animals and saw several others, but never observed one with more than two points on each horn. We nowhere observed the larger species of deer said to be abundant in the Cordilleras farther northward.

Rodents are extremely abundant, especially in the valleys and along the bluffs of the rivers and smaller streams in the vicinity of the mountains, where the entire earth for a depth of nearly two feet is literally undermined over areas of many square miles in extent, with subterranean passages which greatly impede the traveler, whose horse drops in at every step half-way to the knee. In some regions so abundant are these burrowing rodents, especially in the sides of the bluffs, that they become real and not inconsiderable agents of erosion. That they have aided considerably in producing many of the present topographic features I do not in the least doubt, not so much by the actual removal of material as by the production of a condition throughout the surface of the soil and rock such as to render it more easy of being removed by recurring rains. Among those rodents contributing most to the facility with which the bluffs are here being eroded are various species of mice, and especially two species of *Ctenomys*, whose ability and propensity for burrowing can scarcely be overestimated. Formerly rodents were very abundant all along the coast, but since the introduction of sheep some ten years ago they have disappeared almost entirely from the coast region, and the larger species are now rarely seen there.

There is a considerable variety of birds in Patagonia. Water-fowl are especially abundant, as are also birds of prey. I presume that the number of hawks and vultures is scarcely exceeded in any district of equal area elsewhere in the world. Several species of plover, grouse, and snipe are to be found on the pampas, while thrushes, wrens, and sparrows are well represented. Condors are plentiful, not only in the Cordilleras, but also along the more precipitous river bluffs and in the lofty "barrancas" of the coast of the Atlantic as far northward as Port Desire. The rhea, or so-called ostrich, is abundant on the plains, and is occasionally met with in the mountains. Beautifully colored red and black flamingoes and swans are among the more striking inland wading and swimming birds. In the Cordilleras a small green paroquet is very abundant. Several species of fly-catchers are plentiful, while two woodpeckers and two or three thrushes are common. A jacksnipe occurs about the open streams and parks, and five species of owl were taken.

Of fresh-water fishes there does not appear to be a great variety, but we succeeded in finding some of the streams fairly well stocked with two or three species of splendid edible varieties. Sand lizards are seen in great numbers, and present many different colors and vary considerably in shape, especially in the length of the tail. Frogs are present, though rare, but we never saw a snake of any description. Of insects, the Coleoptera seemed best represented. Butterflies were represented by but few species, those usually of the less conspicuous varieties. Dragon-flies are rare. There are considerable varieties of ants, but bees, wasps, and other Hymenoptera are not abundant.

HATCHER'S WORK IN PATAGONIA

On February 29, 1896, Mr J. B. Hatcher, of Princeton, embarked for Buenos Aires, primarily to collect vertebrate fossils and recent organisms in Patagonia for Princeton University, incidentally to obtain photographs and other data pertaining to the aborigines for the Bureau of American Ethnology. He bore letters from both institutions, those from the latter securing him official recognition in Argentina; and during his stay he received every courtesy, as well as most material assistance, from the government of this rapidly growing republic. The success of his work was largely due to these official facilities and to the good offices of ex-Minister Estanislao Zeballos, one of the few honorary members of the National Geographic Society.

From Buenos Aires Mr Hatcher proceeded to Gallegos, the seat of government of the province of Santa Cruz, a future empire of half the area of all Germany, with a population of only about 1,600, including 300 Indians. Outfitting here with a light tent, five horses, and a small cart, Mr Hatcher, accompanied by a single assistant (Mr O. A. Peterson, of Princeton), traversed the coast to Punta Arenas, making extensive collections in paleontology and natural history. Punta Arenas, long an unimportant station, became the center of immigration a few years ago in consequence of discoveries of gold; it is now the capital of the Chilean territory of Magellan, with a population of about 3,400; the entire territory supports a population of some 6,000, including about 800 Indians. Returning to Gallegos, Mr Hatcher and his companion set out toward the Cordillera (or southern Andes) on December 1, 1896, and from that date until April 6, 1897, they saw no human beings save themselves. They journeyed first westward and then northwestward to Rio Santa Cruz, one of the principal rivers of Patagonia. Finding this too large for fording, they followed its banks to the great body of fresh water (Lake Argentina) in which it heads; there they were so fortunate as to find a boat, abandoned by English explorers several years before, which they appropriated and repaired, and in which they ferried their cart and baggage over the stream, swimming their horses behind. Journeying northward near the base of the Cordillera, they discovered, among other new geographic features, a river fully equal to the Santa Cruz in volume, occupying a most unexpected position. It heads in the pampas east of the Cordillera, but flows westward through a profound gorge and undoubtedly falls into the Pacific at some undetermined portion of the rugged Chilean coast. It is fed by glaciers, often of noble magnitude; it is swift and tumultuous, so that it was found impracticable to cross it, or indeed to trace its course, with the facilities at command, more than a part of the way through the cañon in which it traverses the Cordillera. Several weeks were spent in work about this portion of the Cordilleran front. They were not without the incidents common to exploration of uninhabited countries. Sometimes these were of serious character. In one case Mr Hatcher, while separated from his companion, was accidentally struck on the head by the metallic bit of his horse's bridle and so seriously wounded that the horse escaped, leaving him alone and helpless on the pampas for two days and two nights. He recovered sufficiently to rejoin his companion, but the wound and exposure produced erysipelas, by which he was incapacitated for weeks. The difficulty of travel was greatly enhanced by the nearly uniform foulness of the weather; cold, drizzling rains and dense fogs are characteristic of Patagonia, with temperature but little above the freezing point for months at a time. Fortunately game was easily taken, and supplied the chief part of the camp fare.

Returning from the trip into the interior, Mr Hatcher, with his companion, made a voyage through the Strait of Magellan and about Tierra del Fuego, in the course of which many new observations were made on the natural history, geology, paleontology, and ethnology of the region. The various routes traversed are indicated on Mr Hatcher's map, through which an idea of the extent of the journeys may be gained. He returned to Princeton in July, 1897.

As indicated by his article, Mr Hatcher's energies were by no means limited to the collection of specimens; indeed, he utilized his opportunities for geographic, geologic, and ethnologic study in a notably successful manner. The geographic results are stated summarily, though with excess of modesty, in the paragraphs prepared for this magazine, while the preliminary results of the geologic and paleontologic researches appear in several articles in the *American Journal of Science* and the *American Geologist*.

Certain features of southern South America brought out through Mr Hatcher's observations are especially significant to students of geographic development. One of the characteristics of the region is the dearth of soil; another is the paucity of the flora, both in individuals and species, and the fact that the flora of the pampas is evidently derived from that of the Cordillera; still another is the presence of saline lakes, of residuary character, scattered over the pampas. These features indicate conclusively that the Patagonian pampas have but recently been raised from ocean bottom to form dry land. Certain other features give hardly less decisive indication of the manner of lifting. The Pacific coast passes from a lofty archipelago into a fiord-marked sierra, the configuration, on the whole, suggesting recent subsidence; the great Cordillera is trenched by the gorges of rivers (notably the newly discovered Rio Mayer), which have evidently retrogressed through the range so completely that water-parting and mountain-crest no longer coincide; while there is a line of fresh-water lakes skirting the eastern mountain front, which, albeit perhaps partly held in place by morainic dams, undoubtedly owe their preservation to the sluggishness of the rivers flowing toward the Atlantic—and all these features, as well as some others, indicate that the lifting was greater along the eastern margin of the continent, so as to produce a general warping or westward tilting. The history of the evolution of this continental terminus has been complex, as shown by the geologic succession brought out through Mr Hatcher's observations; there have been several oscillations of greater or less extent; doubtless at times the Patagonian Cordillera formed a great archipelago like the present Tierra del Fuego, and the course of Mayer river may have been a strait like the present Magellan; yet the minor episodes but combined to make up the general history of uplifting and westward tilting.

Mr Hatcher has just sailed for Punta Arenas to continue his explorations and surveys. W J M.

THE SUSHITNA RIVER, ALASKA

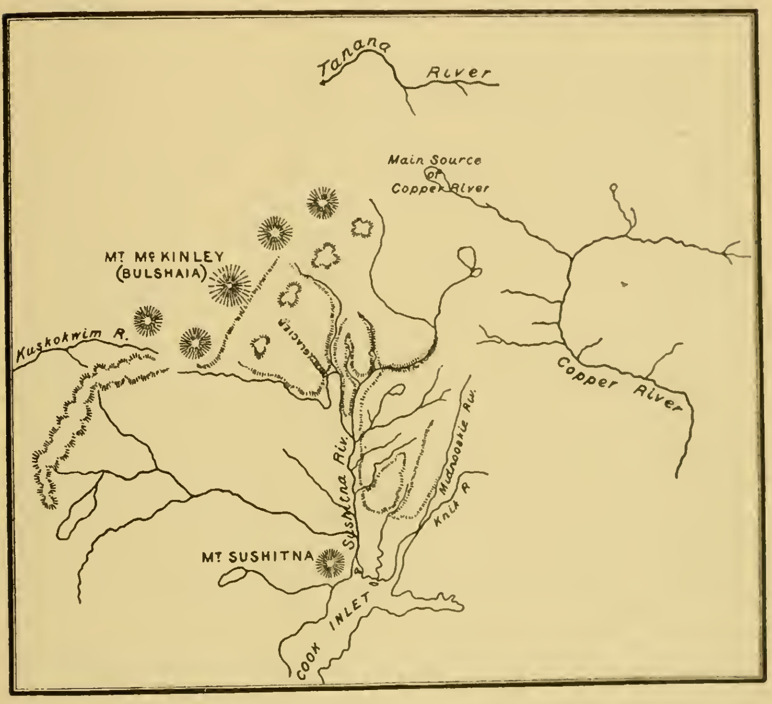
By W. A. Dickey

The Sushitna,* though an almost unknown river, is one of the largest in Alaska, carrying more water than Copper river, though the latter is somewhat longer. It has a delta at its mouth, beyond which extensive mud flats reach far out into Cook inlet. The river is divided into many channels and spread out over the mud flats, rendering steamboat navigation difficult. The tides at this point in Cook inlet rise over 30 feet, yet, notwithstanding this great rise, they have but little effect in checking the swift current of the river, so little as to be unnoticeable a few miles up the stream. The tide flats surrounding the mouth are bare at low water for a distance of nearly ten miles, and are very dangerous to pass. In the treacherous glacial mud a rowboat is liable to sink, and to be held so firmly that the incoming tide, which rises with incredible rapidity, will fail to float it.

The mouth of the river is nearly opposite Turnagain arm, a branch of Cook inlet, which is a great breeder of storms. It is therefore exposed to sudden squalls, which may catch the unfortunate boatman where there is neither landing place nor shelter.

*Sushitna means the great muddy river, and is descriptive.

We had an especially unpleasant experience this spring, spending a cold night in April on these flats, unable to enter the river or to approach near to the mouth, being prevented by great fields of anchor ice, which extended more than a mile from any camping place on shore. About 15 miles up the river the first land above overflow is reached, a tangle of willows and cottonwood giving place to the customary upland growth of the country, which consists of scattered groves of spruce and birch.



MAP OF THE SUSHITNA RIVER, ALASKA

An idea of the volume of water the river carries can be had from its size near the trading station, which is some miles above the influence of tide. Just above the station the river, for the first time hemmed into a single channel, cuts through a rock dyke which crosses its valley diagonally. Here the stream is 1,200 yards in width and is very deep and swift, soundings indicating a depth of over 100 feet. Immediately above this rock dyke the river forks, and it is impossible to tell from the appearance of the two streams which carries the more water, although the northern branch is generally called the main river, and is the one which we ascended.

The Kuskokwim Indians come down the western branch to trade. They say there is an easy passage from the Kuskokwim into this branch of the Sushitna, which would indicate a low range of mountains as forming the watershed between these two valleys, instead of the high, unbroken range indicated on the government charts of previous years.

If this so-called Alaskan range exists, it must be much farther west than is indicated on the charts, for I have been where I could see at least 100 miles west of Sushitna river, and could see no indications of such a range in that direction. A vast, almost level country, covered with forests of spruce and birch, with here and there great swamps, extended to the west as far as I could see with a rather poor pair of field-glasses. It is true that early in June (1897) I could see patches of snow to the west, which would indicate the presence of mountains, but they are not at all high, as in the previous year the snow was all gone in July. The Indians report a large lake on this western branch, and say that the stream forks six days' journey from its mouth.

The other branch has a generally northern direction, though very crooked. Only once in 100 miles above the junction is the river confined to a single channel, and there only where hemmed in by high bluffs on both sides. Many islands and channels, great masses of driftwood, and countless snags characterize this portion of the river, while caving banks, falling trees, and the swift current make the journey both difficult and dangerous. Nowhere could we make any headway except by poling or towing, crossing and recrossing the labyrinth of channels to escape dangerous places. One-third of the boats that have ascended the Sushitna any distance have been lost, either by being swept under the drift and sunk or smashed by caving banks or falling trees. Luckily, however, only one life was lost during the last season, that of a Mr Parsons, of Seattle.

The low mountains that lie between the Midnooskie (Knik) and the Sushitna rivers were apparently about 12 to 20 miles back from the river, and three small branches enter the Sushitna from that side.

While ascending this portion of the river we had many glorious views of Mt McKinley and an unnamed companion southwest of the higher peak. Mt McKinley is in this valley as ubiquitous as the Washington monument in the city of Washington. Everywhere you go in clear weather you can see its glorious summit dominating the northern landscape. There is no question in my mind that it is a very high peak, as we could see three distinct ranges of mountains between our point of observation and its camel-hump summit, which towered thousands of feet above all the other mountains. Two of the three ranges are covered with eternal snow and must be of considerable altitude, though appearing low in comparison with lofty McKinley.

The last range in front of this great peak is very broken and irregular. We could see cliffs that showed fronts of several thousand feet of perpendicular walls, and on all sides were glaciers and snowfields. I have talked with about thirty persons who have seen this great peak from the Sushitna valley in the past two seasons, and they all agree that it is the highest mountain they have ever seen. One party, who had been in the vicinity of the St Elias range, thought it looked higher than any of the mountains of that group.

The Indians of Cook inlet have always called this the Bulshaia (great) mountain, it so manifestly dominates all the other mountains in that portion of Alaska. It appears to me higher than any of the peaks of the Fairweather group, near which we were becalmed on a clear day on our return voyage.

I had also a chance to compare its height and distance with that of Mt Iliamna one clear day when we were camped on an island at the mouth of the river. Field-glasses brought out the detail on Mt Iliamna, but made no change in the cloud-like appearance of Mt McKinley. Iliamna is 12,096 feet high, and was, according to the government chart, 100 miles distant from our point of observation. Notwithstanding its greater distance, Mt McKinley showed a greater angle of elevation above the horizon, and is certainly a much higher mountain. There are four high peaks in the cluster about Mt McKinley, all unnamed at present.

About 90 miles above the lower forks the river again branches into three large streams. The western fork seems to occupy the main valley, though I am of the opinion that the middle fork is the longer and at certain seasons of the year carries the most water. In the hot days of June, July, and August the western branch, fed by the great snowfields and glaciers of the ranges about Mt McKinley, is a roaring torrent, a flowing sea of mud, so much earthy matter does it carry in solution. Parties who have ascended this branch say that about 60 miles up it forks into two nearly equal streams. The southwestern branch they followed a long distance, and found it ran all the way in the low, flat country skirting the foothills of the great range. They ascended a hill, and far to the west could see what they took to be the headwaters of the Kuskokwim, or some other stream, flowing in the opposite direction, with no marked divide between the two rivers.

The branch we followed was the middle fork, which soon entered a narrow valley between low hills, which gradually became higher and higher until we came to a cañon about 60 miles above the forks, through which it was impossible to take our boats. We had supposed from what we could gather from the Indians that there was a waterfall in the cañon, but such does not seem to be the case, though for a distance of about a mile there are very rough rapids in which no boat could live. The walls of the cañon are nearly 1,000 feet high, and in some places are perpendicular. The water, confined in a very narrow channel, looks like a white ribbon at the base of the great walls. We ascended the mountains on both sides and obtained splendid views of the great cluster of peaks about Mt McKinley, which bore a little north of west.

The Copper River, or Midnooskie, Indians, who inhabit the upper waters of the river, all agree that the main source of Copper river is near the headwaters of this branch of the Sushitna and not far from the Tanana. As the government charts place the main source of Copper river north of the Wrangel group of mountains, I have carefully looked up Lieut. Allen's report, and find that his narrative would agree with the statement of the Indians. When Lieut. Allen reached the mouth of the Chitsletchnia river he was in doubt as to which was the main river, as the forks were apparently nearly equal in size. He followed the branch now known as the main river, not because it was the larger, but because he was informed that nearby there were Indians living on it from whom he could obtain food, of which his party were in sore need. He goes on to say that the stream diminished in size rapidly as he ascended it, and soon became less than 100 yards in width. The main source is, probably, as indicated by the Indians, south of the Tanana and near the Sushitna. Lieut. Allen, in his report, falls into the error of confusing the Sushitna with the Midnooskie or Knik river, down which the Midnooskie Indians from the Copper river come each year to trade at the Knik station. They ascend the Tazlina branch of Copper river, cross a low divide, and come down the Midnooskie instead of the Sushitna, as Lieut. Allen erroneously conjectured. The

Tanana Indians last winter came down the Sushitna to trade. They are a very warlike tribe and are accused by the Midnooskies of being cannibals.

The interior of the country has but little game. For many days we saw not a living animal except birds, and but few fish, though salmon run in August and candle-fish in June. We saw more bear than any other large game, but did not kill any. There are colors of fine gold everywhere, but we found no coarse gold, and the signs of gold diminished upstream.

A WINTER WEATHER RECORD FROM THE KLONDIKE REGION

By E. W. Nelson,

Biological Survey, U. S. Department of Agriculture

During the years 1880 and 1881 the Alaska Commercial Company had a fur-trading station on the upper Yukon, in British territory, at no great distance below the mouth of the Klondike, where Dawson City is now located. This station was called Fort Reliance, and was in charge of Mr L. N. McQuesten. It was afterward abandoned and is now in ruins. Mr McQuesten was one of the original prospectors in this region, and his discoveries led to the founding of Circle City and indirectly to the marvelous development that is now taking place in that region. When Mr McQuesten came to St Michael in the spring of 1880 with his winter's gathering of furs I gave him a Signal Service standard minimum thermometer, and he undertook to make a series of daily observations for me at Fort Reliance during his stay there in the fall and winter of 1880–'81. When he returned to St Michael in the spring of 1881 he brought me the subjoined record. It covers the period from the early fall to the opening of navigation on the upper Yukon in spring, and is of peculiar interest at present as showing some of the meteorologic conditions in the area which is now attracting world-wide attention on account of the unprecedented richness of its recently discovered placer mines. It is in this district that some thousands of men are wintering with a reported scarcity of provisions that may result in appalling suffering before navigation opens in spring.

It will be noted in the record that the Yukon froze over during the night of November 2. On the 14th of the following May the ice first started on the river and ran for an hour and then stopped. From this it will be noted that the river was covered with a practically unbroken sheet of ice for a little over six months. On May 17, at 4 a. m., the ice began running again, and was still plentiful on the 19th, but was nearly gone on the 20th. The final entry of this interesting record, made on May 23, is as follows: "Start for St Michael tomorrow."

During my residence at St Michael, from June, 1877, to June, 1881, I learned from the Yukon traders that the ice breaks first in the upper river, and the general breaking up proceeds thence down to the delta, several days intervening between the opening of navigation above and the clearing of the great river below. The fur traders of the upper Yukon usually started as soon as the river became pretty well freed from floating ice, and were joined on their way by the traders stationed lower down. The little flotilla of barges usually reached the river mouth at about the same time. By this time the river delta would be free, and if the sea ice had opened out from shore the boats would proceed northward along the coast to St Michael, 60 miles away. The date for the ice to break away from the coast between the Yukon mouth and St Michael varies greatly and may occur at any time between May 31 and July 1. It usually takes place before June 10. The river boats frequently arrived at St Michael before it was possible for vessels to pass the barrier of pack-ice offshore.

In Mr McQuesten's record the first wild geese were noted on March 31. This is a month before they used to appear along the coast and is a good indication of the more rapid advance of spring on the upper river.

The following summary of these observations brings out some interesting points, but it is probably not ordinarily the case that January should be warmer than either December or February, as it was that season. Commencing with the long nights that come on in October, the temperature sank steadily, and in December was noted the greatest cold of the winter (—67° on the 20th). In January occurred a strange and prolonged upward oscillation of the temperature that probably does not generally occur. Following this during February there was another period of intense cold, which lasted until March 1. In this latter month the effect of the returning sun became strikingly evident. The widest range of temperature in any month (88°) was during March. The thermometer used was a Fahrenheit.

Monthly Summary of Observations of Temperature, Fort Reliance, N. W. T., Winter of 1880–'81

Month.	Highest.	Lowest.	Monthly means. 7 a. m.	12 m.	6 p. m.	10 p. m.
1880.						
September *	53	20	34	46.7	43.7	36.9
October	42	— 10	10.5	25.3	21	17.1
November	40	— 27	4.9	12.2	10	8.6
December	8	— 67	— 34.6	— 29.3	— 29.4	— 30.2
1881.						
January	22	— 41	— 9.1	— 5.5	— 5.4	— 6.6
February	— 2	— 58	— 37.8	— 22.2	— 26.3	— 30.2
March	45	— 43	— 5.5	12.3	10	4.3
April	50	8	24.9	42.2	39.9	32.4
May †	58	10	32.5	45.3	42.4	35.9

* Beginning September 4. † Ending May 23.

RECORD OF DAILY OBSERVATIONS

Date.	Lowest.	7 a. m.	12 m.	6 p. m.	10 p. m.	Wind.	Remarks.
1880.							
Sept. 4	24	30	49	48	35	S. E.	Cloudy.
5	22	28	50	49	38	N. E.	Clear.
6	36	38	50	49	40	N. E.	Clear.
7	34	38	45	40	35	N. W.	Fair.
8	32	48	50	45	40	N. W	Fair.
9	31	36	46	42	39	W.	Cloudy.
10	23	28	49	45	37	N. W.	Clear.
11	24	35	52	48	37	S. W.	Clear.
12	36	48	48	45	40	N. W.	Cloudy.
13	33	37	47	40	33	N.	Clear.
14	29	33	44	36	30	N.	Clear.
15	28	33	53	50	38	S. E.	Light clouds.
16	29	35	52	49	40	S. E.	Light clouds.
17	24	28	50	45	35	S. E.	Clear.
18	29	34	45	43	32	S. E.	Clear.
19	28	32	50	48	38	S.	Clear.
20	25	30	49	46	37	S. E.	Light clouds.
21	25	33	46	43	40	N. W.	Cloudy; rained in the afternoon.
22	26	30	44	42	36	N.	Clear.
23	26	34	50	48	42	S.	Cloudy.
24	40	42	51	47	43	S	Cloudy.
25	32	35	44	42	40	S. W.	Cloudy; rained all day.

Date.	Lowest.	7 a. m.	12 m.	6 p. m.	10 p. m.	Wind.	Remarks.
1880.							
Sept. 26	32	34	43	40	38	N. W......	Clear.
27	24	28	40	35	34	N..........	Clear.
28	20	25	34	38	35	N. W......	Cloudy; rained all day.
29	32	35	40	39	34	S. E.......	Light clouds.
30	28	31	42	38	30	E..........	Clear.
Oct. 1	27	30	40	38	35	E..........	Clear; cloudy in the evening.
2	27	33	42	39	36	S. E.......	Clear; cloudy; rained in the afternoon.
3	24	28	40	38	30	E.........	Clear.
4	19	21	36	34	24	Calm.......	Clear.
5	18	21	37	30	24	Calm.......	Clear.
6	19	23	40	35	33	N. W......	Light clouds.
7	25	29	39	36	34	N. W......	Light clouds.
8	12	15	30	27	24	Calm.......	Clear.
9	10	14	33	32	30	N. W......	Clear.
10	28	33	40	38	35	N. W......	Cloudy; showery.
11	30	32	39	35	30	N. E.......	Clear.
12	11	14	27	30	28	Calm.......	Clear.
13	20	22	(?)	25	22	N..........	Clear.
14	8	12	25	15	8	Calm.......	Clear.
15	2	4	18	12	9	Calm......	Clear.
16	7	18	25	23	23	N. W......	Cloudy; snowed all day.
17	12	15	26	20	14	W.........	Light clouds.
18	10	13	29	20	17	W.........	Light clouds.
19	11	15	30	22	16	W.........	Light clouds.
20	14	18	25	20	17	N. W......	Cloudy; snow showers all day.
21	— 6	— 2	12	— 1	— 6	Calm.......	Clear.
22	— 7	1	13	— 3	— 6	Calm.......	Clear.
23	— 10	— 7	(?)	(?)	6	S. E.......	Cloudy; snowed in the afternoon.
24	4	9	12	8	6	S. E.......	Cloudy; snow showers.
25	4	6	13	10	8	S. E.......	Snow showers.
26	6	8	14	12	10	S. E.......	Light showers of snow.
27	5	7	15	13	9	S. E.......	Cloudy.
28	1	2	5	3	2	Calm......	Clear.
29	— 1	1	4	2	0	Calm......	Clear.
30	— 4	— 1	8	3	— 1	Calm......	Clear.
31	— 2	2	18	15	14	S. W.......	Clear; cloudy in the evening.
Nov. 1	0	11	18	14	0	S. W.......	Snowed in the forenoon; at 2 p. m. clear.
2	— 11	— 10	— 5	1	2	Calm......	Clear; S. W. wind at 4 p. m.; the river froze over last night.
3	2	3	10	10	9	S. W.......	Cloudy; snow showers.
4	8	11	25	22	20	S. W.......	Cloudy; snow showers.
5	— 3	9	10	5	— 3	N..........	Clear.
6	— 6	— 5	4	8	6	S. W.......	Cloudy.
7	— 23	— 15	— 5	— 20	— 23	Calm......	Clear.
8	— 27	— 25	— 10	— 15	— 19	Calm......	Clear.
9	— 26	— 23	— 15	— 15	16	Calm......	Clear; N. wind in the afternoon.

Date.	Lowest.	7 a. m.	12 m.	6 p. m.	10 p. m.	Wind.	Remarks.
1880.							
Nov. 10	— 22	— 20	— 8	— 6	— 5	N. E......	Light clouds.
11	— 5	— i	10	6	4	N. E......	Light clouds.
12	4	36	40	40	39	S. W......	Cloudy; light showers of rain.
13	24	30	31	28	24	N. W......	Cloudy.
14	6	6	10	9	8	N..........	Light clouds.
15	4	4	11	10	8	N. W......	Light clouds.
16	4	6	20	18	15	N. W......	Light clouds; snowed lightly in afternoon.
17	6	7	11	10	8	N..........	Clear.
18	— 3	— 3	4	8	7	Calm.. ..	Clear to 9 a. m.
19	6	8	12	10	9	S. E......	Cloudy; snowed lightly in the afternoon.
20	6	7	13	11	10	S. E......	Cloudy.
21	7	8	15	14	13	S. E......	Cloudy; light showers of snow.
22	10	11	16	16	14	S. E......	Cloudy; snowing lightly.
23	12	13	18	16	15	S. E......	Cloudy; snowing lightly.
24	13	14	20	18	17	S. E......	Light showers of snow.
25	14	15	19	17	15	S. E......	Light showers of snow.
26	4	13	12	4	5	N..........	Clear; 1 p. m., calm.
27	— 14	— 13	10	10	9	Calm......	Clear to 9 a. m.; N. W. wind; cloudy.
28	7	8	18	22	22	S. W......	Cloudy; snowed lightly all day.
29	21	21	35	34	33	S. W......	Rained all afternoon.
30	— 6	22	20	— 3	— 6	N..........	Clear; 1 p. m., calm
Dec. 1	— 22	— 22	— 10	— 8	— 4	Calm... ..	Clear; 10 a.m., N.E. wind.
2	— 4	2	8	6	4	Calm.....	Cloudy.
3	— 18	— 5	0	— 6	— 18	Calm......	Clear.
4	— 26	— 25	— 10	— 21	— 26	Calm.....	Clear.
5	— 51	— 41	— 42	— 48	— 51	Calm.....	Clear.
6	— 53	— 53	— 40	— 38	— 35	Calm.....	Clear; 10 a. m., light N. wind.
7	— 40	— 40	— 38	— 34	— 34	Calm......	Clear.
8	— 37	— 37	— 30	— 31	— 36	Calm......	Clear.
9	— 50	— 50	— 45	— 40	— 35	Calm	Clear; 2 p. m., N. wind.
10	— 35	— 32	— 20	— 20	— 21	N. E......	Snowing lightly.
11	— 40	— 40	— 30	— 28	— 22	Calm......	Clear; 9 a. m., N. wind; clear.
12	— 30	— 25	— 26	— 28	— 30	Calm	Clear.
13	— 35	— 35	— 33	— 30	— 25	N..	Light clouds.
15	— 55	— 55	— 40	— 34	— 30	Calm	Clear; 10 a. m., N. wind.
16	— 38	— 31	— 32	— 34	— 38	N..........	Clear.
17	— 44	— 44	— 35	— 36	— 38	N..........	Clear.
18	— 60	— 45	— 50	— 54	— 60	Calm......	Clear.
19	— 66	— 65	— 63	— 65	— 66	Calm	Clear.
20	— 67	— 49	— 40	— 40	— 42	N..........	Clear.
21	— 42	— 35	— 33	— 30	— 30	N..........	Clear.
22	— 30	— 27	— 22	— 20	— 19	N..........	Light clouds.
23	— 31	— 20	— 18	— 25	— 31	N..........	Clear.
24	— 50	— 50	— 48	— 48	— 49	Calm......	Clear.
25	— 53	— 52	— 50	— 52	— 53	Calm......	Clear.
26	— 56	— 56	— 50	— 48	— 48	Calm	Clear in N. W.

Date.	Lowest.	7 a. m.	12 m.	6 p. m.	10 p. m.	Wind.	Remarks.
1880.							
Dec. 27	—48	—47	—43	—43	—41	N..........	Clear.
28	—41	—40	—31	—22	—20	N. E.......	Light clouds.
29	—18	—18	—16	—15	—16	N. E......	Light clouds.
30	—18	—18	—15	—16	—18	N. E.......	Light clouds.
31	—24	—20	— 8	— 5	— 5	N. E.......	Cloudy; snowed in the afternoon.
1881.							
Jan. 1	—10	—10	— 5	1	5	S. W.......	Cloudy.
2	0	3	6	3	0	S. W.......	Cloudy; snowed lightly in the afternoon.
3	— 6	— 6	— 5	— 5	— 5	N. W......	Light clouds.
4	— 6	— 6	— 4	— 4	— 3	N. W......	Light clouds.
5	— 3	0	3	3	4	N. W......	Cloudy.
6	—16	2	— 5	—10	—16	N..........	Clear.
7	—25	— 2	5	7	8	S. W.......	Cloudy; snowed in the afternoon.
8	8	9	12	13	13	S. W.......	Cloudy; snowed lightly all day.
9	10	12	20	18	15	S..........	Light clouds.
10	— 5	— 2	— 5	— 1	5	N..........	Clear; 2 p. m., E. wind.
11	— 8	— 1	0	— 3	— 8	N.........	Clear.
12	—41	—32	—30	—33	—41	Calm......	Clear.
13	—41	—35	—33	—30	—28	S. E.	Light clouds.
14	—28	—24	—20	—17	—16	S. E.......	Cloudy; snowing lightly in the afternoon.
15	—25	—10	— 8	—16	—25	S. E.......	Cloudy; 2 p. m., calm and clear.
16	—30	—24	—16	—10	—11	S. E.......	Cloudy.
17	—16	—16	—14	—10	— 8	S. E.......	Cloudy.
18	— 9	— 9	— 5	— 6	— 7	S. E.......	Cloudy.
19	—10	—10	— 7	— 9	—10	S. E.......	Cloudy; snowed lightly all day.
20	—12	—11	— 5	— 3	— 2	S. W.......	Light clouds.
21	— 3	— 2	5	5	3	S. W.	Light clouds.
22	2	10	22	21	19	S. W.......	Cloudy; snowed nearly all day.
23	—21	—10	—12	—14	—21	Calm	Clear.
24	—35	—35	—30	—18	—12	Calm......	Clear; 2 p. m., S. E. wind; cloudy.
25	—12	— 6	— 2	— 1	— 1	S. E.......	Cloudy.
26	— 1	1	3	4	4	S. E.......	Cloudy; snowed in the afternoon.
27	4	5	8	8	6	S. E.......	Cloudy.
28	3	3	10	8	5	W....	Clear.
29	—13	—12	— 8	— 8	—13	Light N....	Clear.
30	—25	—20	—15	—20	—25	Calm......	Clear.
31	—48	—45	—36	—41	—48	Calm......	Clear.
Feb. 1	—54	—54	—41	—35	—32	Light N....	Clear.
2	—53	—53	—38	—34	—34	Light N....	Clear.
3	—36	—36	—25	—25	—27	Light N....	Clear.
4	—28	—28	—25	—26	—26	Light N....	Clear.
5	—26	—15	— 2	— 2	— 5	S. E......	Cloudy; snowed lightly all day.
6	—20	—20	—10	—18	—18	Calm......	Clear.
7	—18	—10	— 3	— 3	— 4	N. W......	Cloudy.

Date.	Lowest.	7 a. m.	12 m.	6 p. m.	10 p. m.	Wind.	Remarks.
1881.							
Feb. 8	—10	—10	—4	—5	—10	N. W.... .	Clear.
9	—40	—25	—20	—31	—40	Calm......	Clear.
10	—46	—46	—31	—39	—45	Calm......	Clear.
11	—49	—49	—35	—41	—46	Calm......	Clear.
12	—51	—51	—34	—35	—41	Calm......	Clear.
13	—48	—48	—31	—35	—40	Calm......	Clear.
14	—47	—47	—40	—25	—21	Light N...	Clear.
15	—21	—18	—5	—6	—12	N. E.......	Light clouds.
16	—19	—18	—2	—8	—15	S. E......	Clear.
17	—23	—19	—5	—5	—16	S. E.......	Clear.
18	—25	—25	—8	—15	—24	Light N...	Clear.
19	—48	—48	—25	—38	—40	Calm......	Clear.
20	—49	—49	—27	—35	—39	Calm......	Clear.
21	—47	—47	—25	—36	—40	Calm......	Clear.
22	—46	—46	—23	—33	—40	Calm	Clear.
23	—47	—47	—25	—35	—41	Calm	Clear.
24	—50	—50	—26	—34	—39	Calm......	Clear.
25	—49	—49	—25	—34	—41	Calm......	Clear.
26	—58	—58	—26	—41	—46	Calm......	Clear.
27	—57	—57	—36	—33	—30	Calm......	Clear; 2 p. m., light N. wind.
28	—37	—37	—26	—30	—36	Light N....	Clear.
Mar. 1	—43	—43	—16	—18	—22	Light N....	Clear.
2	—36	—22	3	—7	—16	S...... ...	Clear.
3	—20	—20	4	—3	—6	S..........	Clear.
4	—6	—6	3	1	—2	S..........	Clear.
5	—10	—7	5	3	—10	S.........	Clear.
6	—30	—30	—4	—4	—6	E.	Clear.
7	—19	—19	—3	—4	—18	E.	Clear.
8	—26	—20	—2	—2	—3	S. E.......	Light clouds.
9	—9	—9	—2	—3	—4	S. E.......	Light clouds.
10	—6	—5	2	0	—1	S. E......	Light clouds; snowed lightly in afternoon.
11	—6	—6	—3	—4	—6	E.	Clear.
12	—24	—14	—5	—13	—24	N..........	Clear.
13	—37	—30	—12	—6	—7	N.........	Clear.
14	—10	—4	20	10	3	S...........	Clear.
15	—1	—1	10	8	0	S. E.......	Light clouds.
16	—15	—15	10	5	—2	S. E......	Light clouds.
17	—17	—9	11	11	9	S. E.......	Cloudy.
18	—1	—1	23	18	5	Light S.W.	Clear.
19	—10	0	20	25	30	S. W.......	Cloudy; snowed nearly all day.
20	16	29	36	27	16	....	Snowed in the forenoon; clear at 2 p. m.
21	—2	1	24	22	15	Light S. E.	Cloudy.
22	—3	2	26	25	17	Light S. E.	Cloudy.
23	—2	2	25	24	23	Light S. E.	Cloudy; snow showers all day.
24	9	14	22	18	9	E.	Clear.
25	—10	—10	20	16	10	E.	Clear.
26	—15	—15	16	9	2	E.	Clear.
27	—16	—10	10	11	11	E.	Clear; cloudy in the evening.

Date.	Lowest.	7 a. m.	12 m.	6 p. m.	10 p. m.	Wind.	Remarks.
1881.							
Mar. 28	9	10	22	25	24	N. E.......	Cloudy.
29	10	10	36	40	20	S. W.......	Cloudy; rained all the afternoon.
30	24	25	38	37	35	S. W.......	Cloudy.
31	30	34	45	40	30	S..........	Clear.
April 1	20	22	47	43	40	S..........	Clear; afternoon cloudy.
2	30	31	48	44	30	S..........	Clear.
3	26	28	44	42	37	S. E.......	Snowed in the forenoon; light showers of snow in the afternoon.
4	35	38	43	40	37	W.........	Cloudy; clear in the evening.
5	18	21	44	40	30	Calm......	Clear.
6	12	13	37	36	34	Calm......	Clear; 3 p. m., N. W. wind and cloudy.
7	23	30	36	30	23	Light N.W.	Clear.
8	12	13	33	32	28	Light N.W.	Clear.
9	10	11	35	33	24	Light N.W.	Clear.
10	11	13	38	35	26	Light N.W.	Clear.
11	8	11	35	34	24	Light N.W.	Clear.
12	14	15	38	37	34	S. E.......	Light clouds.
13	26	30	43	40	26	E.........	Clear.
14	15	16	42	40	27	E.........	Clear.
15	18	21	47	45	36	Light S....	Clear; geese were seen today.
16	15	22	49	48	35	S.........	Light clouds.
17	25	27	47	46	40	S..........	Light clouds.
18	33	40	50	49	41	S..........	Light clouds.
19	25	30	49	48	39	S..........	Light clouds.
20	19	26	50	49	44	S..........	Light clouds.
21	33	40	50	47	41	S..........	Light clouds.
22	31	32	42	39	31	S. E.......	Cloudy.
23	28	30	40	37	30	S. E.......	Cloudy.
24	19	24	39	38	36	Light N....	Clear.
25	31	34	40	39	32	Light N....	Clear.
26	25	28	41	37	32	N. E.......	Showers of snow and rain during the day.
27	28	30	38	35	29	E.........	Clear.
28	25	27	39	35	28	E.........	Clear.
29	15	19	40	39	27	N.........	Clear.
30	20	27	42	40	32	S. W......	Cloudy in the afternoon.
May 1	19	23	40	39	35	S. W......	Morning clear; snowed in the afternoon.
2	31	36	43	41	33	S. W......	Showers of snow in the afternoon.
3	25	31	36	30	25	Light N....	Clear.
4	15	25	38	35	30	N. W......	Cloudy in the afternoon.
5	20	25	35	30	24	N.........	Clear.
6	10	12	31	28	23	N.........	Clear.
7	20	23	35	38	35	N. E.......	Cloudy.
8	22	27	45	46	37	S. W.......	Cloudy; light showers of rain in the afternoon.
9	26	30	45	43	34	S. W.......	Cloudy; showery all day.
10	20	25	50	49	39	S. W.......	Light clouds.

Date.	Lowest.	7 a. m.	12 m.	6 p. m.	10 p. m.	Wind.	Remarks.
1881.							
May 11	33	39	54	48	39	S. W......	Cloudy in the afternoon.
12	34	38	50	45	34	S. W.......	Cloudy; showery all the forenoon; clear in the afternoon.
13	28	35	50	49	40	S. W.......	Cloudy.
14	30	36	54	46	33	S...........	Clear; the ice started in the river this afternoon, ran 1 hour, and stopped.
15	25	34	55	54	45	S...........	Light clouds.
16	38	43	58	56	47	S...........	Light clouds; the ice started again at 4 a. m.
17	40	45	42	46	40	E.........	Showery all day; plenty of ice still passing in the river.
18	35	40	45	44	35	E..........	Rained nearly all day; clear at 6 p. m.
19	30	36	54	50	42	S. W.......	Cloudy in the afternoon; there is still plenty of drift ice in the river.
20	33	37	50	45	43	S. W. . .	Cloudy; showery in the afternoon; the river is almost clear of ice.
21	36	40	50	46	42	S. W.......	Rained all the afternoon.
22	35	38	43	40	36	N..........	Clear.
23	28	31	40	39	36	N...... ...	Clear; start for St Michael tomorrow.

THE RUSSIAN CENSUS OF 1897

Until the present year the population of the whole Russian Empire has never been definitely known. Instead of a census the Russian government has depended in the past on partial enumerations, known under the name of "Revisions," of which there have been ten, five in the eighteenth century and five in the nineteenth century. The "Revision" of 1851 gave a population of 67,380,645, and that of 1885, which was not considered entirely trustworthy, aggregated 108,819,332.

According to the census of 1897 the population of the Russian Empire is 129,211,113. The distribution in various parts of the Empire is as follows: European Russia, 94,188,750; Poland, 9,442,590; the Caucasus, 9,723,553; Siberia, 5,731,732; Turkestan and the Transcaspian region, 4,175,101; the Steppes, 3,415,-174; Finland, 2,527,801; Russian subjects in Bokhara and Khiva, 6,412. The most densely populated regions are Poland, 192.6

inhabitants per square mile; the Caucasus, 53.7, and European Russia, 50.6. Siberia contains only one person to each square mile, and the Steppes eight persons.

Mr John Karel, Consul-General of the United States at St Petersburg, points out the peculiar distribution of the population of European Russia. He says:

The distribution of the 94,000,000 inhabitants in European Russia depends principally upon the natural and economic conditions of the plain of Russia, which is cut diagonally from Podolia and Bessarabia to the government of Viatka by the chernoziom (black earth) region. This region comprises less than 658,740 square miles, but if the non-chernoziom governments, in which is included the Moscow industrial district, be added thereto, it contains more than 746,572 square miles, *i. e.*, two-fifths of the whole plain of European Russia, which, according to the census, is inhabited by 63,000,000 people, or by two-thirds of the whole population of European Russia.

The most compact population is centered on the narrow strip formed by the governments of Podolia, the chernoziom part of Volyn, the larger part of Kiev and Poltava, the chernoziom part of Chernigov, the non-steppe chernoziom parts of Kharkov and Voronezsh, and the chernoziom parts of Orel, Tambov, Riazan, and Tula.

The present tendency of population to drift to the cities, less marked in Russia than in Europe generally, is shown by the fact that there are no fewer than 123 cities in which the population exceeds 25,000. The 20 most populous cities are as follows: St Petersburg, 1,267,023; Moscow, 988,610; Warsaw, 614,752; Odessa, 404,651; Lodz, 314,780; Riga, 282,943; Kiev, 248,750; Kharkov, 170,682; Tiflis, 159,862; Vilna, 159,568; Tashkent, 156,506; Saratov, 133,116; Kazan, 131,508; Ekaterinoslav, 121,216; Rostoff-on-Don, 119,889; Astrakhan, 113,075; Baku, 112,253; Tula, 111,048; Kishinev, 108,506; Nijni-Novgorod, 98,503.

A. W. G.

The surprisingly early availability of the Russian census returns is due to the employment of the Hollerith tabulating machine, first used for census purposes by the United States government in 1890.

Out of 2,403,750 Germans who left their native land between 1871 and 1896 about 96 per cent emigrated to the United States. Failing to divert the tide of emigration toward the German colonies in Africa, the government is now seeking to direct it toward certain parts of South America, in preference to the United States, where the peculiarities, language, and customs of the Germans are lost by assimilation and emigrants become competitors with the artisans and agriculturists of the mother country.

CHESAPEAKE & OHIO RY.

THE F. F. V. LIMITED is one of the finest trains hauled over any railway track in America. It runs solid between Cincinnati and New York, the route from Washington being over the Pennsylvania system. It has every modern convenience and appliance, and the dining-car service has no superior if it has an equal. The road-bed is literally hewed out of the eternal rocks; it is ballasted with stone from one end to the other; the greater portion is laid with one-hundred-pound steel rails, and although curves are numerous in the mountain section, the ride is as smooth as over a Western prairie.

One of the most delightful rides in all the route is that through the New River valley. The mountains are just low enough to be clad with verdure to the very top, and in the early spring every variety of green known to the mixer of colors can be seen, while the tones in autumn take on all the range from brown to scarlet.

These facts should be borne in mind by the traveler between the East and the West.

H. W. FULLER, *Genl. Pass. Agent, Washington, D. C.*

CALIFORNIA..

OF course you expect to go there this winter. Let me whisper something in your ear. Be sure that the return portion of your ticket reads via the . . .

Northern Pacific-Shasta Route.

Then you will see the grandest mountain scenery in the United States, including **Mt. Hood** and **Mt. Rainier**, each more than **14,000** feet high, **Mt. St. Helens**, **Mt. Adams**, and others. You will also be privileged to make side trips into the **Kootenai Country**, where such wonderful new gold discoveries have been made, and to **Yellowstone Park**, the wonderland not only of the United States, but of the World. Park season begins **June 1st** each year. Close railroad connections made in Union Station, Portland, for Puget Sound cities and the east, via **Northern Pacific.**

CHAS. S. FEE,

General Passenger Agent, St. Paul, Minn.

SOUTHERN RAILWAY

GREATEST SOUTHERN SYSTEM.

Penetrates with its main line or branches eight States South of the Ohio and Mississippi Rivers, and in conjunction with its friendly allied connections reaches all the commercial centers of the South and Southwest . . .

DOUBLE DAILY VESTIBULED LIMITED TRAINS

. . . BETWEEN . . .

Washington and Nashville via Salisbury, Asheville, Knoxville and Chattanooga.
Washington and Tampa via Columbia, Savannah and Jacksonville.
Washington and Memphis via Atlanta, Birmingham and K. C. M. & B.
Washington and New Orleans via Atlanta, Montgomery and Mobile.
Norfolk and Chattanooga via Salisbury, Asheville and Knoxville.

Pullman Sleeping Cars—Dining Cars—Day Coaches.
Additional Trains for local travelers . . . .

The direct line to the Winter Resorts of { FLORIDA, GULF COAST and TEXAS, ... MEXICO and CALIFORNIA,

—AND THE BEST—

Through Car Line to and from Asheville and Hot Springs—"The Land of the Sky."

Write for Map Folders.

A. S. THWEATT, Eastern Passenger Agent, 271 Broadway, New York, N. Y.
J. C. HORTON, Passenger Agent, 106 E. German Street, Baltimore, Md.
L. S. BROWN, General Agent Passenger Department, Washington, D. C.
J. H. WINGFIELD, Passenger Agent, Norfolk, Va.
S. H. HARDWICK, Assistant General Passenger Agent, Atlanta, Ga.
C. A. BENSCOTER, Assistant General Passenger Agent, Chattanooga, Tenn.
W. H. TAYLOE, Assistant General Passenger Agent, Louisville, Ky.

J. M. CULP, Traffic Manager. W. A. TURK, General Passenger Agent.

The Mutual Life Insurance Co.

OF NEW YORK,

RICHARD A. McCURDY, President,

Is the Largest Insurance Company in the World.

The Records of the Insurance Department of the State of New York SHOW THAT The Mutual Life

Has a Larger Premium Income	($39,000,000)
More Insurance in Force	($918,000,000)
A Greater Amount of Assets	($235,000,000)
A Larger Annual Interest Income	($9,000,000)
Writes More New Business	($136,000,000)
And Pays More to Policy-holders	($25,000,000 in 1896)

THAN ANY OTHER COMPANY.

It has paid to Policy-holders since its organization, in 1843, - - $437,005,195.29

ROBERT A. GRANNISS, Vice-President.

WALTER R. GILLETTE, General Manager. FREDERIC CROMWELL, Treasurer.
ISAAC F. LLOYD, Second Vice-President. EMORY McCLINTOCK, Actuary.
WILLIAM J. EASTON, Secretary.

Burlington Route

TO

ST PAUL

BEST LINE
CHICAGO OR ST. LOUIS

MINNEAPOLIS

Ripans Tabules cure headache.

The Fastest and Finest Train in the West . . . .

IS

UNION PACIFIC
THE OVERLAND ROUTE
WORLD'S PICTORIAL LINE

The Overland Limited

......TO......

UTAH and CALIFORNIA.

FROM 16 TO 20 HOURS
SAVED BY USING

"THE OVERLAND ROUTE."

Double Drawing-Room Pullman Sleepers.
Free Reclining Chair Cars.
Pullman Dining Cars.
Buffet Smoking and Library Cars.

Send for Descriptive Pamphlet "49-96," Folders and other Advertising Matter.
(Mention this publication.)

E. L. LOMAX,
General Passenger and Ticket Agent,
OMAHA, NEB.

THE CHICAGO, MILWAUKEE AND ST. PAUL RAILWAY

.. RUNS ..

Electric Lighted and Steam Heated Vestibuled Trains between **Chicago, Milwaukee, St. Paul and Minneapolis** daily.

Through Parlor Cars on day trains between **Chicago, St. Paul and Minneapolis.**

Electric Lighted and Steam Heated Vestibuled Trains between **Chicago and Omaha and Sioux City** daily.

Through Sleeping Cars, Free Reclining Chair Cars and Coaches between **Chicago and Kansas City, Mo.**

Only two hours from Chicago to Milwaukee. Seven fast trains each way, daily, with Parlor Car Service.

Solid trains between **Chicago** and principal points in **Northern Wisconsin** and the **Peninsula of Michigan.**

Through Trains with Palace Sleeping Cars, Free Reclining Chair Cars and Coaches between **Chicago** and points in **Iowa, Minnesota, Southern and Central Dakota.**

The **finest Dining Cars** in the World.

The **best Sleeping Cars. Electric Reading Lamps in Berths.**

The best and latest type of **private Compartment Cars, Free Reclining Chair Cars, and buffet Library Smoking Cars.**

Everything First-class. First-class People patronize First-class Lines.

Ticket Agents everywhere sell tickets over the Chicago, Milwaukee and St. Paul Ry.

GEO. H. HEAFFORD,
General Passenger Agent, Chicago, Ill.

WHENEVER YOU VISIT WASHINGTON . .

YOU ARE INVITED TO INSPECT THE

✱ MAMMOTH DRY GOODS ESTABLISHMENT ✱

OF

WOODWARD & LOTHROP

Where the **LATEST PARIS NOVELTIES** are always on Exhibition.
The attention of those who anticipate purchasing . . . .

BRIDAL TROUSSEAUX

Is invited especially to extreme PARIS NOVELTIES in matched sets of French Hand-made Lingerie, including Gowns, Skirts, Chemises, Drawers, Corset Covers, &c. These can be furnished in any number of pieces desired. . . . .

HAND-MADE BRIDAL TROUSSEAUX, personally selected in Paris and exclusive in style and design: Three or more pieces . . . . **$10 to $250.**

CORRESPONDENCE SOLICITED. MAIL ORDERS RECEIVE PROMPT AND CAREFUL ATTENTION.

TENTH, ELEVENTH, AND F STREETS N. W. . . . . . WASHINGTON, D. C.

Shortest Line
TO
St. Paul and Minneapolis
and the Northwest

CHICAGO GREAT WESTERN
RAILWAY

"Maple Leaf Route"

For tickets, rates or any detailed information apply to your home agent or write to

F. H. LORD,
Gen'l Pass'r and Ticket Agent,
CHICAGO.

A VITAL POINT

"IMPROVEMENT THE ORDER OF THE AGE."

A TYPEWRITER'S PRINTING MECHANISM

MUST BE SCIENTIFICALLY CONSTRUCTED. THIS POINT IS OF UTMOST IMPORT FOR

EASY OPERATION AND PERFECT EXECUTION.

The Smith.. Premier Typewriters

Superior on This Point as Well as on All Others.

ONLY CORRECT PRINCIPLES EMPLOYED.

The Smith Premier Typewriter Co.,
SYRACUSE, N. Y., U. S. A.

Catalogues and Information at Washington Office, No. 1416 F Street.

THE AMERICAN ANTHROPOLOGIST.

The only American magazine devoted to the science of Anthropology in all its branches is THE AMERICAN ANTHROPOLOGIST, published at the National Capital. This journal is now in its *tenth* year of increasing usefulness.

No magazine ever published on the Western continent is such a storehouse of authentic information concerning ARCHEOLOGY, ETHNOLOGY, FOLK-LORE, TECHNOLOGY, SOCIOLOGY, HISTORY, SOMATOLOGY, PSYCHOLOGY, PHILOSOPHY, and PHILOLOGY. Its contributions to our knowledge of these subjects, especially in so far as they relate to the **American Indians**, past and present, are of world-wide authority. Its contributors are America's foremost scholars.

Is *your* name on the subscription list of the ANTHROPOLOGIST? If not, it should be. No one interested in anthropology in any of its branches can afford to be without it. *Subscribe today.* A new volume begins with the January number.

A bibliography of the anthropologic literature of the world is one of its futures.

Handsomely Printed—Abundantly Illustrated.
Published Monthly—Two Dollars a Year.
Volume XI Begins with January, 1898.

ADDRESS: THE AMERICAN ANTHROPOLOGIST,
1804 Columbia Road, Washington, D. C.

COMMENCED JANUARY, 1888. TWO VOLUMES PER YEAR.

THE AMERICAN GEOLOGIST, 1897.

The Oldest Exclusively Geological Magazine Published in America

TERMS.

To Subscribers in the United States, Canada and Mexico	**$3.50** a year
To other Subscribers in the Postal Union	**4.00** a year

The *AMERICAN GEOLOGIST* is issued monthly from the office of publication at Minneapolis, Minnesota, United States of America. Nineteen volumes are completed; the twentieth began with the number for July, 1897. The magazine has received a cordial welcome and a generous support from leading geologists everywhere and it is now recognized as the exponent of the rapid geological progress that is taking place on the continent of North America, including Canada, the United States and Mexico. Nowhere else in the world are geologic phenomena exhibited on a more extensive scale and nowhere else are results attained of greater economic and scientific importance.

The *AMERICAN GEOLOGIST* lays before its readers from month to month the latest results of geological work. In addition to the longer papers it gives synopses of recent geological publications and brief notes on current geological events.

THE GEOLOGICAL PUBLISHING CO.,
MINNEAPOLIS, MINN.

NATIONAL GEOGRAPHIC MONOGRAPHS

On the Physical Features of the Earth's Surface, designed especially to supply to teachers and students of geography fresh and interesting material with which to supplement the regular text book.

LIST OF MONOGRAPHS COMPRISING VOLUME I:

General Physiographic Processes	J. W. Powell
General Physiographic Features	J. W. Powell
Physiographic Regions of the United States	J. W. Powell
Beaches and Tidal Marshes of the Atlantic Coast	Prof. N. S. Shaler
Present and Extinct Lakes of Nevada	Prof. I. C. Russell
Appalachian Mountains—Northern Section	Bailey Willis
Appalachian Mountains—Southern Section	C. Willard Hayes
Mt. Shasta—A Typical Extinct Volcano	J. S. Diller
The New England Plateau	Prof. W. M. Davis
Niagara Falls and Its History	G. K. Gilbert

Price for one set of ten monographs, **$1.50.** Five sets to one address, **$6.00.** Single monographs, 20c.

Remit with order to AMERICAN BOOK COMPANY,

New York - Cincinnati . Chicago

Ripans Tabules assist digestion.

TERRESTRIAL MAGNETISM

An International Quarterly Journal

Edited by L. A. BAUER
With the Co-operation of Eminent Magneticians

WITH the March, 1897, issue, this Journal, devoted exclusively to Terrestrial Magnetism and allied subjects, such as Earth Currents, Auroras, Atmospheric Electricity, etc., entered on its second volume. The hearty co-operation extended by the workers in this promising field of investigation, as abundantly shown by the numbers thus far issued, has made this Journal the international organ for making known the latest achievements. The magnetic needle has become such a promising instrument of research, not only in terrestrial, but in cosmical physics, that this Journal appeals to a large class of investigators. The geographer, the geologist, the astronomer, the meteorologist—all are interested in the development of the subject of terrestrial magnetism. It should therefore receive their support.

Among the contributors of the main articles in the past have been Messrs. Barus, Borgen, Chree, Eschenhagen, Littlehales, Rücker, Schmidt, Schuster, and de Tillo.

Future numbers will contain:

"The Earth, a Great Magnet,"
By Dr. J. A. Fleming.

"The Electrification of the Atmosphere,"
By Prof. Alexander McAdie.

"The Height of the Aurora,"
By Prof. Cleveland Abbe.

"The Distribution of Magnetic Observatories,"
(Illustrated),
By Prof. Max Eschenhagen,
etc., etc.

The size of the Journal is royal octavo, a volume embracing about 200 pages. Domestic subscription price: **Two dollars**; single numbers, **fifty cents**. Foreign subscription price: **Nine shillings, nine marks, or eleven francs.** Address:

TERRESTRIAL MAGNETISM,
The University of Cincinnati, Cincinnati, Ohio.

PEOPLE like to read about the great and wonderful country of the **Southwest**; of its quaint and curious towns, its ancient civilizations, its natural marvels. They like to get accurate information about **California and the Pacific Coast.** This is because most people want to some day see these things for themselves. . . . .

A charming book covering these facts is issued by the

PASSENGER DEPARTMENT

OF THE

Southern Pacific Railway,

and will be sent to any one, postpaid, on receipt of TEN CENTS.

THE BOOK IS ENTITLED

"Through Storyland to Sunset Seas,"

You can get a copy by writing to

S. F. B. MORSE,

General Passenger Agent,

Southern Pacific,

New Orleans,

and sending **10 cts.** to defray postage.

AND IS A WONDERFULLY HANDSOME VOLUME OF **205** PAGES, WITH **160** ILLUSTRATIONS. . . .

The paper used is FINE PLATE PAPER, and every typographical detail is artistic. It is a story of what four people saw on just such a trip as you would like to make. . . . .

CALIFORNIA..

Of course you expect to go there this winter. Let me whisper something in your ear. Be sure that the return portion of your ticket reads via the . . .

Northern Pacific-Shasta Route.

Then you will see the grandest mountain scenery in the United States, including **Mt. Hood** and **Mt. Rainier**, each more than **14,000** feet high, **Mt. St. Helens**, **Mt. Adams**, and others. You will also be privileged to make side trips into the **Kootenai Country**, where such wonderful new gold discoveries have been made, and to **Yellowstone Park**, the wonderland not only of the United States, but of the World. Park season begins **June 1st** each year. Close railroad connections made in Union Station, Portland, for Puget Sound cities and the east, via **Northern Pacific.**

CHAS. S. FEE,

General Passenger Agent, St. Paul, Minn

Burlington Route

BEST LINE
CHICAGO OR ST. LOUIS

TO
ST PAUL
MINNEAPOLIS

JUDD & DETWEILER, PRINTERS, WASHINGTON, D. C.

Vol. VIII DECEMBER, 1897 No. [illegible]

The National Geographic Magazine

AN ILLUSTRATED MONTHLY

Editor: JOHN HYDE

Associate Editors

A. W. GREELY W J McGEE HENRY GANNETT
C. HART MERRIAM ELIZA RUHAMAH SCIDMORE

CONTENTS

WASHINGTON

PUBLISHED BY THE NATIONAL GEOGRAPHIC SOCIETY

Agents in the United States and Canada

The American News Company, 39 and 41 Chambers Street, New York

Paris: Brentano's, 37 Avenue de l'Opera

Price 25 Cents $2.50 a Year

Entered at the Post-office in Washington, D. C., [illegible]

THE

NATIONAL GEOGRAPHIC SOCIETY

SPECIAL ANNOUNCEMENT

To fill the vacancy in the presidency caused by the lamented death of Mr Gardiner G. Hubbard, General A. W. Greely, U. S. A., has been designated by the Board of Managers as Acting-President. At some personal inconvenience General Greely has acceded to the request of the Board, but has intimated that his official and other duties will render it impossible for him to serve the Society in this capacity for more than a short time.

The Board of Managers have accepted the resignation of Mr Everett Hayden as Recording Secretary, Mr Hayden still remaining a member of the Board. To fill this vacancy Mr F. H. Newell, a former secretary, has been designated, it being the intention of the Board to employ as Assistant Secretary some person who is qualified not only to perform the clerical duties of the position, but also to relieve the editors of the Magazine by acting as business manager of that publication.

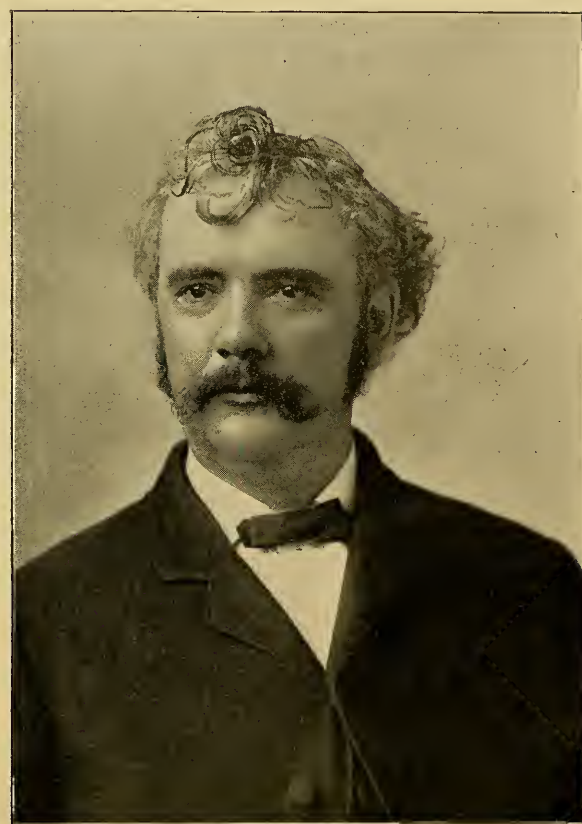
The Society's office has been removed to Room 55, Ohio National Bank Building, on the northwest corner of Twelfth and G Streets N. W. In these more commodious quarters it is expected to so arrange the Society's Library as to make it available to visiting members and their friends. The transaction of business will be facilitated by the addressing of mail to the undersigned at the above address.

F. H. NEWELL,

Secretary

SIR JOHN EVANS

President of the British Association for the Advancement of Science



PROF. W J McGEE

Acting-President of the American Association for the Advancement of Science

THE

National Geographic Magazine

Vol. VIII DECEMBER, 1897 No. 12

THE WASHINGTON AQUEDUCT AND CABIN JOHN BRIDGE*

By D. D. Gaillard,

Captain, Corps of Engineers, U. S. Army

The idea of supplying the city of Washington with water at some day was contemporaneous with the planning of the city, and numerous examinations and surveys were made by Major L'Enfant, the engineer and architect of the Government, under the direction of General Washington, of the Potomac river, the Eastern branch, Rock creek, and numerous springs and small streams, as possible sources of future supply.

The first definite plan to be found among the records of the Washington Aqueduct Office is given in a report made in January, 1851, by Brevet Lieut. Col. George W. Hughes, Corps of Topographical Engineers, to Colonel J. J. Abert, Chief of Topographical Engineers, in compliance with an act of Congress, approved September 30, 1850, appropriating $500 "to enable the War Department to make such examinations and surveys as may be necessary to determine the best and most available mode of supplying the city of Washington with pure water and to prepare a plan and estimate of the probable cost of the same, to be reported to Congress at its next session."

After an investigation of the subject Colonel Hughes proposed to obtain the necessary supply from Rock creek by damming the stream about six miles above the city and bringing the water into a receiving reservoir through a conduit of oval cross-section having an estimated capacity of 8,000,000 gallons in 24 hours.

* Read before the National Geographic Society, October 2, 1897.

It is interesting at this point to compare the estimate of the supply needed for the city in 1851 with that actually furnished in 1897—but 46 years later. The population of Washington and Georgetown was then about 48,000; now it is over 278,000; then 30 gallons was considered by Colonel Hughes a high estimate for the average daily per capita consumption; during the past month the average daily consumption for every inhabitant of the District of Columbia was 173 gallons; then the total estimated maximum consumption of water was 1,500,000 gallons per day; during the past month it actually exceeded 48,000,000 gallons per day.

No action appears to have been taken by Congress toward carrying out the plan proposed by Colonel Hughes, and the next step was one which eventually resulted in the construction of the present aqueduct system. The 32d Congress at its first session appropriated $5,000 to enable the President of the United States to cause to be made the necessary surveys, projects, and estimates for determining the best manner "of affording to the cities of Washington and Georgetown an unfailing and abundant supply of good and wholesome water." In accordance with this legislation the necessary surveys were made in the winter of 1852–'53 by Lieutenant (afterward General) Montgomery C. Meigs, U. S. Corps of Engineers, who, in his report of February 12, 1853, proposed three plans for obtaining the necessary water supply, submitted estimates of the cost of each, and entered into a broad and far-sighted discussion of the subject of supplying the cities with water.

In urging the necessity of a suitable supply he states that it was the general custom in Washington at that time to have all "the water for a family brought by the servant-maids from the street pump," a crude condition of affairs which the average Washingtonian of today will find it hard to believe existed but a little more than 40 years ago.

Briefly summed up, the three sources of supply proposed by General Meigs were as follows: (1) From Rock creek, by means of a dam and a conduit under natural flow. Estimated minimum daily supply, 9,860,000 gallons; estimated cost, $1,258,863. (2) From the Potomac at Little Falls, six miles above Georgetown, by means of a dam across the river, a canal and pumping machinery to raise the water to the reservoirs. Estimated minimum daily supply, 12,000,000 gallons; estimated cost, $1,662,215. (3) From the Potomac, just above the Great Falls, by means of a dam, a masonry conduit, two reservoirs, and the necessary bridges. Estimated daily supply, 36,015,400 gallons; estimated cost, $1,921,244.

This last estimate was based upon a conduit of seven feet in diameter and a bridge of a different design from that finally built over Cabin John creek. General Meigs recommended an increase in the diameter of the conduit to nine feet, which, with the changed plan of the bridge just mentioned, made the final estimated cost about $2,435,000 and increased the estimated capacity of the conduit to 67,596,400 gallons, a most fortunate change for the citizens of the District of Columbia, for, had the seven-foot conduit been built, the limit of its capacity would have been reached about six years ago.

In his report General Meigs urged the adoption of the third plan, calling attention to the fact that the waterworks of this country had been almost invariably designed on an inadequate scale, and that the history of all these works showed that the daily per capita consumption of water was increasing at a rate comparatively rapid. In consequence of this fact and of the rapid growth of population, many of these earlier works proved insufficient within a few years after construction.

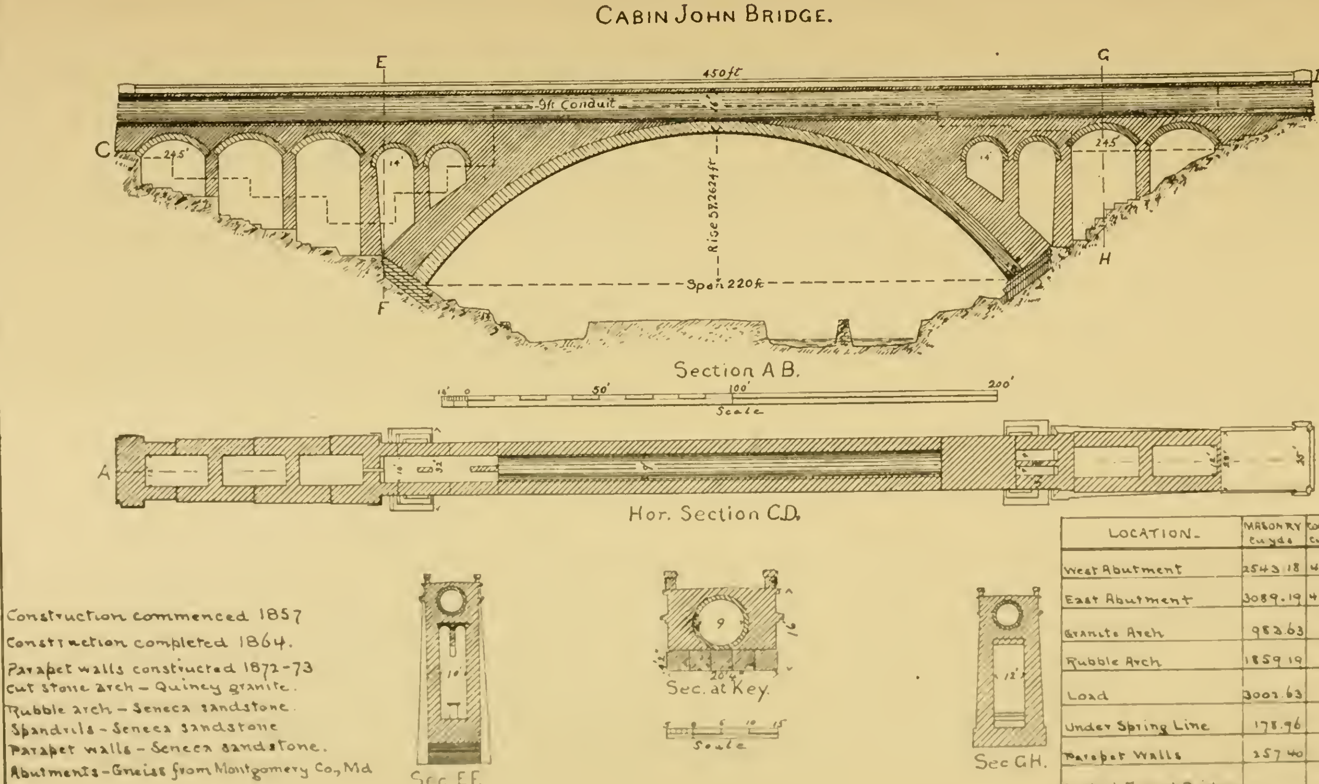
Too much praise, then, cannot be given to the man who in 1853 planned a conduit with an ultimate daily capacity equal to one and one-half times the amount then furnished to the city of London, nearly four times that furnished to Paris, two and one-half times that furnished to New York, five times that furnished to Philadelphia, and one and one-half times that then furnished to Rome, although in A. D. 101 Rome had a daily supply of 377,000,000 gallons. Be it remembered that General Meigs did this when the combined population of Washington and Georgetown was but 58,000, which it was estimated would then require for all public and domestic purposes a total supply of but 5,220,000 gallons, about one-fifteenth of the ultimate capacity of the conduit.

General Meigs' recommendation of the enlarged Great Falls plan and his reasons therefor carried such weight that they received the strong indorsement of General Joseph G. Totten, Chief of Engineers, when he forwarded the report to the Hon. C. M. Conrad, Secretary of War, who submitted it to President Fillmore without comment.

The first appropriation for the construction of the aqueduct was made in March, 1853, and the actual work of breaking ground was commenced in November, 1853. In order that the city might receive a supply of water as soon as possible, work was pushed upon the receiving (Dalecarlia) reservoir and the conduit connecting it with the supply mains, and on January 3, 1859, water from the Dalecarlia reservoir was introduced into the pipes leading to the city. This was not Potomac water, however, but was supplied by the streams emptying into the Dalecarlia reservoir, which streams are now diverted therefrom by the admirable system of protection works completed in 1895 by Colonel George H. Elliot, U. S. Corps of Engineers, retired. This mode of supply continued until the conduit between Great Falls and the Dalecarlia reservoir was completed, in 1863, and on December 5, 1863, Potomac water was introduced into the Dalecarlia reservoir for the first time.

Conns island separates the Potomac at Great Falls into two parts, known as the Maryland and Virginia channels respectively. In order to divert water into the mouth of the conduit-feeder at Great Falls a temporary dam of stone and crib work was built across the Maryland channel, 1857 to 1864, which was replaced by a masonry dam completed in 1867. In 1883–'86 the masonry dam was extended across the Virginia channel. In times of very low water in the Potomac this dam, the crest of which was at an elevation of 148 feet above mean tide at the Washington navy yard, did not raise the water to a height sufficient to fill the mouth of the conduit at Great Falls, and in 1895–'96 the whole dam was raised 2½ feet, so that at low stages of the Potomac the mouth of the conduit is just filled.

The Washington aqueduct system as it exists today is, with but few modifications, that originally planned by General Meigs. The water supply is taken from the Potomac river at Great Falls, about 14 miles above the city. At this point a masonry dam eight feet in width on the top and 2,877 feet in length, completed in 1896, extends across the river from the Maryland to the Virginia shore. The water passes from the feeder, under the Chesapeake and Ohio canal, through the gatehouse and into the conduit, which is circular in cross-section, and for the greater part of its entire length is nine feet in diameter and composed either of rubble masonry plastered or of three rings of brick, but where the soil in which it was built was considered particularly good the inner ring of brick was omitted and the diameter was nine feet nine inches. Where the conduit passes as an unlined tunnel through rock the excavation was sufficient to contain an inscribed circle 11 feet in diameter.



LOCATION.	MASONRY Cu.yds.	CONCRETE Cu.yds.	BRICK WORK. Cu.yds.
West Abutment	2543.18	413.48	
East Abutment	3089.19	439.18	
Granite Arch	983.63		
Rubble Arch	1859.19		
Load	3002.63		
Under Spring Line	178.96		
Parapet Walls	257.40		
Conduit Through Bridge			516.00
TOTAL	11914.18	852.66	516.00

AQUEDUCT BRIDGE OVER CABIN JOHN CREEK, NEAR WASHINGTON, D. C.

The total length of the conduit and the two by-conduits around the reservoirs is 12 miles, and its slope is nine inches in 5,000 feet. Constructed by General Meigs in connection with the aqueduct system are five bridges, two of which are unique among engineering structures and will be briefly described later.

At the distributing reservoir the water passes into four cast-iron mains—48 inches, 36 inches, 30 inches, and 12 inches in diameter respectively. The Dalecarlia reservoir has a storage capacity of about 150,000,000 gallons, is practically without paved slope-walls, and is perfectly protected against pollution from the drainage of the surrounding country. The distributing reservoir has a storage capacity of about 150,850,000 gallons and is divided by a puddled and paved wall (through which is a passageway) into two sections containing 97,600,000 and 53,250,000 gallons respectively. The Georgetown high-service reservoir has a capacity of about 1,500,000 gallons.

In addition to the three reservoirs already mentioned, which form a part of the aqueduct system, there is another reservoir, built and controlled by the Commissioners of the District of Columbia, called the Fort Reno reservoir, with a capacity of about 4,500,000 gallons, the reference of its water surface when the reservoir is full being about 420 feet above mean tide at the navy yard.

The Dalecarlia and distributing reservoirs supply the pumping station and that part of the District which lies below 100 feet above datum. The areas lying between the levels of 100 and 210 feet above datum are supplied by pumping from the U-street station directly into the distributing mains, the Georgetown high-service reservoir being held as a reserve supply. The areas having a greater elevation than 210 feet above datum are supplied from the Fort Reno reservoir. It will be observed, therefore, that the total present storage capacity of all reservoirs is a little less than 307,000,000 gallons, or about six days' supply.

In July, 1897, for the first time in its history the conduit was permitted to discharge its maximum flow, which by current meter observations was found to be 76,500,000 gallons per 24 hours. Today the average daily consumption is about 45,000,000 gallons, or about 60 per cent of the ultimate capacity of the conduit. Ten years ago it was but 35 per cent, or less than 27,000,000 gallons.

To avoid misapprehension it should be stated that while the conduit can supply the distributing reservoir with 76,500,000 gallons per day, yet the pipes leading from the reservoir to the city are already overtaxed in supplying the present rate of consumption, and no relief will be felt by consumers until some method is provided for bringing an increased quantity of water from the distributing reservoir into the city.

General Meigs was in charge of the work upon the Washington aqueduct from the time of the first survey until July, 1860, when he was relieved by Captain H. W. Benham, of the U. S. Corps of Engineers, who in turn was succeeded by Lieutenant James St. C. Morton, of the same corps. On February 22, 1861, after an absence of seven months, General Meigs was again placed in charge, and the work was practically completed by him. In June, 1862, owing to the overworked condition of the War Department, the charge of the Washington aqueduct was transferred from that department to the Department of the Interior, where it remained until April, 1867, when it again passed into the care of the War Department, and has remained there ever since.

In his report upon the proposed line of the conduit, General Meigs states that seven miles after leaving Great Falls the only serious obstacle in its whole course, the valley of Cabin John branch, is encountered. This valley, he says, might be crossed by pipes, but he states that in his project he has avoided them because "they always occasion a loss of head or else exceed in cost the bridges they replace." He therefore first proposed to cross the valley by a bridge 482 feet long and 20 feet wide, supported upon six semi-circular arches of 60 feet span, resting upon piers seven feet thick at the top and of various heights, the highest being 52½ feet. The estimated cost of this bridge was $72,409. This plan was afterward entirely changed and the present magnificent structure, the grandest stone arch in existence, was erected.

The total length of the bridge, including abutments, is 450 feet; its width is 20 feet 4 inches, and its height above the bottom of the creek 100 feet. The span of the arch is 220 feet and the rise 57.26 feet. It was begun in 1857 and completed, with the exception of the parapet walls, in 1864. These walls were built in 1872–'73, vehicles having been prevented from getting off the bridge prior to that time by timber guards. All the original plans of the bridge are signed by General Meigs as chief engineer of the Washington aqueduct and by Alfred L. Rives, assistant engineer, Cabin John division. The entire bridge contains 13,283 cubic yards of stone masonry, concrete, and brick-work, and it cost, complete, about $254,000. The cut-stone arch is of Quincy

(Massachusetts) granite, the abutments are of Montgomery county gneiss, and the rubble arch, spandrils, and parapet are of Seneca sandstone.

Contrary to the general impression, the space between the spandril and abutment walls is not solid, but contains several arches, built, as shown in the drawing, to effect a saving in masonry. Materials were transported to the bridge by boat *via* the Chesapeake and Ohio canal and Cabin John creek, across which a dam was built near the canal, and the pool thus formed was connected with the latter by a lock.

On the south side of the west abutment of the bridge the following inscription is cut:

Washington Aqueduct,
Begun A. D. 1853. President of the U. S.
Franklin Pierce. Secretary of War,
—— ——. Building A. D. 1861.
President of the U. S., Abraham Lincoln.
Secretary of War, Simon Cameron.

This inscription originally contained the name of Jefferson Davis, which was cut out in the summer of 1862 by the contractor by order of the Secretary of the Interior, Hon. Caleb B. Smith, to whose department the aqueduct had been recently transferred. If forgetfulness of the bare historical fact as to who was Secretary of War at the time was the object sought by the erasure, the result has been a woeful failure, for the inherent curiosity of mankind is such that the erased name is more strongly impressed upon the memory of the visitor than would have been the case had it remained untouched.

In concluding the description of the Washington aqueduct and its special structures, it is proper to call attention to another of its bridges, the bridge over Rock creek on Pennsylvania avenue, as noted for its bold originality as is Cabin John bridge for its grand proportions.

This bridge is unique among the aqueduct bridges of the world, in that the two 48-inch mains, through which now flows about one-half of the water used by the city, themselves form the arched ribs which support the roadway overhead. The span of this bridge is 200 feet and its rise 20 feet. At the time it was built it was the only one of its kind in the world, and it enjoys, it is believed, this distinction at the present day. It was much commented upon by European engineers, and was illustrated in many of the foreign scientific and engineering journals of the time.

CABIN JOHN BRIDGE — WASHINGTON AQUEDUCT — THE LARGEST STONE ARCH IN THE WORLD

From a Photograph by Elliott P. Hough

GARDINER GREENE HUBBARD

It is with the most profound regret that we record the death of Mr Gardiner G. Hubbard, which occurred at his country house, Twin Oaks, near Washington, on Saturday, December 11.

While the Joint Commission of the Scientific Societies of Washington mourns the loss of a many-sided and broad-minded president, the Smithsonian Institution a most active and sagacious regent, the Columbian University a generous and indefatigable trustee, and other educational, patriotic, and benevolent institutions of the national capital a liberal benefactor, a wise counselor, or an earnest colaborer, it is in the National Geographic Society and its work that the most conspicuous gap has been created. The President of this Society from its foundation, Mr Hubbard was enabled by a combination of circumstances as exceptional as it was fortunate to sustain a relation to it that is probably without a parallel in the history of scientific societies. It is no new thing for such societies to enjoy the benefactions of wealthy and generous patrons and the inestimable advantage of the wise counsels of far-seeing and judicial-minded advisers concurrently with the inspiring influence of men of the broadest culture and the most progressive ideas. Rarely if ever before, however, have these qualities and functions been united in one individual, or has there been so singularly varied a capacity for usefulness as was given to Mr Hubbard and as he exercised to its fullest extent. The loss to the National Geographic Society is for this reason an irreparable one, and the ordinary expressions of regret seem cold and conventional.

It is impossible, in this number of the Magazine, to attempt a portrayal of Mr Hubbard's unique personality, or to do justice to the nobility of his character, or render adequate tribute to his unexampled services to the Society. We can only record his deeply lamented death, refer thus briefly to his untiring labors for the advancement of science, and announce that a more extended notice of his life and work will appear in the January number of this journal.

J. H.

POLLUTION OF THE POTOMAC RIVER,

By F. H. Newell,

Chief Hydrographer, U. S. Geological Survey

The facts concerning the pollution of the Potomac river are of peculiar concern to the residents of Washington because of the fact that the supply for domestic and municipal use is derived mainly from that stream, only a small portion being obtained from wells or springs. This water we know to be polluted, but opinions differ widely as to whether these pollutions are negligible or may be sources of ever-present danger to the community.

In order to discuss the subject intelligibly it is necessary to have clearly in mind the situation of the catchment basin of the river, as well as the relative position of the various tributaries and of the principal towns and political divisions. We of course know that the Potomac is one of the principal rivers of the Atlantic slope, receiving the drainage from an area which lies about midway of the eastern side of the United States. It rises in the Alleghany mountains, its drainage basin embracing portions of the states of Pennsylvania, Maryland, West Virginia, and Virginia. At this part of the system the mountains have a general trend a little north of northeast, the narrow valleys between the ridges are nearly parallel, and thus the streams coming from the mountain sides unite in creeks or rivers flowing either northeasterly or southwesterly. Taking the Potomac basin as a whole, by far the greater number of the tributaries flow toward the northeast, the streams coming from the northern part of the basin being relatively small. The main river itself, receiving from point to point the tributaries from each side, cuts directly across the mountains, having a southeasterly direction, although in detail its course is quite crooked.

The absence of lakes, marshes, and broad valleys renders the tributary streams rapid in their delivery of precipitation upon the basin, the Potomac being subject to sudden floods, and the dry season discharge being very small. For this reason the river as a source of power is not so valuable as might be expected from the size of its drainage area. At the points where the river cuts through the successive mountain ridges the slope is rapid, but there are no falls of considerable magnitude until the stream has passed the Piedmont plateau and reached the border of the softer Cretaceous rocks. Here, at the fall line, it forms a succession of cataracts, a drop of 90 feet occurring within a short distance at the Great Falls. At about this locality the city of Washington has been placed, its situation being governed by the questions of navigation and of water-power. These have been the factors which have contributed largely to the growth and development of important cities along what is known as the Fall line, extending from New York to Georgia. Just before the river takes its plunge over the Great Falls a small portion of its water is diverted into an aqueduct, which, following along the north side of the river, delivers by gravity a supply of water to the reservoirs, which in turn feed the water system for the city.

One of the most notable features is that the river receives only a few short streams from the north, the greater portion of the water coming from the south and flowing northeasterly in the nearly parallel narrow valleys between the mountain ridges. The rivers meander through trough-like valleys, cut out mainly in limestone, the bounding ridges being of sandstone or other hard resisting rocks. These ridges rise to heights of 2,000 feet or more and are usually forestclad. The precipitation from these ridges, usually in the form of rain, is partly evaporated or taken up by vegetation, about 50 per cent or a little more flowing down the steep hillsides to the valleys.

This run-off water is pure and clear, but upon reaching the lowlands it mingles with the washings from the rich soils and cultivated fields, and becomes, in time of flood at least, turbid and yellow. The lowlands, especially of the wide valleys such as the Shenandoah, are notably rich, and prosperous farms are to be found their entire length. These have induced the growth of villages and towns, some of which, under the stimulus of small manufacturing industries, are rapidly growing. As a rule these are situated upon some stream, since their location has been primarily determined by a water-power mill or ford. The refuse from all these towns is, as a matter of course, discharged into the stream.

Potomac river, as the name is commonly applied, results from the union of the North branch, the stream above which Cumberland, Md., is located, with the South branch, at a point about 12 miles below this city. The North branch and the main stream into which it empties form the state boundary between Maryland and West Virginia. The South branch lies wholly within this latter state. At their headwaters these two branches flow in a general northeasterly direction, nearly parallel to each other, the North branch being to the west of the Alleghany front and the South branch to the east. The total drainage area of the North branch at Cumberland is 891 square miles, or about 8 per cent of the entire catchment area above the city of Washington. The total drainage area of the North branch at its mouth, or where it joins the South branch, is 1,365 square miles, being a trifle smaller than the area drained by the latter.

The waters of the North branch of the Potomac, even near its head, are naturally somewhat dark in color, and it is stated by the older inhabitants of the region that it has always been thus, owing probably to the presence of decaying vegetable matter from the forests. This is further increased by the effluents from the saw-mills, tanneries, and coal mines, so that at the old mill-dam near Keyser the polluted water agitated by the fall boils and foams, forming in the early morning a thick layer of whitish-brown froth.

In order to obtain a general conception of the amount of pollution, it is necessary to know how much water is carried by the river. This, of course, varies from day to day and even hour by hour. These minor fluctuations are slight, and by taking special care during time of flood it is possible to know how much water is delivered by the main stream and its principal tributaries. Without entering into a discussion of how this is accomplished, it is sufficient to state that the results are given in a table showing the average daily flow throughout the year in cubic feet per second.

The minimum flow of the river has been considered to be that obtained by Mr William R. Hutton in 1856, 1,063 cubic feet per second. It is probable that during the past fall (1897), owing to the protracted dry weather, the discharge sank to about this amount. At that time the water received into the conduit is stated to have been from 75 to 90 second-feet, or from 7 to 9 per cent of the total volume of the river.

It is evident that the quantity of water in the Potomac, especially at times of flood, is very considerable, and that sewage and waste material dumped into it from towns and manufacturing establishments must be greatly diluted, but in times of low water this must necessarily become less so. The quality of the water is therefore becoming more and more a matter of concern because of the fact that with the increase of population in the Potomac basin the artificial impurities will increase and the amount of water to be taken out at Washington will also be greater, while the natural flow of the stream is practically unaffected. As before stated, the impurities are of two kinds, natural and artificial. The natural impurities consist mainly of the finely divided soil washed from the agricultural lands of the valleys, this being for the most part the residual matter left by solution of limestones. It exists in such fine particles that while the water is in motion it is not deposited and may remain in suspension for days, even after the water sample has been put into a closed bottle.

The proportion of this mud varies from time to time, being greatest during floods and least during periods of low water, when the supply is received by percolation from underground sources. At such times the water is clear and entirely unobjectionable as far as casual observation is concerned, but the flow in the river is greatly diminished and the proportion of sewage must be notably increased.

While the natural impurities are usually so apparent and annoying to the eye through the dirty color and muddy sediment, the artificial impurities, on the other hand, are not so readily noted. The heavier particles of the waste from the towns and manufacturing establishments are washed down the stream slowly and are gradually burned up or oxidized or pass into solution in the form of various organic compounds. These, as a rule, do not notably discolor the water, and some of them may even aid in giving a bright, sparkling effect, so that very dilute sewage when exposed to light and air for a few hours may be unobjectionable to the eye, although carrying with it a great load of objectionable substances or minute animal or vegetable life.

The pollution of the Washington water supply would be very little if the headwaters of the Potomac could be cut off just below Cumberland, and while the water is very bad at that point, it should be remembered that it is there a comparatively small stream, with a minimum discharge of less than 60 feet per second, while the minimum discharge at Point of Rocks, so far as observed, is about 800 second-feet, and the Monocacy and a number of smaller tributaries reach the river between that point and the intake of the waterworks at Great Falls.

In times of low water, when, of course, these pollutions bear the largest ratio to the total supply, the Potomac at Cumberland probably contributes not more than six per cent of the water carried by the Potomac at Great Falls, and this small percentage traverses about 190 miles of broad river bed, agitated and broken by numerous shoals and diluted by fresh waters bearing more or less oxygen and sediment tending to its purification. While these influences contribute to ameliorate the quality of the water, it cannot be contended that the supply for this city is entirely as it should be.

Sufficient has been said to indicate that a considerable amount of filth of all kinds is habitually dumped into the river, and that this is steadily increasing. It is not desirable to describe or characterize this material under any stronger term than sewage, as the details are too disgusting to be given in a public address. It may properly be claimed, however, that no matter how bad the material is at the point where discharged, it becomes neutralized or destroyed before the water containing it reaches the Washington aqueduct. The self-purification of rivers is a phrase which has been made the excuse for much carelessness or indifference, but there is no doubt that streams do tend to rid themselves of much of their undesirable load.

The conditions along the Potomac are particularly favorable, for the water passes over many broad riffles where it is exposed to light and air, and many deleterious substances are unquestionably burned up, while others may possibly be dragged down by the finely divided sediment which is usually present. Thus the chemicals used in the pulp mills, tanneries, and other factories are greatly diluted, and by reaction upon each other and upon the small amount of lime carried in solution probably form harmless compounds. The momentous question therefore is as to the behavior of the small micro-organisms, to which the modern students of disease attribute such potent influence on the human system. Take, for example, the typhoid bacillus, which is said to live even in ice for a hundred days or more and to develop in soil, retaining its vitality for a year and even increasing from a single cell to 16 million individuals in 24 hours. It may be questioned whether such an organism is rendered harmless in the journey of from two to four days or more from the sewers of towns up the river to the mouth of the aqueduct.

We are comforted by the assurance that harmful bacteria are rarely found in Potomac water; but still this may not set us wholly at rest, for negative evidence in such a case proves little. The discussion of the probable danger from sewage must be left to experts in other lines, for the work in hand pertains mainly to ascertaining the quantity of supply, its variations, and its use. The facts which have been put on record are those concerning the source and quantity of water in the river, the location and character of the polluting agencies, and inferentially the degree to which the sewage or waste is diluted by the annual flow of the stream.

Until state or national legislation can be secured to regulate such matters, the Potomac, as in the case of all interstate streams, must serve as a sort of sewer into which town and manufacturing establishments empty their refuse, and this fact must be borne in mind in all considerations of water supply. The improvement of water supplies from this source should begin at both ends—that is to say, pollution should be prevented as far as possible and the water supply for a city should be filtered. The state of Massachusetts has set the example in this respect, preventing the pollution of streams by gradually forcing towns to provide suitable sand filters for sewage before allowing it to discharge into certain rivers, and also by providing similar sand filtration for the water which is to be used for municipal purposes. The system of intermittent sand filtration has been found to be efficacious not only in taking out visible particles but in nitrifying and destroying the smaller organisms apparently so potent in matters of public health.

THE DELTA OF THE MISSISSIPPI RIVER*

By E. L. Corthell, C.E., D.Sc., etc.

The Mississippi delta proper extends over 100 miles by the course of the river above the city of New Orleans. The materials composing this great mass of sedimentary deposit have been partly disclosed by numerous artesian wells which have from time to time been driven for the purpose of obtaining, if possible, potable water. The most notable instance, and where probably the most careful observations were made, is the artesian well at Lafayette square, New Orleans. At a depth of 1,042 feet the tool was broken and the work ended, but driftwood was pumped up at the last foot.

*Abridgment of paper read before the Geographical Section of the British Association for the Advancement of Science, Toronto, August 24, 1897.

Many interesting facts bearing upon the question of the geological formation of the Mississippi delta were brought to attention two years ago through the investigations and discussions connected with an engineering question which arose between the executors of the late Mr James B. Eads and the War Department as to what is the legal plane of reference for ascertaining the depths and widths of channel which Mr Eads was required by the law of the Federal Congress to maintain between the deep water of the South Pass of the Mississippi river and the Gulf of Mexico.

On Belize bayou, which leads out to the Gulf from one of the now unused passes of the river, stands an old Spanish magazine, built over 200 years ago. At the time of building the jetties at the mouth of the South Pass this magazine was in a fair state of preservation. The exterior was intact and there were no cracks which would indicate settlement, the building standing perfectly level, but with the surface of the water stretching across the arch which crowned the entrance door, the sill of which must have been at least ten feet below the water. That was in the year 1877. Nineteen years later a part of the structure had been removed, but enough of the roof and arches remained to show that the subsidence had continued steadily during that period of nineteen years at about the same rate as during the preceding two hundred years. It may be stated that this rate, both from this instance and from other information, is, at the mouth of the Mississippi, about one-half of one-tenth of a foot per annum. Numerous illustrations going to prove the general subsidence of the delta lands might be stated. Not only are these lands unstable in a vertical direction, but they are often found to be so in a lateral direction. It is an interesting engineering as well as physical fact that an accurately measured base line exactly seven hundred feet in length was found, after a lapse of five years, to be 712 feet in length. It has been found impracticable to maintain with sufficient accuracy for reference purposes bench-marks, level heights, and tide gauges. This subject is quite fully discussed in the Report of the Mississippi River Commission for 1894, pages 2794–2797, where the following important statement is made: "Discrepancies in bench-marks and level heights and gauges could only be satisfactorily accounted for by the most plausible explanation of the subsidence of the whole delta, making gauges and bench-marks at the mouth of South Pass unreliable." This remark is made by Mr J. A. Ockerson, assistant engineer to the commission.

On page 2697 of the same report the commission itself confirms Mr Ockerson's statement by its own opinion, as follows: "The main object of this resurvey was to elicit some information bearing upon the question of the stability of the land about the mouth of the river. In the report of Assistant Engineer Ockerson, appended to the report of the secretary, a number of figures and comparisons are given, based upon this survey and prior ones, indicating a progressive depression of the alluvial delta near the mouth of the river." An interesting diagram, designed to show the changes referred to, assumes that either the tide gauge had gone down or the level of the Gulf had gone up over one foot in twenty years. Numerous pertinent facts might be brought forward to show, in addition to the above, that the lands had gone down and that the Gulf level had not changed. It is a fact well known to people living in the delta of the Mississippi that large tracts of land were long ago abandoned in consequence of overflow by Gulf waters, due to the sinking of the lands.

The conditions are very different now from those existing prior to the construction of levees. There are at present no annual accretions of sedimentary matters from the periodical overflows of the river. These accretions formerly were a little more than equal to the annual subsidence of the lands.

As to the question of the rising of the Gulf level, careful investigations and inquiries around the entire Gulf coast from Yucatan to Florida disclose no indications of any such elevations. The factors in forming the great hydraulic conditions of the Gulf operate so steadily from year to year and from cycle to cycle that we should naturally expect that, with the exception of small annual changes due to wind and tides, the mean surface of the Gulf would remain practically at the same level. The difference in precipitation, fluvial discharge into the Gulf, and evaporation is very slight as compared with the great current forces that make and maintain the Gulf level. From very careful observations, it may be stated that the mean precipitation, river discharge, and evaporation amount, all told, to a little over three cubic miles per day. This volume "sinks into utter insignificance when compared with that produced by the inflowing current of the Yucatan channel, which, according to a calculation from Lieutenant Pillsbury's current observations, hurls the enormous quantity of six hundred and fifty-two cubic miles of water per day into the Gulf."*

*See a paper by A. Lindenkohl, Assistant U. S. Coast and Geodetic Survey, in *Science*, N. S., Vol. iii, No. 60, February 21, 1896.

The geology of the delta of the Mississippi is an interesting local study. The effect of the withholding by the levees from the great areas of the delta of the annual contributions of sedimentary matters, and the steady, though slow, subsidence of these areas, is one which should be taken into account in deciding the important question of how to protect the people from the flood waters of the river. No doubt the great benefit to the present and two or three following generations accruing from a complete system of absolutely protective levees, excluding the flood waters entirely from the great areas of the lower delta country, far outweighs the disadvantages to future generations from the subsidence of the Gulf delta lands below the level of the sea and their gradual abandonment due to this cause. While it would be generally conceded that the present generation should not be selfish, yet it is safe to say that the development of the delta country during the twentieth century by a fully protective levee system, at whatever cost to the riparian states and the Federal Government, will be so remarkable that people of the whole United States can well afford, when the time comes, to build a protective levee against the Gulf waters, as the city of New Orleans has done on a small scale against the sea waters of Lake Pontchartrain, and as Holland has done for centuries and is now about to do on a still larger scale, in removing the sea waters themselves in the great projected réclamation of the lands submerged by the Zuyder Zee. Mr Eads once said, in an eloquent speech on the subject of the importance of the Mississippi river and its delta channels to the sea: "This giant stream, with its head shrouded in Arctic snows and embracing half a continent in the hundred thousand miles of its curious network, and coursing its majestic way to the southern Gulf through lands so fertile that human ingenuity is overtaxed to harvest their productiveness, has been given by its Immortal Architect into the jealous keeping of this Republic."

THE ANNEXATION FEVER

A curious and interesting example of the survival of inherited traits, on a large scale, is seen in the instinct for the acquisition of territory, which is manifested by all nations, savage or civilized, in greater or less degree.

In the olden time, when the earth was peopled by savages, the acquisition of territory by conquest involved not alone the extension over the conquered region of the jurisdiction of the conqueror, but possession in fee. The conquered territory was made as profitable as possible to the conqueror. It may have been looted for his benefit, or it may have been taxed for all it would bear. In whatever way it was done the conquered territory was made a source of profit to the victorious party.

That sort of thing passed out of vogue among civilized nations ages ago, and today among such people the acquisition of territory means simply a change of jurisdiction. The laws and the flag of one nation are substituted for those of another. The nation acquiring the territory collects taxes, and in turn assumes the duty of protecting the people of the acquired territory from one another and from foreign enemies. The nation is not enriched by the acquisition. It may or it may not be strengthened, according to the character of the acquisition.

But while the results of acquiring territory have thus become radically changed, the desire, the instinct for its acquisition remains apparently in full force. Without inquiring whether in any one case it will be an advantage or a disadvantage for a country to extend its limits, ninety-nine out of every hundred of its people urge its extension. In other words, the great mass of the people concerned act merely upon instinct, such instinct being simply the remains from the time when acquisition of territory meant an increase of property.

The question whether accessions of territory are desirable or not turns upon many considerations, among them being the character and resources of the proposed accession, its situation and distance, the condition of its people as regards civilization, and the character of the people and of the government of the annexing country.

The United States, of all nations, should go very slowly in this matter, first, because since it stands at the head of the nations in point of civilization, almost any addition of people to its numbers will reduce the average civilization, and consequently the strength and industrial capacity of its people. Second, because under its principle of home rule, annexed provinces will be called on to govern themselves in all local matters, while the general government will be held responsible by foreign governments for all hostile acts committed by such annexed states against their citizens; and, third, because all annexations involve responsibilities in case of war for which we are unprepared and show little disposition to prepare ourselves.

Viewed critically, our annexations of territory up to and including the Mexican cessions were wise and have justified the foresight of our statesmen. We needed Louisiana to control the Mississippi; the purchase of the Floridas settled a dispute of long standing, removed Spanish power from our midst, and gave us the entire Atlantic and Gulf coasts; the addition of Texas simplified our southern boundary, and the Mexican cessions rounded up our area of jurisdiction into compact form. But why we should have purchased Alaska is past finding out. A few of our citizens have profited by the fur and fish trade, but the government has been embarrassed and put to much expense on account of this region, and more embarrassment and more expense are certain in the future.

The majority of our people wish to annex the Hawaiian islands. For what reason it is difficult to see. Hawaii is 3,000 miles away from our nearest shore. While the governing class is largely made up of our own kin, the vast body of the population is Kanaka, Chinese, Japanese, and Portuguese—not by any means a desirable addition to our numbers. The annexation of these islands would greatly increase our responsibilities and correspondingly weaken us, without in any way adding to our well-being. It is said that they will furnish us a coaling station in the mid-Pacific. Under whatever jurisdiction these islands may be, our vessels can coal there freely in time of peace. In time of war our vessels will find occupation enough at home without wandering away from the coaling stations on our shores. We are not likely to take the offensive in a war with any first-class power, especially a naval power. It is certain that in case of war with such a power one of our first acts would be to give up all such outlying dependencies, since their defense would be utterly impracticable.

There is another side, however, to this Hawaiian matter. There is no doubt but that the ruling class in Hawaii would be better off under our jurisdiction than if isolated, or even under English jurisdiction. Shall we, for their good, ignore the manifest disadvantages to ourselves of this union? It may be doubted if we have reached this stage of altruism.

What has been written of Hawaii applies with much greater force to Cuba, whose annexation has been actively urged, even to the extent of offering to purchase the island from Spain. Why should we want Cuba? An island, separated from us by sea, sparsely populated by an alien, semi-civilized people speaking a different language, with no experience in self-government, with a history, traditions, and sympathies wholly different from ours: could we hope to make them one with us? Can we afford to dilute our national legislature with a score or more of Spanish Cubans? Can we afford to assume responsibility for the acts of such a home government as the Cubans are likely to set up?

As with Hawaii, there is no question about the advantage to Cuba of such annexation; but in this case even altruism would say nay; for, assuming for the moment that the mission of the United States is to better the condition of mankind, her efficiency for this mission would be too greatly impaired by such an act.

There is constantly more or less talk about the annexation of Canada. There is less objection to this than in the case of any other possible addition to our jurisdiction. It would practically eliminate Great Britain from North America, would add a population which on the whole is no less civilized than the average of our people, and a territory a part of which, at least, is of value as an agricultural region.

Having glanced at the merits and demerits of proposed additions to our area and population, it will be instructive to extend our view and glance at the history of other nations in this matter and the results of their acts. Of all nations, Great Britain has shown the greatest greed for land. Her jurisdiction is as wide as the earth. The little island in western Europe governs many millions of square miles, including Canada, Australia, India, Egypt, and South Africa, besides scores of smaller colonies. Wherever the cross of St George waves, good government and safety to persons and property are assured. To enforce her jurisdiction over all these dependencies she finds it necesary to maintain a large standing army and a navy which is by far the largest of all the nations; and yet, in spite of her large standing army and her immense navy, she is one of the weakest of nations, because her responsibilities have been increased in still greater proportion.

What has she gained by her policy of acquiring territory? In what way have her people gained more bread and cake? Has her commerce been increased materially? Her total foreign trade in 1894 was £624,000,000, of which her colonies contributed £166,000,000. The United States alone contributed £119,000,000. Have the annexed regions furnished homes for much of her swarming population? In all her colonies there are found some 9½ millions of people of English descent. In the United States alone are found not less than 40½ millions of persons of British descent. Vastly more of her people have gone to the United States than to her colonies.

It is not to be supposed that Great Britain is doing all this work for pure philanthropy; still, in following her acquisitive instinct, she has been, on the whole, one of the greatest agencies for good, by the spread of civilization, that the world has known.

HENRY GANNETT.

SIR JOHN EVANS AND PROF. W J McGEE

Whether one of the ultimate results of that decided tendency to the specialization of knowledge and of all scientific investigation which constitutes so striking a characteristic of the present age will be to render it impossible for a man to become eminent in more than one department of intellectual activity remains to be seen. That that time has happily not yet arrived is perfectly clear, both the British and the American Associations for the Advancement of Science having this year been presided over by men who have attained the highest distinction in more than one department of science.

By occupation a civil engineer and paper manufacturer, and highly successful in both capacities, Sir John Evans has made so great an impress on the scientific work of his time as a geologist, an antiquary, and an anthropologist, as well as in numismatics and applied chemistry, that the leading British societies representing these different sciences have all successively honored him with their presidency, a circumstance almost unprecedented. Attaining at 74 years of age the chair rendered illustrious by the names of Herschel and Brewster, of Lyell and Murchison, of Huxley and Tyndall, he has only one more scientific distinction to look forward to—the presidency of the Royal Society.

Thirty years the junior of his eminent English compeer, Prof. W J McGee has likewise taken his place in the very front rank of anthropologists after attaining distinction as a geologist. His scientific career began with a detailed survey of an extensive area in Iowa at private cost, in the course of which important principles were developed. Later, as one of that splendid body of men who have made the United States Geological Survey the wonder and envy of all civilized nations, he spent a decade in solving the problems of the coastal plain and neighboring districts, in developing new principles for the classification of formations, and in compiling the standard geological maps of the United States and of the State of New York. He established the Potomac, Lafayette, and Columbia formations and traced them and other deposits throughout southeastern United States, his personal mapping of formations and systems covering an area of over 300,000 square miles. In his later work as Ethnologist in charge of the Bureau of American Ethnology he has made additions of the very greatest importance to our knowledge of the aboriginal races of the North American continent, and has greatly enriched anthropological literature, both by his official reports and his numerous contributions to the transactions of scientific societies. No worthier representative of American science could have been found to preside over the American Association during the year of the visit of the British Association to this continent than Prof. W J McGee. J. H.

SOME RECENT GEOGRAPHIC EVENTS

In the expectation that opportunity would be afforded to make them the subject of special articles, several recent occurrences of considerable geographic interest have so far been allowed to go without mention in this journal. The publication of the concluding number of the present volume, however, calls for at least a brief notice of them, if only as a matter of record.

These interesting events include the Andrée Balloon Expedition to the North Pole and the de Gerlache Expedition to the Antarctic, the return of the Jackson-Harmsworth Expedition from Franz Josef Land, of Lieutenant Peary from Greenland, and of Dr Sven Hedin from Central Asia; the successful ascent of Mount St Elias by Prince Luigi of Savoy, and the Mazama Expedition to the summit of Mount Rainier, with the lamented death of Professor Edgar McClure.

Herr S. A. Andrée, accompanied by Dr Strindberg and the engineer, Herr Fraenckell, ascended in his balloon, the *Eagle*, from Danes island, Spitzbergen, on the afternoon of Sunday, July 11, under favorable meteorological conditions. From that day to this nothing has been heard of the adventurous explorer and his two companions. Many eminent geographers have regarded the expedition as an impracticable if not absolutely foolhardy enterprise, but Herr Andrée's fellow-countrymen, at least, have not lost faith in his skill, courage, and endurance. Dr Nils Ekholm, who originally intended to accompany the expedition, but eventually declined to do so, in the belief that the impermeability of the balloon was not satisfactory, inclines to the opinion that Herr Andrée has descended somewhere between the Pole and Franz Josef Land; that he would endeavor to make his way to the provision depot that had been established in advance, and that

HERR S. A. ANDREE

no surprise need be felt in the event of no communication being received from him until next summer or fall. Mr Frederick G. Jackson, the leader of the Jackson-Harmsworth Expedition, says he sees nothing to prevent Andrée, with good luck, from accomplishing his purpose, but adds, significantly, that it is quite impossible for any one to say where he is likely to be.

For the Antarctic the *Belgica* sailed from Antwerp on August 16. The ship was fitted out in the best possible manner, and her crew, which consists largely of Norwegians, was most carefully selected. It is expected that the voyage will be completed within two years, but a three-years' supply of provisions has been taken. The *Belgica* will go first to the east of Grahams Land in George IV sea, and then winter in Australia. The second year will be devoted to Victoria Land. The steamer is well equipped for scientific investigations as to marine specimens and submarine deposits.

The Jackson-Harmsworth Expedition to the North Polar Regions, which left England on July 11, 1894, in the steam-yacht *Windward*, arrived in the Thames on the 3d of September last, having left Franz Josef Land on August 6. This expedition has solved a most interesting geographical problem, having not only determined the northern coast line of Franz Josef Land, hitherto absolutely unknown, but proved, if not the non-existence of Gillis Land, at least the fact that it does not lie in the longitude that has been assigned it. The three years spent in the Polar Regions by this admirably equipped expedition (the entire cost of which was borne by Mr A. C. Harmsworth, who has since placed the *Windward* at the service of Lieutenant Peary) have resulted in many important additions, not merely to our knowledge of Arctic geography, but to various other sciences.

Lieutenant Peary's most recent expedition to Greenland is of note chiefly on account of the success that has attended his efforts to bring back with him the Cape York meteorite, 45 tons in weight. That this is a genuine meteorite has in certain quarters been called in question, but the consensus of opinion among the most eminent authorities leaves no room for doubt as to its extraterrestrial origin.

The return of Dr Sven Hedin from his four years' exploration of the less-known portions of Central Asia is a notable occurrence. Dr Hedin left Stockholm in October, 1893, returning to that city, his birthplace, on May 10 last. He made many important discoveries, among which were two ancient cities, now buried in the sands, whose paintings and sculptures bear witness to a high degree of civilization at a remote period of antiquity. Dr Hedin's explorations were made at the expense of the King of Sweden and Norway and a few private individuals.

The Duke of the Abruzzi (Prince Luigi of Savoy) and his companions reached the summit of Mount St Elias, without accident, on July 31. It took 38 days of hard traveling to reach the foot of the mountain from the point of debarkation, but the actual ascent, while exceedingly arduous, was made under most favorable conditions and many very fine photographs were secured.

The expedition of the Mazamas to the summit of Mount Rainier—so long looked forward to—was made in the last week of July, but of the large number of persons who started from Tacoma only a few reached the summit, and the lamentable death of Professor Edgar McClure, who fell over a precipice during the night of July 27–28, cast a gloom over the entire subsequent proceedings. Professor McClure, who occupied the chair of chemistry in the Oregon State University, was an experienced mountain-climber, having scaled all the principal peaks of the Cascade range. A valuable article from his pen on the Altitude of Mount Adams, Washington, appeared in the April, 1896, number of this magazine. J. H.

GEOGRAPHIC LITERATURE

The Founders of Geology. By Sir Archibald Geikie. Pp. x + 297. London and New York: Macmillan and Company. 1897. $2.00.

"Had the study of the earth begun in the New World instead of the Old, geology would unquestionably have made a more rapid advance than it has done. The future progress of the science may be expected to be largely directed and quickened by discoveries made in America, and by deductions from the clear evidence presented on that continent." Thus writes Sir Archibald Geikie, easily the foremost geologist of Great Britain if not of Europe, in his preface; and American geographers and geologists cannot fail to be gratified by this appreciative expression concerning their opportunities and their work. In the half dozen succeeding chapters or "lectures," the kindly promise of the preface is fulfilled, but with little further reference to the western hemisphere. It is singular that although geology is next to the youngest among the sciences, no competent student has sought hitherto to write the record of its growth; Lyell, indeed, made some essay in this direction, and our own Marsh has taken up one aspect of the subject, but neither of these masters professed to make his work both comprehensive and exhaustive. Now comes Sir Archibald, with unprecedented facilities, with the commendable desire of tracing without prejudice those efforts which contributed most materially to the making of the science, and with a disposition to assign due meed of credit to every "founder." The task is delicate and difficult, involving large reading, firm grasp of the science, warm sympathy for pioneering even when of the crudest, and judicial ability of a high order; yet it is done with such signal skill, with such boldness and fairness, that the little book at once takes rank among the classics of science. Beginning with the cosmogonists, Sir Archibald soon passes to the naturalists; and his review is specially noteworthy in bringing out clearly the important contributions to earth-science made by one whose name has seldom been heard in this generation—Jean Étienne Guettard, author of "a new application of geography" and of the earliest known geologic map, one of the first to describe appreciatively the work of rain and rivers in modifying geographic features and to accurately note the geographic distribution of fossils, first discoverer of the volcanic origin of the extinct craters of central France. Passing thence to Werner and to Hutton (and his interpreter, Playfair) with their rival "theories of the earth," he proceeds to parcel credit duly to d'Archiac, Barrande, von Buch, Buckland, Cuvier, Darwin, De la Beche, Sir James Hall, Lyell, Murchison, de Saussure, Sedgwick, William Smith, and a score of less known makers of the science; his treatment being the more satisfactory to geographers by reason of his own full appreciation of modern physical geography—the New Geology. American readers may find the work incomplete at first blush by reason of the omission of such names as those of our own Hall, the principal author of the "New York system," of Hilgard, the prophet of southern geology, and of Powell, the discoverer of the baselevel and thus the founder of physiography; but further reading will reveal the author's policy of avoiding characterization of the work of living leaders. Sir Archibald's style is simple and clear and the book-making is admirable; so the treatise is easy reading, while its substance is made accessible by a full index.

W J M.

Java, the Garden of the East. By Eliza Ruhamah Scidmore, Author of Jinrikisha Days in Japan. Pp. 339, with illustrations. New York: The Century Company. 1897. $1.50.

Fastidious readers are indebted to the Century Company for some three hundred and fifty pages of as artistic book-making as the year has seen—artistic in typography and paper, artistic in illustration, and still more artistic (though this is but the publishers' good fortune) in literary form and content—and the book is no less instructive than artistic. Toward the end of the fifteenth century the spirit of conquest awoke from its long sleep of the dark ages, and first Iberia and then Netherland entered on careers of exploration and colonization. All men took note of the Spanish conquests, partly because they included a New World; but somehow the less brilliant moves of the Dutch on the world's checkerboard have not been followed with equal attention—at least by English-speaking peoples. So Batavia has long been half recognized through the mists of a provincial language as some sort of contributor toward the solid wealth of Amsterdam and 's Gravenhage (reduced by us, in self-defense, to The Hague), while Java was still more vaguely glimpsed as the coffee plantation of the Dutch East India Company. True, there is a rich literature grown out of the Dutch conquest and colonization, in which Java and its capital city are faithfully pictured in all their stages of growth since the first vessels from Holland reached them about 1590; true, special students of geography and of trade interests are familiar with these records in the language of the Lowlands; yet to the mass of intelligent people the scant information gleaned through the alien literature was but the dry and dusty bones of dead knowledge. So Miss Scidmore's book comes as a fragrant breath direct from the lush nursery of the Orient—and a breath so redolent of the mystical potency of eastern legend (and western, too) as to regenerate the skeleton in full flesh and vigorous vitality. The author spent months in the country; she saw with occidental eyes, indeed, yet all the more clearly because without the curious oriental haze which distorts the vision, sometimes little, often much; her pen pictures and sun pictures alike bear inherent evidence of fidelity; and the general presentment of "The Garden of the East" is done in vigorous lines and strong colors. As time passes, literature changes; of old, the writer devoted a lifetime to a book (writ perchance for a single reader), which was often a heaviness to the spirit; of late, a more fanciful yet more vigorous style has grown up under the pressure of magazine editors compelled to meet, more promptly than the bookmakers, the demands of modern readers; and now this literary quality—which is represented by the best writings of two score authors, chiefly American—is going into the books. In this style Miss Scidmore writes; each sentence is filled with idea and every paragraph throbs with vitality and brims over with good humor, while the light of delicate fancy and solid culture shines out between the lines—each chapter is a gem, and the whole a chaplet of brilliants. The first chapter is "Singapore and the Equator;" the second "In 'Java Major';" the third "'Batavia, Queen of the East';" next "The Kampongs;" then "To the Hills;" the sixth "A Dutch Sans Souci;" the seventh "In a Tropical Garden;" the eighth and ninth "The 'Culture System';" the tenth "Sinagar;" the eleventh "Plantation Life;" the twelfth "Across the Preanger Regencies;" the thirteenth "'To Tissak Malaya';" then "Prisoners of State at Boro Boedor," followed by "Boro Boedor" and "Boro Boedor and Mendoet;" the seventeenth is "Brambanam;" the eighteenth "Solo: the City of the Susunhan;" next is "The Land of Kris and Sarong;" then comes "Djokjakarta," followed by "Pakoe Alam: The 'Axis of the Universe';" the twenty-second is "'Tjilatjap,' 'Chalachap,' 'Chelachap';" then follows "Garoet and Papandayang," and lastly (save a rather too condensed index) follows "'Salamat'," the soft farewell of the land of the Malay. It is impossible to epitomize these chapters, already condensed to the utmost; suffice it that apparently every appropriate subject is treated or at least touched lightly—the myth of the coco-de-mer is rectified and that of the "deadly upas" punctured skillfully; the coffee plantations are described, and the vile product of the local chef duly anathematized; the tea industry receives attention, and the unconventional hotel customs are not neglected; even Krakatoa, that world's volcano which happened to erupt so near to Java, comes in for a share of space. The book hardly professes to be scientific, and may be unworthy of entombment alongside the musty tomes of the Dutch societies; but it can be commended as a thoroughly readable and fully fin de siecle contribution to that semi-scientific literature which is neither so heavy as to sink straightway into the depths of desuetude nor so light as to drift into oblivion. W J M.

Natural Elementary Geography. By Jacques W. Redway, F. R. G. S. Pp. 144, with maps and illustrations. New York, Cincinnati, Chicago: American Book Company. 1897. 60 cents.

For many years teachers have realized that geographical text-books were unsatisfactory, and that the teaching of geography was as a consequence equally so, but without being able to better them.

Geography, as it has been heretofore taught in the schools, is not a science. It is little more than a mere mass of unconnected facts relating to the earth's surface. Teachers and pupils are but beginning to understand that geography is in the truest sense a science, in that all phenomena of the earth proceed from cause to effect, and that geography is the fundamental science upon whose broad back rest nearly all other sciences.

The birth of the new science of physiography, the study of the relief of the earth, gave a decided direction to geography teaching. The "Committee of Ten," appointed by the National Educational Association in 1892, in its report made this the leading feature of geography. It was a step in the right direction, but at the same time it limited the scope of geography to a study of the surface features of the earth. Later, the "Committee of Fifteen" took a great step in advance, presenting the science of geography in its full breadth and scope, not only as embracing the surface features of the earth, but their influence upon man and his industries, which is the ultimate end of all geography.

The above book is the first of a series of school geographies now being issued by the American Book Company. In scope it is fully in accord with the Report of the Committee of Fifteen, as it teaches not only the origin of the surface features of the earth, but their relations to man, his life, and his activities. It also embodies the most approved pedagogical methods, leading the child from the known to the unknown, from those things which he can see and appreciate through his senses to those which he must realize by the aid of his imagination. It is admirably illustrated, both as to cuts and maps, and the illustrations are used for the purpose of assisting the text, not merely to make a pretty book.

Without disparaging other recent text-books on geography, it is safe to say that in scope and method of treatment this book is far the most successful that has yet appeared. H. G.

PROCEEDINGS OF THE NATIONAL GEOGRAPHIC SOCIETY, SESSION 1897–'98

Excursion and Field Meeting, October 2, 1897.—Saturday afternoon excursion to Cabin John bridge by electric cars. Field meeting in the pavilion. Attendance about 250. After introductory remarks by President Hubbard, short addresses were delivered by Mr W J McGee on the Development of the Geography of the Region and by Mr Arthur P. Davis on the Pollution of Potomac Water. A paper prepared by Capt. D. D. Gaillard, U. S. Corps of Engineers, on Cabin John Bridge and the Washington Aqueduct was then read by Mr E. B. Hay, and the meeting adjourned to inspect the bridge and explore the surrounding country.

Special Meeting, October 22, 1897.—President Hubbard in the chair. Afternoon lecture by Prince Kropotkin on Russia and Siberia.

Reception to Dr Nansen, October 26, 1897.—Evening reception to Dr Fridtjof Nansen by the National Geographic Society at the Arlington hotel. President Hubbard, with members of the honorary reception committee, received the guests and presented them to Dr Nansen. About 1,600 persons were present. Later the President made a short address of welcome, and after remarks by Vice-President Greely and Engineer-in-Chief Melville, U.S.N., Dr Nansen addressed the Society, expressing his cordial appreciation of the hearty welcome and his indebtedness to American explorers, especially those of the *Jeannette* expedition, for the idea of his own voyage in the *Fram.*

Special Meeting, October 29, 1897.—Mr W J McGee in the chair. Vice-President Greely addressed the Society on Recent Geographic Progress.

Regular Meeting, November 5, 1897.—Vice-President Gilbert in the chair. Mr Robert T. Hill gave an illustrated lecture on the Geography of Jamaica and its Relation to Antillean Development.

Excursion and Field Meeting, November 6, 1897.—Saturday afternoon excursion to High island by electric cars for Brookmont, whence the party, consisting of about 350 members and guests, walked to the north end of the island. The field meeting was called to order by Mr McGee, and Mr Frederick V. Coville delivered a short address on the Coloration and Fall of Autumn Leaves. Later, at a meeting on the east side of the island, Mr Coville spoke of Adaptations for the Natural Distribution of Seeds, with practical illustrations.

ELECTIONS.—New members have been elected as follows:

September 16.—Lieut. Chas. P. Elliott, U.S.A., Miss Grace G. Isaacs, R. E. Redway.

October 6.—Mrs Mary O. Agnew, Rev. C. M. Bart, Major R. G. Batten, Mrs Julia P. Beckwith, H. M. Brayton, L. A. Conner, Jos. Dague, Miss Ellen C. Dyer, L. O. Garrett, Mrs Thos. Hovenden, Edwin A. Hill, Mrs Nora Hoegelsberger, Edgar Janney, M.D., Miss Virginia Kersey, Mrs J. B. Kendall, Henry Krogstad, M.D., Capt. F. Michler, U.S.A., W. E. Nalley, Miss Louisa G. Nash, Wilfred H. Osgood, Miss Mary B. O'Toole, A. Patten, M.D., Miss C. Augusta Pope, Hon. L. A. Pradt, G. W. Prewitt, M.D., J. W. Reisner, Wm. J. Rhees, Chief-Engineer C. R. Roelker, U.S.N., Jared G. Smith, Dr G. L. Spencer, O. H. Tittmann, Miss Mary E. C. Walker, Miss Helen I. Walsh, Edwd. C. Wilson, Miss Emma E. Woodard, Miss Hallie L. Wright.

October 22.—Miss Amelia R. Amos, Miss Jennie P. Andrews, Dr Frank Baker, F. L. J. Boettcher, Henry T. Burr, Eugene Byrnes, Miss Eliz. Carss, Robert S. Chilton, Thos. H. Clark, Major P. E. Dye, Saml. E. Fouts, W. J. Elstun, M.D., C. G. Gould, Miss Etta Griffin, F. P. Hackney, Mrs Wm. Hayden, Archibald Hopkins, F. M. Hosier, Dr L. O.

Howard, Miss Ida Howgate, D. S. Jackman, Mr N. J. Knagenhjelm (Chargé d'Affaires, &c., &c., Legation of Sweden and Norway), Chas. A. Keffer, Miss Mary Leet, Edwin R. Lewis, M.D., Frank B. Littell, Prof. Lee D. Lodge, Walter S. Logan, Miss Annie E. Loomis, Chief-Engineer H. Main, U.S.N., Mrs M. E. Martin, Miss N. E. S. McLean, Geo. Mason, Miss Frances M. Moore, John D. Morgan, Miss Susie P. Morris, Geo. L. Morton, Mrs Mary H. Myers, Rev. E. M. Paddock, Mrs Delia C. Perham, Edwd. T. Peters, Gifford Pinchot, Geo. H. Plant, Jr., Frank Playter, Fred. W. Pratt, Rev. Wallace Radcliffe, D.D., F. J. Randolph, Miss S. A. Reilly, T. B. Sanders, H. M. Schooley, D.D.S., Hon. H. W. Seymour, N. H. Shea, Miss E. J. Shively, Paul Simpson, Thos. J. Sullivan, Dr J. M. Sterrett, Miss Ida Thompson, Mrs Thos. L. Tulloch, Judge W. Vandevanter, Hon. F. A. Vanderlip, Surg.-Gen. W. K. Van Reypen, U.S.N., Miss Margaret S. Vidal, Major A. L. Wagner, U.S.A., H. Randall Webb, Henry W. Wheeler, Jas. L. White, Gen. E. Whittlesey, R. E. L. Wiltberger, D.D.S., W. F. Willoughby, Miss C. McL. Wright.

October 29.—Mrs Alta C. Baldwin, Miss C. R. Barnett, Major H. von Bayer, Wm. T. Biehl, Gen. Z. R. Bliss, U.S.A., Col. G. B. Brackett, Miss Sara G. Browne, Miss Susan W. Carson, Mrs J. D. B. Chany, Miss May S. Clark, Miss Florence Conger, Señor Don Luis F. Corea, Dr S. L. Crissey, Mrs Nellie H. Crocker, Rev. Dr G. S. Duncan, Miss Isabella Erwin, Miss M. E. Etheridge, Louis T. Farabee, Lawrence C. Forman, Miss L. M. Fox, Hon. James A. Gary, Miss Mary C. Guinn, Mrs Mary J. Hedges, Robt. T. Hill, Col. A. L. Hough, U.S.A., Miss F. S. Knobloch, Rev. E. B. Leavitt, Chas. A. Leith, Wm. W. Lesh, J. B. Mann, Frank B. Martin, S. S. McClure, Mrs Donald McLean, Col. Wm. H. Michael, Wm. Moore, M.D., Fred. A. Ober, J. A. Ockerson, C.E., Jesse L. Parker, Miss Mollie V. Paxton, Miss Eva H. Quinn, Prof. Geo. L. Raymond, Miss J. E. Richards, Geo. A. Ross, Miss Mary I. Sedgley, Mrs S. H. Shields, Rev. C. A. Smith, Robt. A. Smith, Chas. McG. Sweitzer, Gen. N. B. Sweitzer, U.S.A., Miss H. R. Talcott, Geo. Totten, Jr., Rev. John Van Ness, Dr Geo. B. Welch, Geo. Westinghouse, Jr., E. S. Whitney, Miss G. H. Williams, J. B. Wimer, Simon Wolf, Mr Alexander Zelenoy (Russian Legation), Miss Lillie L. Zimmerman.

GEOGRAPHIC NOTES

EUROPE

Great Britain. The report of the ordnance survey of Great Britain states that the area revised during the year ending March 31, 1897, was 4,623 square miles. The sale of maps realized £17,715.

Iceland. The Althing, or Icelandic parliament, has resolved to grant an annual subsidy of 35,000 kroner for 20 years to a company which has undertaken to lay a submarine cable from Iceland to Scotland *via* the Faröe isles. The Danish government also has promised financial aid, and it is expected that the cable will be laid early next summer.

Germany. The annual production of lumber in Germany is estimated at 8,300,000 tons. The imports have risen from 2,800,000 tons in 1891 to 3,200,000 tons in 1896, but according to Mr T. E. Moore, United States commercial agent at Weimar, there is not the slightest disposition to relax the stringent forest regulations which have so long been in force. Mr Moore adds that at the rate at which the devastation of forests is now going on in Russia, Sweden, and Galicia, those countries will soon have the same experience as Spain, which has been deprived of a part of her natural riches by the shortsighted policy of past generations.

ASIA

Korea. Korea is becoming to a large extent the rice granary of Japan and Japanese manufactures are driving the products of other countries out of the Korean market simply by virtue of their cheapness.

Hong-Kong. The total tonnage entering and leaving the port of Hong-Kong in 1896 amounted to 16½ millions. Of this about 7½ millions represented the tonnage of junks and river steamers, leaving about nine million tons engaged in foreign trade, of which more than one-half was British.

Siberia. Railway communication has now been established between Khabarovka and Vladivostok, and the line will be opened for traffic at an early date. The Russian government has purchased ten tons of choice seed grain from the Canadian experiment stations for distribution among the Siberian farmers.

NORTH AMERICA

Canada. The mineral output of British Columbia in 1896 amounted to $7,146,425, as compared with a total of $2,668,608 in 1890.

Mexico. The Mexican government has officially promulgated a concession for a railroad from Chihuahua to the Pacific coast. The length of the line will be 372.8 miles. and to aid in its construction the government agrees to pay the promoters a subsidy of $4,600,000. It has also granted a concession, without subsidy, for the construction of a railroad from Presidio del Norte, on the Rio Grande, state of Chihuahua, west, *via* Chihuahua city, to a point on the Pacific coast in the state of Sinaloa. U. S. Consul R. M. Burke states that the mineral wealth of the region through which these roads must pass is beyond calculation.

AUSTRALASIA

The Australasian gold yield during 1896 amounted to 2,375,948 ounces, an increase of 16,704 ounces on the preceding year.

The forests of the colony of Western Australia cover an estimated area of 20,400,000 acres and contain marketable timber to the value of £124,000,000.

Queensland has at last agreed to join in the Australasian federation movement, and the Federal Convention has adjourned until January, 1898, when Queensland will be represented.

CHESAPEAKE & OHIO RY.

THE **F. F. V. LIMITED** is one of the finest trains hauled over any railway track in America. It runs solid between Cincinnati and New York, the route from Washington being over the Pennsylvania system. It has every modern convenience and appliance, and the dining-car service has no superior if it has an equal. The road-bed is literally hewed out of the eternal rocks; it is ballasted with stone from one end to the other; the greater portion is laid with one-hundred-pound steel rails, and although curves are numerous in the mountain section, the ride is as smooth as over a Western prairie.

One of the most delightful rides in all the route is that through the New River valley. The mountains are just low enough to be clad with verdure to the very top, and in the early spring every variety of green known to the mixer of colors can be seen, while the tones in autumn take on all the range from brown to scarlet.

These facts should be borne in mind by the traveler between the East and the West.

H. W. FULLER, *Genl. Pass. Agent, Washington, D. C.*

CALIFORNIA..

OF course you expect to go there this winter. Let me whisper something in your ear. Be sure that the return portion of your ticket reads via the . . .

Northern Pacific-Shasta Route.

Then you will see the grandest mountain scenery in the United States, including **Mt. Hood** and **Mt. Rainier,** each more than **14,000** feet high, **Mt. St. Helens, Mt. Adams,** and others. You will also be privileged to make side trips into the **Kootenai Country,** where such wonderful new gold discoveries have been made, and to **Yellowstone Park,** the wonderland not only of the United States, but of the World. Park season begins **June 1st** each year. Close railroad connections made in Union Station, Portland, for Puget Sound cities and the east, via **Northern Pacific.**

CHAS. S. FEE,

General Passenger Agent, St. Paul, Minn.

SOUTHERN RAILWAY

GREATEST SOUTHERN SYSTEM.

Penetrates with its main line or branches eight States South of the Ohio and Mississippi Rivers, and in conjunction with its friendly allied connections reaches all the commercial centers of the South and Southwest . . .

DOUBLE DAILY VESTIBULED LIMITED TRAINS

. . . BETWEEN . . .

Washington and Nashville via Salisbury, Asheville, Knoxville and Chattanooga.
Washington and Tampa via Columbia, Savannah and Jacksonville.
Washington and Memphis via Atlanta, Birmingham and K. C. M. & B.
Washington and New Orleans via Atlanta, Montgomery and Mobile.
Norfolk and Chattanooga via Salisbury, Asheville and Knoxville.

Pullman Sleeping Cars—Dining Cars—Day Coaches.
Additional Trains for local travelers . . . .

The direct line to the Winter Resorts of { FLORIDA, GULF COAST and TEXAS, ... MEXICO and CALIFORNIA,

—AND THE BEST—

Through Car Line to and from Asheville and Hot Springs—"The Land of the Sky."

Write for Map Folders.

A. S. THWEATT, Eastern Passenger Agent, 271 Broadway, New York, N. Y.
J. C. HORTON, Passenger Agent, 201 E. Baltimore Street, Baltimore, Md.
L. S. BROWN, General Agent, 705 Fifteenth St. N. W., Washington, D. C.
J. H. WINGFIELD, Passenger Agent, Norfolk, Va.

S. H. HARDWICK, Assistant General Passenger Agent, Atlanta, Ga.
C. A. BENSCOTER, Assistant General Passenger Agent, Chattanooga, Tenn.
W. H. TAYLOE, Assistant General Passenger Agent, Louisville, Ky.

J. M. CULP, Traffic Manager. W. A. TURK, General Passenger Agent.

The Mutual Life Insurance Co.

OF NEW YORK,

RICHARD A. McCURDY, President,

Is the Largest Insurance Company in the World.

The Records of the Insurance Department of the State of New York SHOW THAT The Mutual Life

Has a Larger Premium Income - - -	($39,000,000)
More Insurance in Force - - - - -	($918,000,000)
A Greater Amount of Assets - - - -	($235,000,000)
A Larger Annual Interest Income - - -	($9,000,000)
Writes More New Business - - - -	($136,000,000)
And Pays More to Policy-holders - -	($25,000,000 in 1896)

THAN ANY OTHER COMPANY.

It has paid to Policy-holders since its organization, in 1843, } - - $437,005,195.29

ROBERT A. GRANNISS, Vice-President.

WALTER R. GILLETTE, General Manager. FREDERIC CROMWELL, Treasurer.
ISAAC F. LLOYD, Second Vice-President. EMORY McCLINTOCK, Actuary.
WILLIAM J. EASTON, Secretary.

Burlington Route

TO

St. PAUL
MINNEAPOLIS

BEST LINE
CHICAGO OR ST. LOUIS

Ripans Tabules cure headache.

The Fastest and Finest Train in the West . . . .

—is

UNION PACIFIC
THE OVERLAND ROUTE
WORLD'S PICTORIAL LINE

The Overland Limited

......TO......

UTAH and CALIFORNIA.

FROM 16 TO 20 HOURS
SAVED BY USING

"THE OVERLAND ROUTE."

Double Drawing-Room Pullman Sleepers.
Free Reclining Chair Cars.
Pullman Dining Cars.
Buffet Smoking and Library Cars.

Send for Descriptive Pamphlet "49-96,"
Folders and other Advertising Matter.
(Mention this publication.)

E. L. LOMAX,
General Passenger and Ticket Agent,
OMAHA, NEB.

THE CHICAGO, MILWAUKEE AND ST. PAUL RAILWAY

. . RUNS . .

Electric Lighted and Steam Heated Vestibuled Trains between **Chicago, Milwaukee, St. Paul and Minneapolis** daily.

Through Parlor Cars on day trains between **Chicago, St. Paul and Minneapolis.**

Electric Lighted and Steam Heated Vestibuled Trains between **Chicago and Omaha and Sioux City** daily.

Through Sleeping Cars, Free Reclining Chair Cars and Coaches between **Chicago and Kansas City, Mo.**

Only two hours from Chicago to Milwaukee. Seven fast trains each way, daily, with Parlor Car Service.

Solid trains between **Chicago** and principal points in **Northern Wisconsin** and the **Peninsula of Michigan.**

Through Trains with Palace Sleeping Cars, Free Reclining Chair Cars and Coaches between **Chicago** and points in **Iowa, Minnesota, Southern and Central Dakota.**

The **finest Dining Cars** in the World.

The **best Sleeping Cars. Electric Reading Lamps in Berths.**

The best and latest type of **private Compartment Cars, Free Reclining Chair Cars, and buffet Library Smoking Cars.**

Everything First-class. First-class People patronize First-class Lines.

Ticket Agents everywhere sell tickets over the Chicago, Milwaukee and St. Paul Ry.

GEO. H. HEAFFORD,
General Passenger Agent, Chicago, Ill.

WHENEVER YOU VISIT WASHINGTON . . .

YOU ARE INVITED TO INSPECT THE

MAMMOTH DRY GOODS ESTABLISHMENT

OF

WOODWARD & LOTHROP

Where the **LATEST PARIS NOVELTIES** are always on Exhibition.
The attention of those who anticipate purchasing . . . .

BRIDAL TROUSSEAUX

Is invited especially to extreme PARIS NOVELTIES in matched sets of French Hand-made Lingerie, including Gowns, Skirts, Chemises, Drawers, Corset Covers, &c. These can be furnished in any number of pieces desired. . . . .

HAND-MADE BRIDAL TROUSSEAUX, personally selected in Paris and exclusive in style and design: Three or more pieces . . . . . **$10 to $250.**

CORRESPONDENCE SOLICITED. MAIL ORDERS RECEIVE PROMPT AND CAREFUL ATTENTION.

TENTH, ELEVENTH, AND F STREETS N. W. . . . . WASHINGTON, D. C.

Shortest Line
TO
St. Paul and Minneapolis
and the Northwest

CHICAGO GREAT WESTERN
RAILWAY

"Maple Leaf Route"

For tickets, rates or any detailed information apply to your home agent or write to

F. H. LORD,
Gen'l Pass'r and Ticket Agent,
CHICAGO.

A VITAL POINT

"IMPROVEMENT THE ORDER OF THE AGE."

A TYPEWRITER'S PRINTING MECHANISM

MUST BE SCIENTIFICALLY CONSTRUCTED. THIS POINT IS OF UTMOST IMPORT FOR

EASY OPERATION AND PERFECT EXECUTION.

The Smith.. Premier Typewriters

Superior on This Point as Well as on All Others.

The Smith Premier Typewriter Co.,
SYRACUSE, N. Y., U. S. A.

ONLY CORRECT PRINCIPLES EMPLOYED.

Catalogues and Information at Washington Office, No. 1416 F Street

THE AMERICAN ANTHROPOLOGIST.

The only American magazine devoted to the science of Anthropology in all its branches is THE AMERICAN ANTHROPOLOGIST, published at the National Capital. This journal is now in its *tenth* year of increasing usefulness.

No magazine ever published on the Western continent is such a storehouse of authentic information concerning ARCHEOLOGY, ETHNOLOGY, FOLK-LORE, TECHNOLOGY, SOCIOLOGY, HISTORY, SOMATOLOGY, PSYCHOLOGY, PHILOSOPHY, and PHILOLOGY. Its contributions to our knowledge of these subjects, especially in so far as they relate to the **American Indians**, past and present, are of world-wide authority. Its contributors are America's foremost scholars.

Is *your* name on the subscription list of the ANTHROPOLOGIST? If not, it should be. No one interested in anthropology in any of its branches can afford to be without it. *Subscribe today.* A new volume begins with the January number.

A bibliography of the anthropologic literature of the world is one of its futures.

Handsomely Printed—Abundantly Illustrated.
Published Monthly—Two Dollars a Year.
Volume XI Begins with January, 1898.

ADDRESS: THE AMERICAN ANTHROPOLOGIST,
1804 Columbia Road, Washington, D. C.

COMMENCED JANUARY, 1888. TWO VOLUMES PER YEAR.

THE AMERICAN GEOLOGIST, 1897.

The Oldest Exclusively Geological Magazine Published in America

TERMS.

To Subscribers in the United States, Canada and Mexico	$3.50 a year
To other Subscribers in the Postal Union	4.00 a year

The *AMERICAN GEOLOGIST* is issued monthly from the office of publication at Minneapolis, Minnesota, United States of America. Nineteen volumes are completed; the twentieth began with the number for July, 1897. The magazine has received a cordial welcome and a generous support from leading geologists everywhere and it is now recognized as the exponent of the rapid geological progress that is taking place on the continent of North America, including Canada, the United States and Mexico. Nowhere else in the world are geologic phenomena exhibited on a more extensive scale and nowhere else are results attained of greater economic and scientific importance.

The *AMERICAN GEOLOGIST* lays before its readers from month to month the latest results of geological work. In addition to the longer papers it gives synopses of recent geological publications and brief notes on current geological events.

THE GEOLOGICAL PUBLISHING CO.,
MINNEAPOLIS, MINN.

NATIONAL GEOGRAPHIC MONOGRAPHS

On the PHYSICAL FEATURES OF THE EARTH'S SURFACE, designed especially to supply to teachers and students of geography fresh and interesting material with which to supplement the regular text-book

LIST OF MONOGRAPHS COMPRISING VOLUME I:

GENERAL PHYSIOGRAPHIC PROCESSES	J. W. Powell
GENERAL PHYSIOGRAPHIC FEATURES	J. W. Powell
PHYSIOGRAPHIC REGIONS OF THE UNITED STATES	J. W. Powell
BEACHES AND TIDAL MARSHES OF THE ATLANTIC COAST	Prof. N. S. Shaler
PRESENT AND EXTINCT LAKES OF NEVADA	Prof. I. C. Russell
APPALACHIAN MOUNTAINS—NORTHERN SECTION	Bailey Willis
APPALACHIAN MOUNTAINS—SOUTHERN SECTION	C. Willard Hayes
MT. SHASTA—A TYPICAL EXTINCT VOLCANO	J. S. Diller
THE NEW ENGLAND PLATEAU	Prof. W. M. Davis
NIAGARA FALLS AND ITS HISTORY	G. K. Gilbert

Price for one set of ten monographs, **$1.50**. Five sets to one address, **$6.00**. Single monographs, **20c.**

Remit with order to AMERICAN BOOK COMPANY,

New York - Cincinnati - Chicago

Ripans Tabules assist digestion.

TERRESTRIAL MAGNETISM

An International Quarterly Journal

Edited by L. A. BAUER
With the Co-operation of Eminent Magneticians

WITH the March, 1897, issue, this Journal, devoted exclusively to Terrestrial Magnetism and allied subjects, such as Earth Currents, Auroras, Atmospheric Electricity, etc., entered on its second volume. The hearty co-operation extended by the workers in this promising field of investigation, as abundantly shown by the numbers thus far issued, has made this Journal the international organ for making known the latest achievements. The magnetic needle has become such a promising instrument of research, not only in terrestrial, but in cosmical physics, that this Journal appeals to a large class of investigators. The geographer, the geologist, the astronomer, the meteorologist—all are interested in the development of the subject of terrestrial magnetism. It should therefore receive their support.

Among the contributors of the main articles in the past have been Messrs. Barus, Börgen, Chree, Eschenhagen, Littlehales, Rücker, Schmidt, Schuster, and de Tillo.

Future numbers will contain:

"The Earth, a Great Magnet,"
BY DR. J. A. FLEMING.

"The Electrification of the Atmosphere,"
BY PROF. ALEXANDER McADIE.

"The Height of the Aurora,"
BY PROF. CLEVELAND ABBE.

"The Distribution of Magnetic Observatories,"
(Illustrated),
BY PROF. MAX ESCHENHAGEN,
etc., etc.

The size of the Journal is royal octavo, a volume embracing about 200 pages. Domestic subscription price: **Two dollars**; single numbers, **fifty cents**. Foreign subscription price: **Nine shillings, nine marks, or eleven francs.** Address:

TERRESTRIAL MAGNETISM,
The University of Cincinnati, Cincinnati, Ohio.

PEOPLE like to read about the great and wonderful country of the **Southwest**; of its quaint and curious towns, its ancient civilizations, its natural marvels. They like to get accurate information about **California and the Pacific Coast.** This is because most people want to some day see these things for themselves. . . . .

A charming book covering these facts is issued by the

PASSENGER DEPARTMENT

OF THE

Southern Pacific Railway,

and will be sent to any one, postpaid, on receipt of TEN CENTS.

THE BOOK IS ENTITLED

"Through Storyland to Sunset Seas,"

You can get a copy by writing to

S. F. B. MORSE,

General Passenger Agent,

Southern Pacific,

New Orleans,

and sending **10 cts.** to defray postage.

AND IS A WONDERFULLY HANDSOME VOLUME OF **205** PAGES, WITH **160** ILLUSTRATIONS. . . .

The paper used is FINE PLATE PAPER, and every typographical detail is artistic. It is a story of what four people saw on just such a trip as you would like to make. . . . . . .

THE

National Geographic Society

ORGANIZED, JANUARY, 1888

ACTING-PRESIDENT

A. W. GREELY

VICE-PRESIDENTS

MARCUS BAKER
WILLIAM H. DALL
G. K. GILBERT
A. W. GREELY
C. HART MERRIAM
HERBERT G. OGDEN

TREASURER

HENRY GANNETT

RECORDING SECRETARY

F. H. NEWELL

CORRESPONDING SECRETARY

ELIZA RUHAMAH SCIDMORE

MANAGERS

CHARLES J. BELL
H. F. BLOUNT
F. V. COVILLE
DAVID T. DAY
EVERETT HAYDEN
JOHN HYDE
W J McGEE
W. B. POWELL

SECRETARY'S OFFICE

Room 55, Ohio National Bank Building, Twelfth and G Sts. N.W., Washington

The National Geographic Society, the object of which is the increase and diffusion of geographic knowledge, has a paying membership of 1,400. Its membership is not restricted to practical geographers, but is open to any person in good standing who may be sufficiently interested in its work to seek admission. The annual subscription is: for active members, $5.00 per annum; for corresponding members, $2.00 per annum. Active members pay also an entrance fee of $2.00 on election. THE NATIONAL GEOGRAPHIC MAGAZINE is sent regularly to all members, both active and corresponding.

Donations for the founding of Prize Medals and Scholarships are respectfully solicited.

Burlington Route

TO

ST. PAUL

BEST LINE
CHICAGO OR ST. LOUIS

MINNEAPOLIS

JUDD & DETWE[illegible] WASHINGTON D. C.

SMITHSONIAN INSTITUTION LIBRARIES
3 9088 01299 3192