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CONTENTS

Strange Sights in Far-Away Papua. By A. E. Pratt, Gill Medalist of the Royal Geographic Society. Illustrated.

Bolivia—A Country Without a Debt. By Senor Y. Calderon, Minister from Bolivia to the United States. Illustrated.

Our Heralds of Storm and Flood—Being an Account of the Various Activities of the United States Weather Bureau in Saving Life and Property. By Gilbert H. Grosvenor. Illustrated.

The Work in the Pacific Ocean of the Magnetic Survey Yacht "Galilee." By L. A. Bauer, Director, Department of Terrestrial Magnetism, Carnegie Institution. Illustrated.

Hunting the Grizzly in British Columbia. By Joseph Wendle.

Scenes from North Africa.

A Strange and Remarkable Beast.

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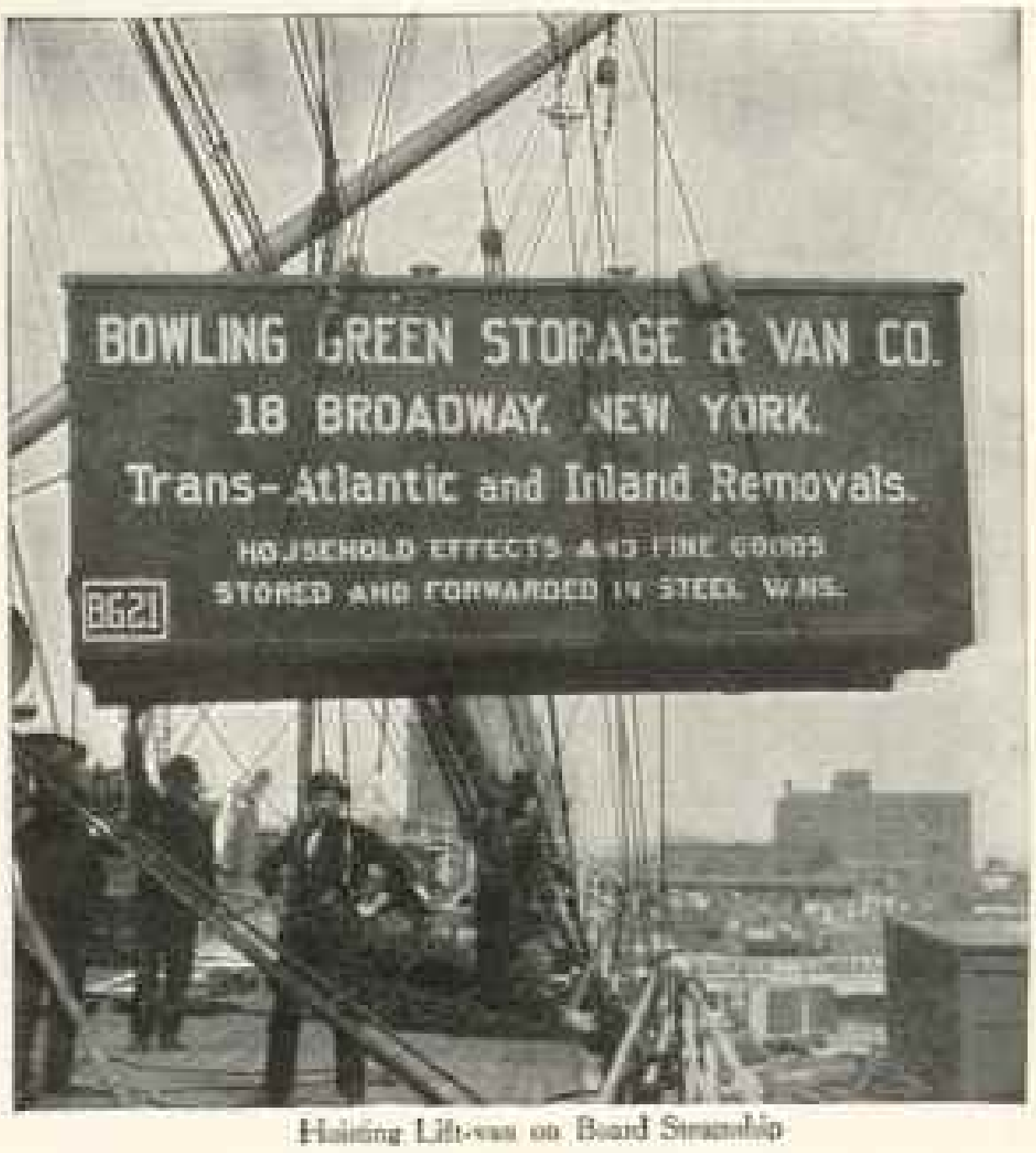

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VOL. XVIII, No. 9 WASHINGTON SEPTEMBER, 1907

THE NATIONAL GEOGRAPHIC MAGAZINE

STRANGE SIGHTS IN FAR-AWAY PAPUA

SEEN BY A. E. PRATT

Gill Medalist of the Royal Geographic Society

The following article has been abstracted by the Editor from "Two Years Among the Cannibals of New Guinea," by A. E. Pratt, and recently published by J. B. Lippincott Co. Pp. 360. 6x9 inches. 54 illustrations and map.

IN the course of thirty years of almost continuous journeying in both hemispheres, it has been my fortune to stray far from the beaten tracks and to know something of the spell and mystery of the earth's solitudes. My work in quest of additions to the great natural history collections, both public and private, of England, and to a less extent of France, has led me to the Rocky Mountains, the Amazon, the Republic of Colombia, the Yangtse gorges, and the snows of Tibet; but it is safe to say that none of these has aroused my interest and curiosity in so great a degree as the scene of my latest and my next expedition, the still almost unexplored Papua, the second largest of the world's islands, and almost the last to guard its secrets from the geographer, the naturalist, and the anthropologist.

Fifty years ago schoolboys, looking at their map of Africa, blessed the Dark Continent for an easy place to learn. A few names fringed the coast; inland nearly all was comprehended under the cheerful word "unexplored." Such in great measure is the case with New Guinea today. Its 300,000 square miles of territory, held by Great Britain, Germany, and the Netherlands, and now lying fallow, are destined in the course of the next half century to enrich the worlds of commerce and of science to a degree that may to some extent be forecasted by what is already known of very restricted areas.

Be this as it may, one thing remains sure, the extraordinary value of Papua to the man of science, particularly to the entomologist and the ornithologist. In the department of ornithology alone we already know of 770 different species of birds inhabiting the mainland and the islands, which places it in this respect far above Australia, which, with a superficial area nine times greater, possesses less than 500 species in all.

The ethnologist, too, has in Papua a happy hunting-ground, for the tribes on the fringe of exploration present wonderful varieties of type, and as the mountain fastnesses of the interior are gradually opened up, there can be no doubt that rich material for the propounding of new problems and perhaps the solution of old

ones will come to light. Language is curiously diversified; here you meet a tribe with a distinct speech, and camping near them for a time you learn the common currency of their tongue; a few miles further on appears another people, perhaps not greatly differing in type, but with another language altogether.

THE FIERCE TUGERI OF DUTCH NEW GUINEA

I went first to Merauke, in Dutch New Guinea, to explore and collect in new territory, but the long-standing difficulty with the warlike Tugeri tribe was still acute, and the very day after I landed we had abundant proof of how unwise it would be to penetrate into the interior. On that day three or four Javanese convicts, who were working on the edge of the clearing, were heard to shout as though in distress. In five minutes an armed guard was on the spot, but all the convicts were found decapitated by the head-hunting Tugeri. The heads had been taken off with the bamboo knife so cleverly that the doctor on board our ship told me that no surgeon with the latest surgical instruments could have removed so many heads in so short a time. This bamboo knife of the Tugeri is a very remarkable weapon. It is simply a piece of cane stripped off from the parent stem, leaving a natural edge as keen as the finest tempered steel.

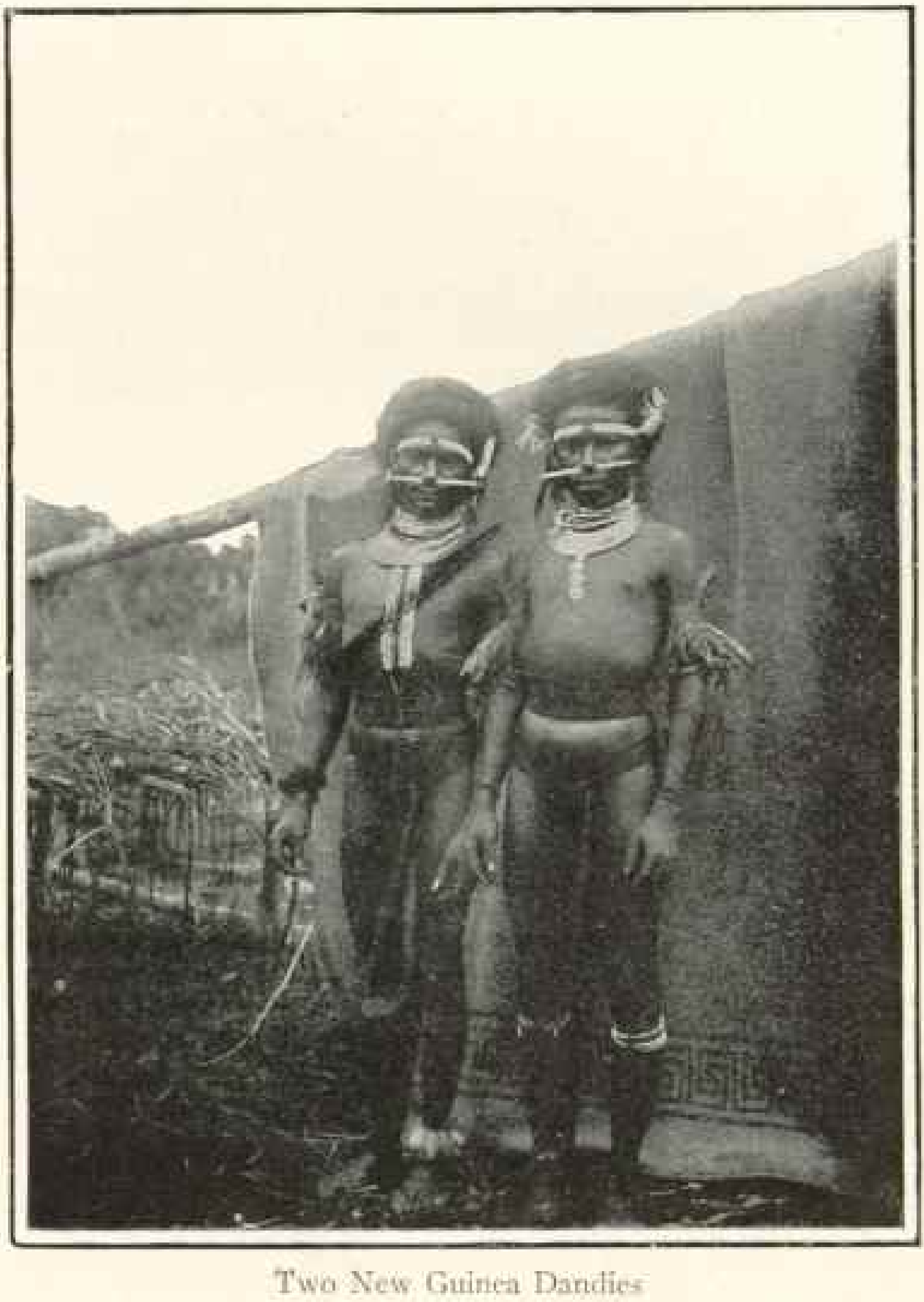
My opportunities for observing the Tugeri were therefore necessarily limited, but I am, I believe, the first person who has made any study of this remarkable tribe, and as far as I am aware they have remained hitherto undescribed. They are a very numerous people, inhabiting a tract of country extending as far west as the Marianne Strait and as far east as the Fly River, at longitude 141°.

The Tugeri are a fine race, very fierce, and absolutely unspoiled by European vices. The men stand about 5 feet 8 inches on an average, and are clean-limbed, powerful fellows, capable of any amount of endurance. As a race, they are broad-shouldered, sinewy, and of enormous strength. No European can draw their bow. This weapon is made of a longitudinal section of the bamboo. Near the grip the diameter is about 3½ inches, and the wood tapers at each end to a diameter of ¾ inch. The string is of twisted fiber, and the arrow, which is made of a reed, carries to a distance of at least 300 yards. Like all savages, they are admirable marksmen.

CURIOUS ORNAMENTS OF THE TUGERI

The men wear an enormous ear ornament of bamboo bent into an open ring. Round the periphery of this ring the flesh of the lobe of the ear, previously perforated, is stretched in infancy, and as the individual grows the natural spring of the bamboo stretches the flesh more and more, until in manhood a loop is formed big enough to hold a ring of at least 4 inches in diameter. It is extraordinary how the tribesmen contrive to move amidst the tangled forest without hindrance from this abnormal expansion of the lobe, the most unusual flesh decoration to be found among mankind. When the bamboo is out the loop hangs like a long pendant, a perfect skein of flesh, a peculiarly hideous accessory of savage adornment. Some of the Tugeri wear an apology for a beard, or, rather, two scraggy tufts of hair depending from each side of the chin. The use of pomatum in any form is unknown. The teeth are strong and fairly regular, but perfectly brown, owing to the habit of chewing the betel-nut.

For personal adornment the Tugeri wear two crossed straps of dogs' teeth strung together with grass. Each strap is about 3 inches wide, and is formed of nine parallel rows of teeth. The strap that rests on the left shoulder passes under the right armpit; that over the right shoulder passes outside the left arm above the elbow. The straps are lightly fastened at the point where they cross the breast. Round the right arm, just above the elbow, they wear a curious armlet. In the case of the richer tribesmen, this is of shell. The breadth is



Two New Guinea Dandies

Notice their tight-laced waists and the nose ornaments (chimani) of polished shell. (See page 569.) This series of photographs are from "Two Years among New Guinea Cannibals," by A. E. Pratt. J. B. Lippincott Co., publishers.

Curious Drums of the Tugeri (Dutch New Guinea)

The body of the drum is cut and hollowed from a solid trunk and curiously carved. The drumheads are of lizard skin

from 5 to 6 inches. On the stomach, to the right, are two or three horizontal scars, made by cutting or burning. These are self-inflicted for superstitious reasons. The lower part of the stomach is tightly drawn in (often extremely tight) with a coil of finely plaited fiber. This seems to be worn for elegance alone, and tight-lacing is a ruling fashion among the Tugeri dandies: the tighter the lacing the greater the dandy. From fifteen to sixteen years of age the young men are hopeless victims to fashion. The Tugeri go barefoot, but wear grass anklets adorned with shells, which rattle like castanets, as they walk. I observed, however, no dances, although these, I understand, are performed in their villages. For decency's sake they wear a shell, after the manner of the statuesque fig-leaf, and their costume is completed by a necklace of dog's teeth and small pieces of bone, such treasures as a savage prizes.

A strange part of the Tugeri's paraphernalia was their extraordinary drums. The body of these, shaped like a dice-box, was hewn out of a solid log, hollowed, and curiously carved. Midway at the narrowest point was a clumsy handle, also hewn from the log. The drum-heads are of lizard skin. The performer carries the instrument by the handle in the left hand and beats with his right. The noise is prodigious.

A UNIQUE TRADING VILLAGE

Leaving Dutch New Guinea, I proceeded down the coast to Port Moresby, the seat of the British government of New Guinea. From here I planned to penetrate about 200 miles into the interior and make a permanent camp among the hills, in order to carry out the object of my expedition—the collection of butterflies and moths. But before leaving the coast I had an opportunity of seeing something of a very interesting village, Hanuabada, a sort of miniature Venice, where all the houses are built on piles over the water. The people of this village annually send out a trading expedition to a distance of several hundred miles to dispose of the pottery manufactured by them.

For weeks before the annual trading expedition Hanuabada is full of life. At every turn one comes upon women crouching on the ground, fashioning lumps of clay into wonderfully perfect pottery, for which the village is famous. The men folk, although they do not condescend to take part in the actual fashioning of the pots, are good enough to dig the clay, which they take out of the ground with a stone adze, a flat stone blade lashed to the shorter extremity of a forked stick, the longer extremity forming the handle.

There is a distinct organization of labor among the potters, the women being divided into "makers" and "bakers." Several "makers" work together in a group. They use no wheel, but seize a lump of clay with both hands and make a hole large enough to get the right hand in, whereupon they gradually give the vessel its contour. After being roughly shaped, it is smoothed off with flat sticks or the palm of the hand. The finished article of Hanuabada ware is in the form of a flattened sphere with a very wide mouth and a neatly finished rim six or eight inches across. Farther to the east, along the coast, the pottery is highly decorated, but it is much more crude in form and has no fine rim. The pots are dried in the sun for several days, and then they are turned over to the "bakers," whose fires are blazing in every street. There are two methods of baking: one is to lay the pot on a heap of hot ashes; the other to build the fire right around it. The vessel is watched through the whole process, and is continually turned on the fire with a little stick thrust into the mouth.

When many hundreds of pots have been completed the Hanuabada people begin to think about the disposal of their wares. Their great market is at Parum, a long way up the coast. They barter their pottery for sago with the natives of that district, and it is very curious to note that this extensive trading organization on the part of an utterly savage

people has been in existence from time immemorial and is no imitation of European methods. To reach Paruru the potters must undertake a perilous voyage, for which they are dependent on the tail of the southeast monsoon. The captains, of course, have no knowledge whatever of the science of navigation and sail their vessel by cross-bearings, or, when out of sight of land, by sheer instinct. The vessel is constructed of a number of canoes lashed together, and is propelled by two batlike sails.

Another interesting feature of this region was the presence there of a piebald people. For the most part their bodies were brown, but they were marked with pinkish patches, unevenly distributed. It is not improbable that this marking might be due to a disease contracted from a too constant fish diet, but if it were a disease I could not discover that it gave any discomfort. Against this theory must be set this fact, that I observed one man in whom the light markings predominated. In fact, he was quite fresh-colored, like a European, and had light hair. These piebald people were not a class apart from the rest of the Hula villagers, but shared their life in every respect.

PENETRATING INTO THE FOREST

At times the brushwood was very dense and we had to cut our way, but where the forest was closely matted above, forming a thick canopy, which excluded the light, nothing, of course, could grow beneath. At points where the light penetrated the undergrowth was immediately thick again. The path, such as it was, was stony and hard. As we trudged along in the wet we made the acquaintance of a new discomfort. This manifested itself in the presence of a leech, a little creature about ¾ inch long, with slender body, very much smaller than the European variety, but inflicting the same sort of three-cornered bite. The native carriers offer the easiest victims, for the leeches fasten upon their bare heels in great numbers, and they had constantly to stop and brush them off with little switches which they carried in their hands. Sometimes, when the leeches had bitten very deep, the carriers had to lay down their loads and pull them off with their fingers. They would endure them until they became too bad, say when a dozen or so had adhered to each foot. At this time we did not suffer much, but later on, in the journey from Faula to Mafulu, they got over the tops of our boots and socks and attacked our ankles. The bite was not actually painful, and the presence of our enemy was not revealed until we realized that our feet were wet with blood. The chief haunts of the leech are wet stones and moss and low herbage.

EDIBLE PALM AND EXTRAORDINARY ORCHIDS

About the elevation that we were traversing there grows a particular kind of palm, peculiarly grateful to the native when he is hungry, a not infrequent occurrence, and at such moments of stress they discard their loads, search out this palm, and cut it down. At the top, just below the crown of the palm, the last shoot, about six feet long, remains green. It is opened lengthways and is peeled until the inside layers are reached. These layers are straw-colored, like asparagus, and to the taste are sweet, slightly dashed with acid. Europeans, as well as natives, can eat great quantities of this wholesome and enjoyable food with impunity. It is excellent also for quenching thirst, for which it is often most convenient, as it grows in waterless regions.

The gloom of the forest was diversified by the colors of its extraordinary orchids. One of these (*Grammatophyllum speciosum*), which had made its home on a lofty tree, was of almost incredible luxuriance, and could the whole plant have been secured it would not have weighed less than half a ton. I despatched one of my native boys to climb the tree to see if he could secure a specimen. He went about his task in the native fashion. The climber stands with his face to the trunk, which, as well as his body, is encircled with a hoop, and his ankles are tied together.

A Piebald Tribe: The Motu-Motu People of Hood's Bay and a Typical Kalo House

The piebald people are one of the mysteries of New Guinea, and their origin is unexplained. The spear in the warrior's hand is made of hard redwood, sharpened, and has no metal. The house is built on an open wooden framework, and the flooring of the dwelling-room begins at the bottom of the closed-in gable. On this inflammable floor, within the thatch of flag grass, they actually have a fire on a mud hearth. The slanting pole is a ladder for the inhabitants. In some cases they have little ladders for the dogs.

First he leans back until his body has purchase on the hoop, and then, at that moment, by the leverage of his ankles, he makes an upward movement of about a foot. Then, falling backward against the hoop and pressing his feet against the trunk, he is supported for the next spring. This operation is repeated with marvelous dexterity and rapidity, and with this contrivance the youth makes his way to the top. There is no tree in New Guinea that a native cannot climb thus.

Under a large tree that rose to a height of some 150 feet were huge mounds, quite five feet high, of veritable sawdust, that seemed to proclaim the presence of man. On a nearer approach the wonder became greater, for the heaps were being continually augmented by a constant rain of sawdust of different grains, some finer than others. No human sawyer, of course, was there, but the tree, to a height of at least 100 feet, was riddled by coleopterous larvæ. Several families of these were represented. The tree, which was about five feet in diameter and had a thin bark, was, as might be expected, dying. It must have possessed some strange attraction, for it was most unusual in New Guinea to find beetles thus congregated. The distribution is usually very scattered. The holes were probably made at first by small beetles of various families, but chiefly Anobiadæ, followed as a rule by Bronthidæ, later probably by Longicorniæ. One species follows the other into the same hole, each succeeding species bigger than its predecessor. Sometimes the lepidoptera make borings, but this sawdust was much finer. Only a few living branches remained on the tree, which was a mere shell. It was, however, so well protected from winds that it still stood.

STINGING TREES AND STINGING PLANTS

The difficulties of our march were heightened by certain natural features, particularly by the stinging-trees, which occurred close to Madui. The tree in shape, size, and foliage resembles a sycamore, and has a leaf of which the under side is extremely rough and covered with spines. These possess a stinging power like that of the nettle, only much worse, and the irritation lasts far longer. The slightest touch is sufficient to wound. First a white blister appears, then redness, covering about a square inch around each pustule; rubbing aggravates the irritation, which shortly becomes maddening. The pain is not allayed for at least twelve hours, and I have never observed any natural antidote growing in the vicinity of this stinging-tree, as the dock-leaf grows near the nettle. Needless to say, the natives take the utmost care to give these trees a wide berth.

A smaller stinging-plant, resembling our nettle, only larger, with a rough under side of pale pea-green, is also found at *intervals* in the forest; both sides of the leaf possess the power of irritation. The natives use it as a universal specific for all ailments. As soon as they come on a clump of this plant the women discard their loads and gather bundles of the leaves, which they carefully preserve for future requirements. It is also applied, probably for the sheer pleasure of it, when they have no actual disorder, and it is quite common for them to rub their bodies lightly with the leaves. This causes violent irritation, followed by a feeling of pleasant numbness, like that which results from the application of menthol. For a mosquito bite this is a most admirable remedy, since the irritation of the bite is allayed and goes down long before the irritation of the leaf has passed. It is a curious example of the old medical practice of counter-irritation. Although we were glad to resort to it for mosquito bites, no European would, without that cause, risk the irritation for the sake of possible future benefits.

THE SPIDER'S FISHING NET

One of the greatest curiosities that I noted during my stay in New Guinea was the spiders' web fishing-net near Waley. In the forest at this point huge spiders' webs, 6 feet in diameter, abounded. These are woven in a large mesh, varying from 1 inch square at the

outside of the web to about ⅛ inch at the center. The web was most substantial, and had great resisting power, a fact of which the natives were not slow to avail themselves, for they have pressed into the service of man this spider, which is about the size of a small hazel-nut, with hairy, dark-brown legs spreading to about 2 inches. This diligent creature they have beguiled into weaving their fishing nets. At the place where the webs are thickest they set up long bamboos, bent over into a loop at the end. In a very short time the spider weaves a web on this most convenient frame, and the Papuan has his fishing net ready to his hand. He goes down to the stream and uses it with great dexterity to catch fish of about one pound weight, neither the water nor the fish sufficing to break the mesh. The usual practice is to stand on a rock in a backwater where there is an eddy. There they watch for a fish, and then dexterously dip it up and throw it onto the bank. Several men would set up bamboos, so to have nets ready all together, and would then arrange little fishing parties. It seemed to me that the substance of the web resisted water as readily as a duck's back.

AN ARMY OF SOLDIER-CRABS

On one of our expeditions along the coast we saw one of the most extraordinary sights of all our travels—many thousands of soldier-crabs traversing the sandy beach in detached, regularly ordered bodies, that moved evidently by the signal of some common commander. These "armed battalions" stretched for miles, and no matter what figure they assumed, whether wedge, triangle, or rhombus, the dressing, so to speak, of the outer ranks was perfect, and would have put many a volunteer corps to shame. Not a crab was out of line. The advance was fairly rapid, and was always toward the sea for a distance of, say, two hundred yards. When the crabs come out of their holes in the sand they throw themselves into this compact for-

A Spider's Web as a Fishing-net: A Strange New Guinea Device

A very huge and strong spider's web, common to New Guinea, is used by the natives as a fishing-net. They set up in the forest a bamboo, bent as in the picture, and leave it until the spiders have covered it with a web in the manner shown.

Fishing with the Spider's-web Net

The natives are here using the curious net prepared in the manner shown on page 567

mation probably for safety. There was no walking along the beach for them, there being scarcely a clear hundred yards for miles. When approached they quickened their pace perceptibly.

The individual crab is small and has no shell. The spread of the legs would probably be 1½ inches, and the body is of dark fawn-color, exactly resembling the wet sand of the beach, so that the creature's hue is without doubt yet another of Nature's adaptations for protection. It is remarkable also that it imitates only the wet sand, for the dry sand is of a dazzling silky whiteness.

Equally wonderful is the bower-bird, at once gardener, architect, and artist. Not only does it build the most extraordinary nest known to naturalists—a long, tunnel-like bower, framed like a delicate Gothic arch—but it actually lays out a garden. I have myself seen the creature's marvelous achievement. It has definite color-sense, for it picks the blossoms of orchids and arranges them in alternate lines of mauve and white. The whole impulse is, of course, the universal one of love, for among its rows of flowers it dances to its mate. This was probably the prettiest and most fascinating of all the sights provided by Nature in New Guinea, that land of surprises.

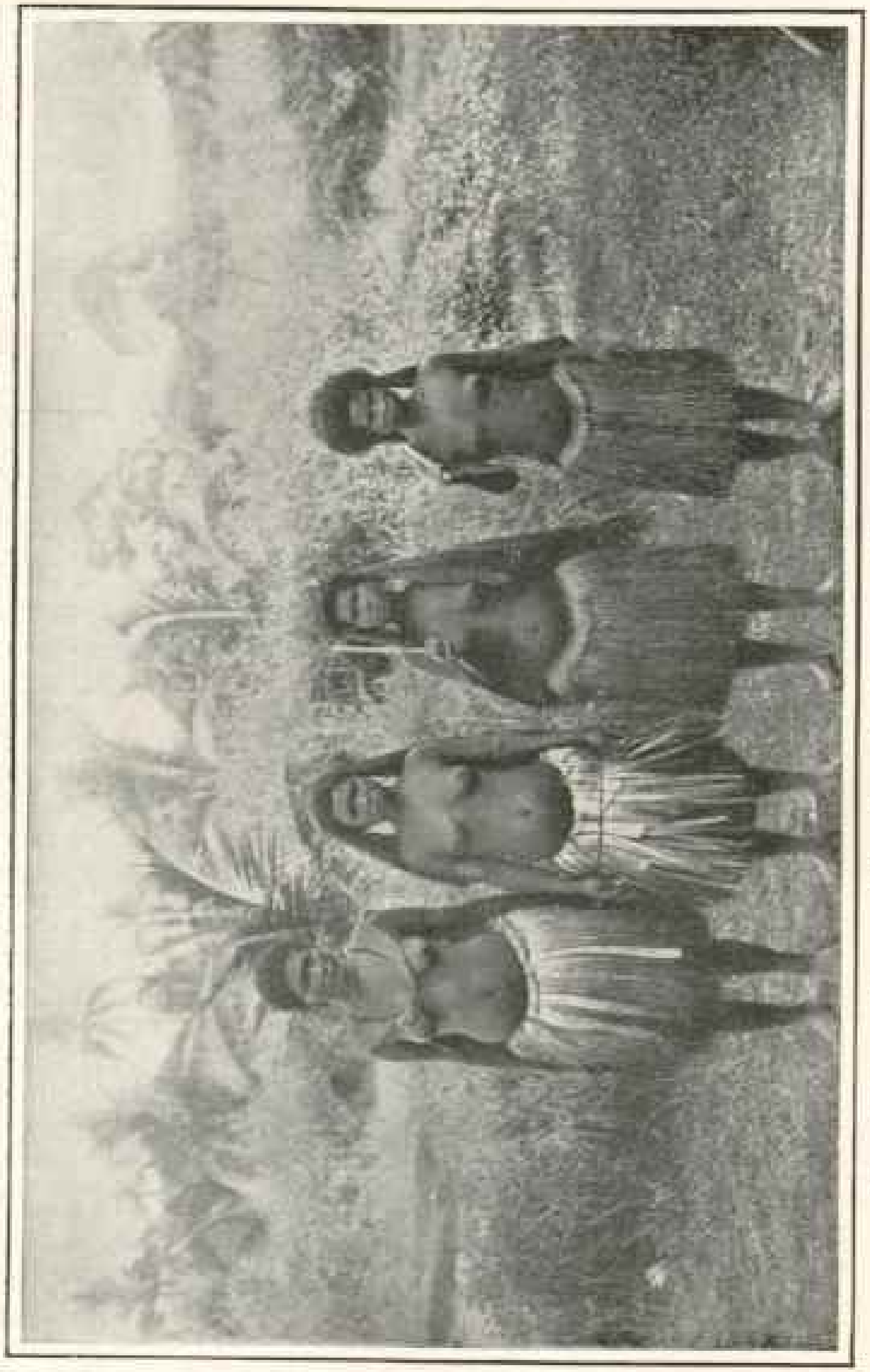
REMARKABLE NOSE ORNAMENTS AND HEAD DRESS

The chief costume of the women of the coast tribes is the extraordinary petticoat made of grass or of a wide-bladed weed, each leaf of which would be about 3 inches wide. The blades composing this garment fall down perpendicularly from a waist-band, to which layer after layer is attached, until the "rami" has that fine spread which used to be attained by more civilized women by a contrivance which was called a "dress-improver." As we went inland and rose gradually higher and higher in the mountains, we observed that the "rami" was growing shorter and shorter, until at length it disappeared altogether, and one may reasonably consider the absence or presence of this garment as the great symbol of division between the coast natives and those of the highlands proper.

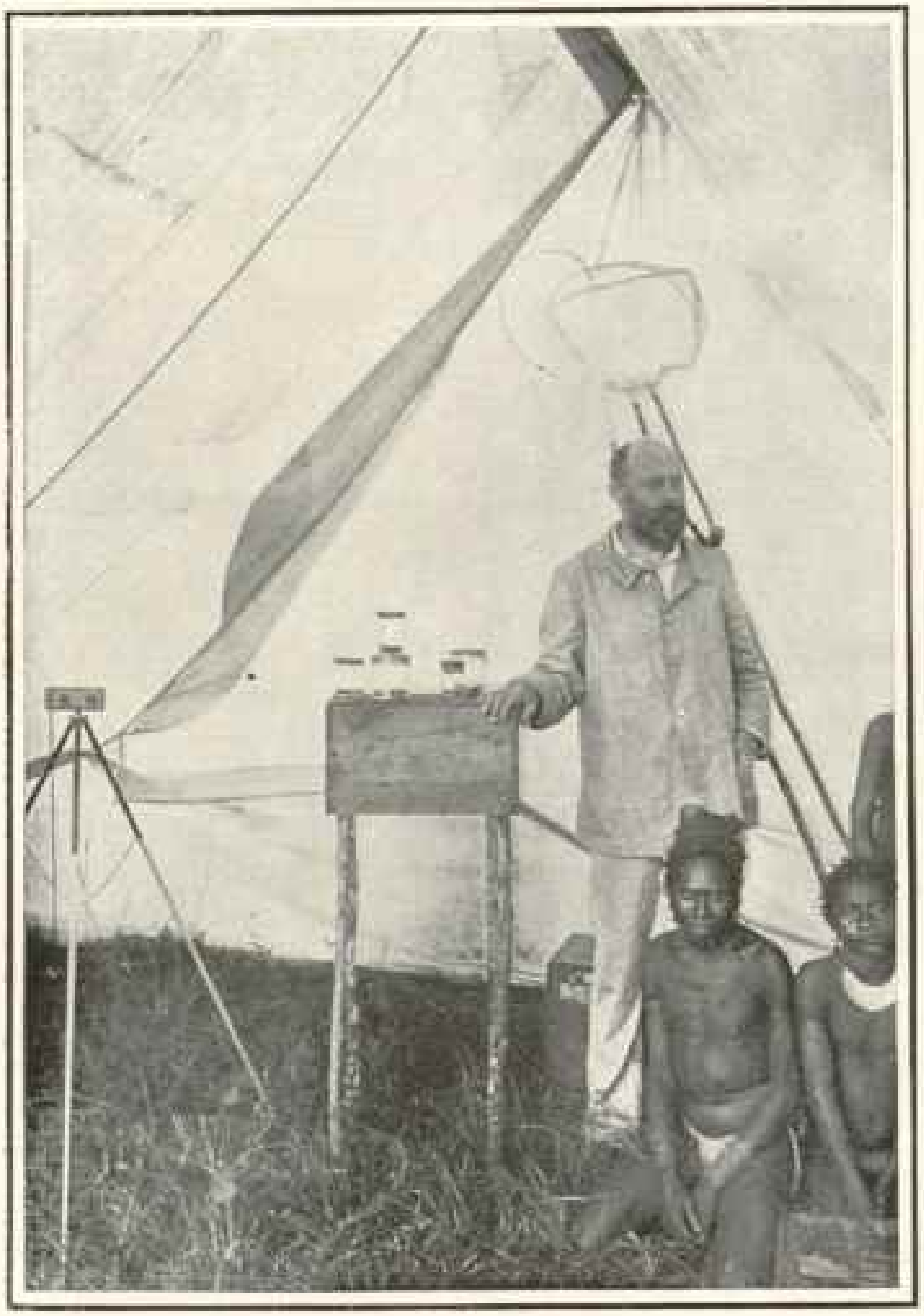
Among the men, both highland and lowland, the great symbol of dandyism is the "chimani," or nose ornament. This is made from a section of a shell about ⅜ of an inch thick in the middle and tapering most beautifully toward the ends. It is accurately made, perfectly round and polished, and a good example would be about a span long. A fine "chimani" very often has two black rings painted round it about one inch distant from the end. These things are manufactured by the coast people, and they drift by exchange through the whole country. Very few young blades can afford to possess one, and accordingly it may be lent, either for a consideration or as a very special favor. The possessor of one of these ornaments could easily buy a wife for it, and sometimes it is paid as a tribal tribute by one who may have to pay blood-money, or is unable to give the statutory pig as atonement for a murder.

But the most splendid of all the articles of the Papuan costume is the feather head-dress, 16 feet high, which forms the central point of attraction when it occurs in a tribal dance. This ornament is extremely rare and is always an heirloom, for it has taken generations to complete. It is a wonderfully fantastic device of feathers, built upon a light framework. The Bird of Paradise and the Gaura pigeon are laid under tribute for its construction, and the feathers of the different birds and of different species of the same bird are kept carefully apart and are arranged in rows according to their natural order. A few lines of Bird of Paradise, a few lines of Gaura pigeon, then a few lines of another species of Bird of Paradise, and so on. The whole contrivance is most fantastic, and looks really impressive in the weird light of the torches, as the dancers, decorated with flowing bunches of grass behind, proceed with their revel.

Although the women do all the hard



New Guinea Women Wearing the Rami, or Petticoat Made of Leaves



Mr A. E. Pratt and Some Native Collectors

work of the house and in the field, they are nevertheless regarded with affection. It is erroneous to suppose that they are compelled to be burden-bearers because they are lightly esteemed. As far as my own observation goes, the men are left free of loads, or are given lighter loads, in order that they may be ready to protect the women from the sudden raids of other tribes. Their gardens are often a considerable distance from the village, and the women never go to gather yams or taro or to till their patches without an escort of young men as protectors.

On the other hand, the men are not idle, but perform their part in the economic system by acting as hunters. Their chief game is the pig, the cassowary, and the wallaby. They hunt this quarry with spears, and drive the game into nets which have been spread between the trees and posts in the forest over considerable

area, forming a corral, approached by a long decoy, two long lines of nets gradually converging. When the nets have been set the drive commences. The beaters extend themselves for considerable distance, and with the assistance of dogs gradually force the game toward the corral; birds and beasts are forced into the center in crowds. At length the hunters close round the opening, a final rush is made, and the victims are despatched with spears. These hunting bouts occur only at long intervals and on the lower slopes of the mountains. After a successful drive, there is a great jollification. Fires are built in the camp, the game is roasted, and in an incredibly short space of time every portion disappears and the people are lying around gorged.

CURIOUS METHODS OF BLEEDING

A curious form of bleeding is in use among the tribes, especially among the younger men. The bleeding is performed by two persons, who sit opposite to each other. The operator takes a small drill, or, rather, probe, of cassowary bone brought to an extremely fine point, and this is attached to the string of a tiny bow, about four inches long. Holding the bow as if he were going to shoot, the operator aims the little probe at the patient's forehead, draws the bow slowly, and lets the string go; the probe is thus brought into sharp contact with the patient's skin, and the operation of drawing the bow and letting fly the arrow is repeated again and again until blood is drawn. It should be remembered that the probe or arrow is always attached to the string and never escapes. The patient now leans forward and the blood is allowed to flow profusely onto the ground.

I have often seen as much as half a pint allowed to escape. When faintness supervenes the wound is staunched with ashes or any convenient styptic and the patient sits up. If the ashes fail to act, cautery with a hot cinder is practiced. Headache is the usual trouble for which this remedy is applied, and this frequency of bleeding may be the reason why there is no heart disease or sudden death among the natives. This may probably lend color to the theory of some physicians, that the increase of heart disease and sudden death in civilized nations is due to the entire abandonment of bleeding, once certainly carried to excess.

During our journeyings in the interior we depended on native help alone, and the people we employed were not, one might say, scared out of their usual way of life by the presence of a large body of white men. I and my son went absolutely alone into the wilds, with no white lieutenant. We cast ourselves, as it were, on the hospitality of the aboriginal Papuan (and cannibal at that), but we had no reason to regret our draft on the bank of savage fidelity.

BOLIVIA—A COUNTRY WITHOUT A DEBT

By Senor Y. Calderon

Minister from Bolivia to the United States

I HAVE been honored by the National Geographic Society in being asked to make an address, under its auspices, on the subject of Bolivia, my country. I accepted the invitation with pleasure, coming, as it did, at the time when the recent historic visit of the Secretary of State, Mr Root, to South America has awakened special interest toward the republics situated south of the Isthmus of Panama.

It may be said that the foresightedness and wisdom of this great statesman has torn the veil that obscured the vision of those republics and revealed to this country the young nations striving for progress and peaceful development.

I was fortunate in hearing the addresses of the honorable Secretary of State, delivered in Kansas City* and in Cincinnati, and I earnestly recommend to all of those who are interested in the prosperity of the sister republics, and in fostering our mutual relations, to study them with careful attention.

You are aware of the spontaneous ovations with which Mr Root was received by the countries where he touched on his voyage. From the first moment, he gained the esteem and the confidence of the southern republics. With feeling and eloquent words he interpreted the sentiments of this great nation and the message of peace, of fraternity, and of respect for their sovereignty was proclaimed to the world by one of the highest officials as well as one of the most eminent citizens of this country.

The reception of Mr Root in South America, besides being a personal tribute offered to his merits, was the sincerest expression of good will with which they accepted the proffer of friendship sent by the government and the people of North America.

In his last message sent to Congress, the great American who so brilliantly guides the destiny of this Republic has confirmed in clear and forcible words the friendly declarations of the Secretary of State, thus giving them governmental sanction and dispelling the mistrust created under the wrong impression that the United States had designs on establishing its supremacy and dominion over all the continent. The words of President Roosevelt reveal the high spirit of justice that guides his policy, and mean the application of the "square deal" to international relations.

If the progress and stability that prevail in the South American republics had not been known by Mr Root and he had gone on his visit expecting to see some of the insurrections which are supposed to be occurring constantly, he would have been greatly disappointed. In place of military chiefs arrayed against each other, of cities given over to disorder and war, he would have found, as he did find, peoples filled with life and anxious to put themselves on a level with the most advanced of the globe.

OUR PAST DID NOT TRAIN US FOR THE EXERCISE OF LIBERTY

We have inherited from our ancestors traditions little suited for the exercise of liberty and the respect for human personality. Our education was not like that of the English colonies in North America; the political life of the Spanish colonies was controlled by the delegates of the crown, and the people had nothing to do but to blindly obey.

In honor of the good intentions of the

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An address to the National Geographic Society, January 25, 1907

mother country, it may be said that the Spanish laws contained numerous and very paternal dispositions in favor of the distant American dominions and of the aborigines whose fate is and has been so cruel.

In practice it was another thing; the Hispano-Americans were excluded from all the most important posts and lived in a depressive condition as compared with that of the men from the Spanish peninsula. In regard to the great mass of aborigines, their position was much sadder than that of slaves. Condemned and forced to work in the mines by drafts, called *mitas;* excluded from the benefits of instruction and deprived of all their rights, they acquired the vices of the conquerors and lost the virtues of their ancestors.

In order that we may form an idea of the despotism to which the descendants of the Inca Empire were subjected, it may be mentioned that they, a race of beardless men, were compelled to buy shaving razors, and for an Indian to appear on horseback was considered a misdemeanor punishable by whipping.

The Spanish possessions in America were closed to all contact with the world and isolated from intercourse and exchange of ideas with the peoples of Europe. The fundamental principle of government was to exact absolute obedience to the king and his representatives, and in religious matters, under the withering hand of the Inquisition, freedom of conscience was condemned.

Such conditions were not the best preparation for beginning the life of independent republics and to proceed without stumbling.

The people of the United States of North America not only imbibed from their English ancestors the love of order and habits of liberty, but had a vast territory free from obstacles, fruitful and watered by great rivers, and placed opposite Europe, from whence came a constant current of immigration that has greatly contributed to its advancement.

The Latin republics of South America, although occupying a territory more than double the size of the United States, encounter the great barrier of the Andes through the continent, from north to south, preventing the communication of the peoples.

The distance separating them from Europe is almost twice as great and much more difficult to travel. The immigrant arrives in this country in a few days and at a small expense, while the voyage to South America is so long and so costly as to prevent him from going there.

In order to correctly judge the conditions and the development of the English colonies after their emancipation, as compared with the progress made by the Spanish colonies, it is well not to forget these circumstances.

The Spanish conquerors have left behind them a legend unrivaled in the world's annals for audacity and perseverance. If they had displayed less cruelty toward the vanquished and greater respect for human rights and less thirst for gold, the pages of their history would be the most brilliant of mankind.

We, their descendants, if we inherit many of their defects, have also the noble qualities that make the Spanish people the most chivalrous of Europe, with a history filled with great examples of patriotism and heroic achievement.

THE VAST INCA EMPIRE WHICH FLOURISHED FOR 500 YEARS AND IN WHICH PROPERTY IN LAND DID NOT EXIST

Before I begin to speak of the actual conditions in Bolivia, permit me to draw a sketch of the historic antecedents preceding the organization of the Republic.

Situated at an altitude of 12,500 feet above the level of the sea and secluded between two great branches of the Andes, lies the mysterious Lake Titicaca, whose waters form the boundary between Peru and Bolivia. There, on the Bolivian side, is found, among others, the Island of the Sun, from whence pro-

ceeded, according to tradition, Manco Capac, his wife and sister, Mama Ocllo, founders of the Inca Empire. They claimed to be direct descendants of the sun and came to the world to civilize it and to establish the reign of peace and good will. Manco Capac taught the men to cultivate the soil, while his wife instructed the women in the art of spinning and weaving. And thus, under a theocratic and paternal government was developed a vast empire—the grandest experiment of an organized communism recorded by history.

Careilazo de la Vega, in a work entitled "Royal Commentaries," has left us an attractive and simple picture of this admirable social organization, in which the individual disappears in order to become a mere factor in the general well-being. Property in land did not exist; the fields were allotted periodically and the harvests were divided into three parts, destined to the Inca, to the maintenance of worship, and to the public in general. The paternalism of the Incas went as far as to exercise a permanent vigilance over the private life, as their subjects were not permitted to have their doors closed; so that all their acts might be subject to inspection by the authorities.

The Inca Empire, during the five centuries of its existence, extended in the north to the present confines of the Republic of Colombia, and south as far as Chile and the northern part of Argentina, embracing a great portion of the Pacific coast, and all of the territory of the present republics of Ecuador, Peru, Bolivia, and northern Chile. Attesting the advanced degree of its civilization are the monuments remaining on the Island of the Sun and those of Cozco, as well as the ruins of the magnificent system of roads throughout the Inca's dominion.

However, in spite of the ten or twenty millions of inhabitants, it fell as a statue of clay before a few score of adventurous Spaniards, who in a few years made themselves masters of the country and submitted the inhabitants to servitude, almost without resistance. Educated in the religious respect of the sacred power of the descendants of the Sun, they had lost the strength and manhood of nations invigorated by individual freedom.

The power under whose shadow they had lived being broken and destroyed and being suddenly left to themselves, the subjects of the Incas fell easily under the dominion of the conquerors, whose arrival confirmed the popular tradition that some day men with beards would come from over the seas and take their homes.

CITIES OF GOLD AND SILVER

Once possessed of the country, the Spanish extended rapidly their search for gold and silver throughout the territory. In 1548 Alonzo de Mendoza founded La Paz, today one of the principal cities of Bolivia, attracted thither by the rich gold ore of the rivers of that section. In fact, the mines of Chiquiaguillo, just outside the city, have produced great quantities of gold and nuggets of considerable value. In 1718 the Marquis de Castel Fuerte sent to Madrid a nugget weighing 760 ounces of gold, and recently the German company that works these mines sold, among other nuggets, one encrusted in quartz weighing 52½ ounces, of which 47 ounces were gold. It may be affirmed that all of the rivers in the vicinity of La Paz flowing from the Cordilleras carry gold.

The city of Potosi was founded in 1545, and fifty years later it had reached a population of 160,000 because of the enormous richness of the mountain at whose foothills stand the city. The quantity of silver produced by the mines of Potosi for more than three centuries is fabulous and has made its name a synonym of wealth. The city became a goal for all classes of adventurers, bankrupt Spanish nobles, merchants anxious to make fortunes, and all kinds of men contributed to make Potosi a center of prodigality, of romantic adventure and disorder.

The chronicles of Potosi are interesting as well as instructive. We see depicted the customs of those ages, with all their preoccupations and fanaticism as well as the spirit of chivalry and love of adventure. Spanish hidalgoes prided themselves on squandering great fortunes in feasts and revelry, which often caused strife among the bands in which the city was often divided.

ANECDOTES OF THE MINERS

The anecdotes of those times that have reached us are really curious and amusing, and as samples I will relate some of them: A miner named Quiroz was one of the most fortunate of his day—a man of generous spirit, who by his liberality won the affection of his fellow-men. It is related that he caused to be made a series of drawers in an immense wardrobe in his home, and in each drawer he would put a sum of money, varying from one to thousands of dollars. Then, as today, there was no lack of men anxious to secure a living without work, and when any one presented himself to ask for help he was ordered to open one of the drawers and try his luck. The prodigality of this man became a proverb; it was said, "After God, Quiros" (Despues de Dios, Quiroz).

On a certain feast day the butlers of two great houses met in the public market, and both wished to purchase a certain delicacy, very rare in such a place as Potosi. The competition was started between the two, who tried to outbid each other. One of the butlers, believing that the price had gone too high, and that he had done enough to uphold the name of his master, left the other with the coveted prize, and when he reached home and related what had occurred he was promptly discharged for not having sustained the honor of the house and allowed the other fellow to get the best of him.

One of the characteristics of those times was the religious fanaticism; and the miners, in order to insure their salvation or pardon for their sins, donated enormous sums of money for the building of churches and convents, and this explains why so many churches are found today in the old Spanish towns.

The Carnegies of those days did not possess the broad and high mind of our own Carnegie, who has once more shown his noble ambition by his recent magnificent gift of $750,000 toward the building of the palace for the use of the Bureau of the American Republics, which will be a lasting monument to their friendship and the cosmopolitan sentiments of its promoters.

If in political and administrative affairs the sovereign will of the king and his representatives was the law, so in domestic life the father, as chief of the family, was equally the supreme ruler, the wife and children being his subjects. It may surprise the young ladies to hear that in many cases the contracting parties, whose marriages were always arranged by the respective fathers, did not know each other until the time of the ceremony which was to link them together for life as man and wife.

For fear that the girls would employ their time in writing love letters, many fathers prohibited their daughters from learning to write, and the only books to be had were those of a devotional character and the lives of the saints. Despotism feared light, and books not approved and selected by the ecclesiastical authorities were strictly forbidden.

It is easy to see that public instruction was very limited and little encouraged. The city of Sucre, capital of Bolivia, known in colonial times as Charcas, had an university and was the residence of the Royal Audiencia, whose jurisdiction extended over all the territory that today constitutes Bolivia, and it was at the same time the highest tribunal of justice and the delegated authority of the king in administrative affairs.

THE WAR FOR INDEPENDENCE

Thus, under the reign of absolute submission to the crown of Spain and its representatives, the colonies of South

America lived condemned to inaction and outside of the march of progress of the world, until the social upheaval known as the French revolution changed the basis of modern society and made its influence felt in the far-off Spanish colonies.

Contemporaneously the English colonies of North America had won their independence and organized a federal republic, destined to become the greatest example of popular government and a complete demonstration of the life-giving influence of democracy.

These great historic events encouraged the Hispano-American colonies to fight for their freedom, which they had longed to attain.

The invasion of Spain by Napoleon and the capture of Ferdinando VII offered a favorable opportunity for a general uprising. The city of La Paz was among the first to openly proclaim independence, and on the 16th of July, 1809, organized a Junta Fuitiva, called to advance the noble work of political redemption of all the continent.

Spain tried to drown the revolution in blood, and committed the most atrocious deeds. The chiefs of the revolution were condemned to death, and, as a lesson and warning, their bodies were quartered and placed on poles along the public roads.

The hour of regeneration, however, had arrived, and nothing could stop the efforts of a people determined to secure their freedom. The stubborn fight continued for fifteen years. The territory of Alto Peru, now Bolivia, was the theater of daily combats, and there was not a village or piece of ground that was not consecrated with the generous blood of her sons fighting for liberty. As illustrating cruelties perpetrated by the Spaniards, it is stated that once they entered the city of Tarija carrying on their lances the heads of the patriots killed on the field of battle.

The victory of Ayacucho, on the 9th of December, 1824, won by the Venezuelan General Antonio José de Sucre, terminated the war, and thus the South American countries secured their emancipation.

The provinces of Upper Peru held the first national congress in Sucre, and on the 6th of August, 1825, was proclaimed and established the Republic of Bolivia.

UNHAPPY BECAUSE OF MILITARY PRESIDENTS

The independent life of Bolivia began under auspicious circumstances. Under the enlightened guidance of Sucre, the victor of Ayacucho, a hero illustrious for his virtues, his love of progress, as well as his deep respect for the law, the Republic without doubt might have advanced rapidly toward the path of freedom and order; but unfortunately a military insurrection, prompted by intrigues of neighbors and personal ambitions, although condemned by the whole country, caused the resignation of the presidency of Sucre.

He was succeeded by General Santa Cruz, who, called by one of the factions in which Peru was divided, invaded that republic and organized the Peru-Bolivian Confederation. With the title of Supreme Protector, he occupied with Bolivian troops the capital of Lima, where he fixed his residence; but, owing to the opposition of the contrary bands, aided by Chile, fearful of the increased power that the Peru-Bolivian Confederation might develop, put an end to it in a few years.

With Santa Cruz began the sad period of military chiefs and the efforts of the people to free themselves by the disastrous remedy of revolution, whose fatal influence was shown when, weakened and divided by our internal dissensions, we were worsted in the war with Chile.

The disasters and losses resulting from this war awakened the patriotic sentiment of the nation, and then the Bolivians undertook to repair by peace and work the losses caused by anarchy.

Today the country is peaceful, under a free government elected by popular vote,

and endeavoring with all of her energies to develop the riches with which Providence has endowed her soil.

If I have not tired your kind attention I will draw a rapid sketch of the present conditions of my country, her government, and the work being done to make productive the mineral and vegetable wealth of her territory.

THE GEOGRAPHY OF BOLIVIA

The great geological disturbances that in remote ages transformed the continent of South America and produced the wonderful upliftings of the Andes are very marked in Bolivia. This mountain chain, traversing the whole length of the continent, divides itself in Bolivia into two principal branches—the one of the west, forming a kind of wall between the sea and the interior, closely follows the coast; the other, extending toward the east and known as the Cordillera Real, presents a series of majestic peaks eternally resplendent in crowns of snow and lifting their heads to heights of more than 21,000 feet, as the Illimani, and the Illampu, with 21,700, and others equally imposing.

The high plateau of Bolivia occupies an area of more than 66,000 square miles, with a mean altitude of from 10,000 to 13,000 feet above sea-level. It is difficult to say whether the obstacles offered by the vast mountain walls to free traffic and the communication of the people is not more than compensated by the prodigious quantity of minerals they contain, and that make Bolivia one of the richest countries of the globe.

The forests and vast plains extending eastward, with about 7,000 miles of navigable rivers, comprise a fertile agricultural territory embracing more than 300,000 square miles.

The total area of Bolivia is more or less 709,000 square miles, and it is therefore the third nation of South America, as regards size; but unfortunately the population does not yet correspond to its extensive territory, amounting only to a little more than 2½ millions.

As the Spaniards settled first in the mining regions, the section of Bolivia situated east of the Cordillera Real, which includes the extensive territories watered by the tributaries of the Amazon and the Plata, is the least populated. There are found the forests, filled with fine woods suitable for all industrial purposes, such as railway ties, building and cabinet-making. Some of these woods are as hard as iron. Rubber, Peruvian bark, and a multitude of useful and medicinal plants abound in this soil, whose wonderful fertility could easily support many millions of inhabitants. The coffee and cocoa are conceded to be of the finest quality, and fruits and all tropical products are abundant. The climate is generally healthful and suitable for settlement by European races.

The mean temperature of the lowlands of the Amazon to an altitude of 2,000 feet above sea-level is 74°; to an altitude of 8,000, it is 66°; and in the central plain, where the altitude varies from 10,000 to 12,000 feet, it is 50°. It is calculated that to every 181 meters of ascent in the mountains there is a drop of one degree in the temperature.

It may be said that in Bolivia there are only two seasons—the rainy season, which corresponds to summer, and extends from December to May, and the dry, or winter, season, lasting from May to December. In the latter months it seldom rains and the sky is clear and bright. The rains are more copious in the east, and at times the rivers overflow and rise as high as ten meters above their ordinary level.

Almost all of the navigable rivers of Bolivia flow into the Amazon, the most important being the Beni, which receives the Madre de Dios, the Orton, and others before reaching its confluence with the Mamoré, when it takes the name of Madeira, one of the most powerful tributaries of the Amazon. Unfortunately the navigation of this great river is obstructed by a series of very dangerous rapids. The government of Brazil has agreed by treaty to construct a railroad

around these rapids and thus expedite the Amazon route. The Pilcomayo and the Bermejo are also rivers of importance that flow toward the southeast and empty into the Paraguay.

The eastern region of Bolivia is also rich in grazing lands, where the stock industry promises to be highly lucrative. Today there are found vast herds of wild cattle roaming over the lands.

Lake Titicaca, on the boundary line between Peru and Bolivia, is notable for its great altitude, for its romantic traditions, and for the monuments of that distant epoch yet standing on the Island of the Sun. The lake's surface extends over an area of more than 5,200 square miles.

If the natural exuberance and richness of the eastern section of Bolivia is remarkable for its products, the region of the Cordilleras is, I will say, the great storehouse of mineral wealth. The silver mines of Potosi, Oruro, Colquechaca, Huanchaca, and many others have contributed hundreds of millions to the richness of the world. No less abundant are the deposits of copper, bismuth, zinc, cobalt, gold, and tin. On speaking of the commerce of Bolivia I will mention the quantities of these minerals exported today.

THE COMMERCE OF BOLIVIA

The main causes that hinder the development of Bolivia's wealth are: The difficulty and cost of transportation, the lack of capital, and the scarcity of population. To what an extent the high rate of freight hinders the growth of industries in Bolivia, it is enough to state that coal at the seacoast is worth from 18 to 25 shillings, or, say, $4 to $6, more or less, per ton; taken to the mines in the interior of Bolivia, according to the distance, yet this may not exceed five hundred miles, and the price will be from $40 to $80.

A large number of mining enterprises, as well as the eight banking institutions, are financed with national funds. Recently two German banks have been established in La Paz.

The constitution of Bolivia is very liberal and is based on the unitarian system of central government. The President is elected every four years by direct popular vote. The legislative power is exercised by a senate and house of deputies, and the judiciary by a supreme court appointed by the senate, and by inferior courts and other judges.

Foreigners enjoy the same franchises as the natives, and may hold property, work the mines, etc., all in conformity with the laws.

Bolivia is the only country in South America that has not suffered from earthquakes, and when felt they were almost imperceptible and of no consequence.

Within the last few years the international commerce of Bolivia has increased considerably. In 1905 it reached 69,665,000 in Bolivian money—an increase of thirty per cent over the figures of the previous year—and according to the statement of President Montes in his last message to Congress, in 1906 it will reach 80 millions, and when the railroads now in course of construction are completed these figures could be easily doubled in a short time.

The commerce with the United States has also grown in recent years, and the construction of the railways will greatly augment the present movement. The importations into Bolivia in 1905 amounted to $1,720,000; and yet this small sum is a large increase compared with previous years. On the other hand, the importations of Bolivian products into the United States hardly reached $60,000, while Bolivia produced rubber, tin, cocoa, coca leaves, Peruvian bark, and many other articles of great consumption in the United States, and which are purchased in Europe to be brought here.

The exportation of silver averages 13,000,000 ounces a year; of copper, 5,000 tons, more or less; the production of tin grows from year to year, so that from 1897, or ten years ago, when the production was about 3,000 tons, it had reached 17,000 in 1905, and during the

past year it is probable that the exportations exceeded 20,000 tons of pure tin.

It is impossible to foresee the marvelous development that railway facilities will offer to this industry, as well as to the general progress of the country. Bismuth, zinc, and gold represent quantities no less important.

In spite of all the obstacles that the Bolivian industrials have encountered on passing through the Amazon, the exportation of rubber in 1905 amounted to 1,700,000 kilos. This is a product whose output could be easily increased when the railroads are completed. Sir Martin Conway calculates as not improbable that there may be about 50 millions of rubber trees in the region of the Upper Beni alone. Each tree is supposed to yield annually from three to seven pounds of rubber. Bolivia also exports considerable quantities of alpaca wool, the finest chinchilla and vicuña skins, and other national products.

The position Bolivia occupies in the heart of South America gives to her commercial and international importance, and, although deprived of her coast on the Pacific, she is in immediate contact with five of the most advanced republics; and it is to their interest to encourage mutual trade for the benefits that will naturally result. And this is not all. The main railway line under construction in Bolivia has a continental bearing, for the connection that it will establish between the Argentine system, that is now being extended to the interior of Bolivia, with the Peruvian railroads coming from the north and the Pacific coast. Then Lima in Peru, La Paz in Bolivia, and Buenos Aires in Argentina will be united within a few years by a continuous railway spanning the 2,500 miles, more or less, that separate the capital of Peru, on the Pacific, from the capital of Argentina, on the Atlantic, and will form an important section of the Pan-American Railway.

For the first time United States capitalists are taking an interest in the construction of railways in that section of South America. The Argentine roads were built with English capital, and the same is the case with those of Brazil and Chile, where the majority of the roads are government property. Peru constructed her railways with national funds, but had to cede them for a term of years to her English creditors. Bolivia, then, is the first country where, in coöperation with the Bolivian national resources, American capital is being invested.

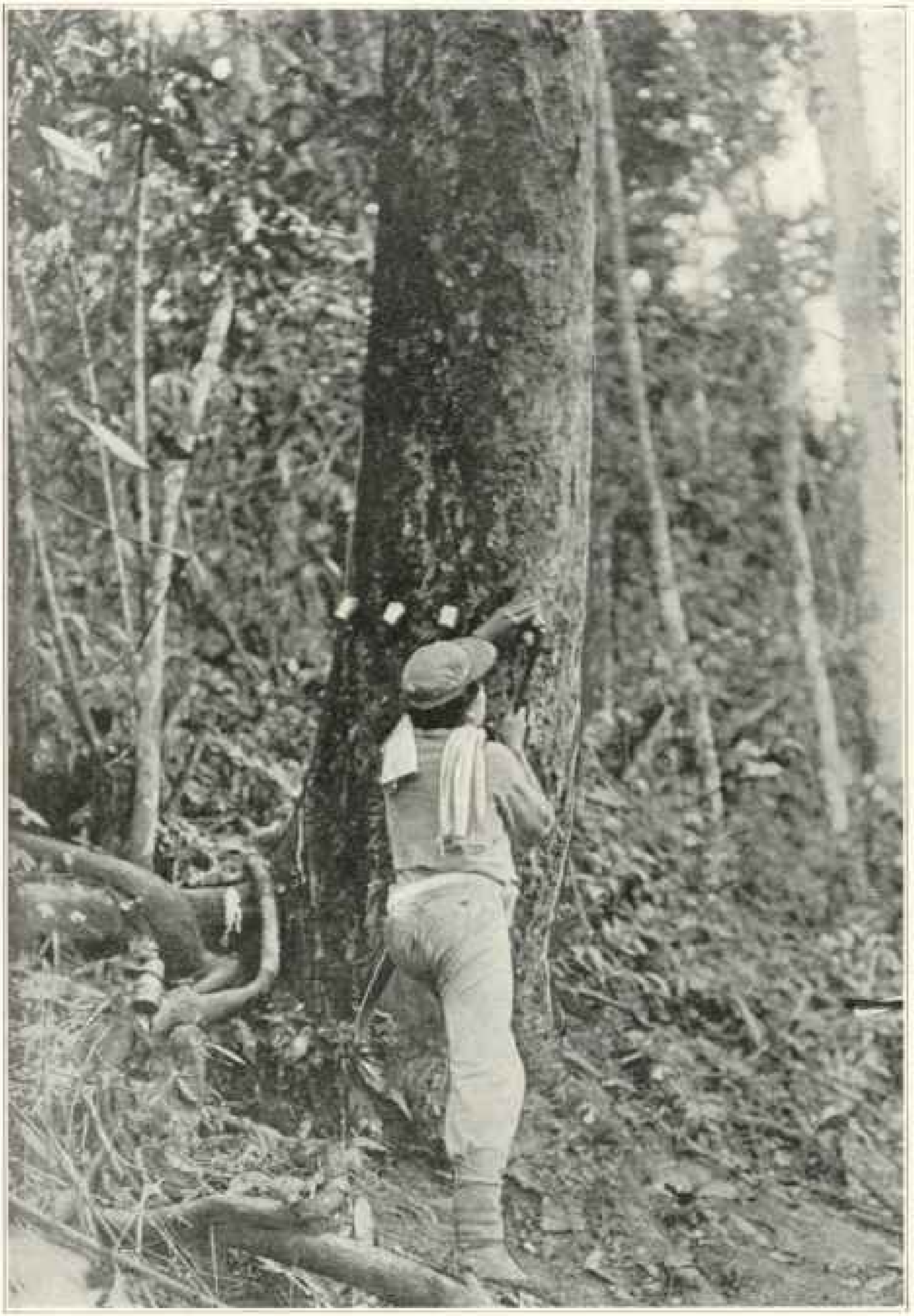
NEARLY 1,000 MILES OF RAILROADS TO BE BUILT BY AMERICAN CAPITAL.

It has been my aim and I had the good fortune to succeed in interesting representative New York bankers in the great work of giving life to my country by means of roads through rich deposits of minerals and open to the world her virgin forests. My government has concluded directly with the bankers a contract that is today being executed. The lines to be constructed by the American syndicate are from La Paz to Tupiza, 530 miles; Oruro to Cochabamba, 133 miles, and La Paz to Puerto Pando, 200 miles; in all, 863 miles. Of these railroads the one from La Paz, passing by Oruro and Potosi to Tupiza, will form the chain uniting the republics of the Pacific with those of the Atlantic, besides traversing the richest metallic zone that exists, perhaps, in the world. The line from Oruro to Cochabamba will open to commerce the fertile valleys of the interior of that section, the most thickly populated of Bolivia, and make that part of the country accessible to the navigable branches of the Mamoré.

The railroad from La Paz to Puerto Pando, a port situated at the headwaters of the Beni, will open the territories of the Beni, where rubber grows in such abundance, coffee, and all the most precious tropical products, as well as the various classes of woods. This railroad will have the peculiarity of passing in a few hours from the frigid zone of the high plains, where there is practically no vegetation, to the tropical region of the orange and the sugarcane. In a distance

Rubber Gatherers in Bolivia

For this illustration and the three following pictures, the NATIONAL GEOGRAPHIC MAGAZINE is indebted to the Commercial Museum of Philadelphia



Tapping the Rubber Tree in Bolivia

of less than thirty miles the traveler will be transported, as if by magic, from a temperature of perhaps 40° or less to one of 70° or more, as he descends through wonderful scenery to the other side of the great eastern chain of the Andes.

But these railroads are not the only ones called to transform in some years the economic life of Bolivia and give to her rank and importance to which her size and position entitle her. By a treaty of peace recently celebrated with Chile, that republic agrees to build, and work has already commenced, a railroad from Arica to La Paz, a distance of some 309 miles. That line will unite Bolivia with the Pacific by a road much more direct than that at present afforded by the Antofagasta line, which is 575 miles long, or that from Mollendo to La Paz via Lake Titicaca, a distance of 533 miles. The Arica road will bring the city of La Paz within 8 or 10 hours' time of the coast.

The Bolivian Congress authorized more than a year ago the building of a railway from the borders of the Paraguay River to Santa Cruz, one of the most mediterranean cities, but destined to become one of great importance. The projectors have deposited the sum of 100,000 pesos as a guarantee for the execution of the contract, and the construction materials have begun to be transported by way of the Plata and Paraguay Rivers. The length of this line will be 497 miles. This route will offer free communication to the rich oriental zone by way of the Plata and the Paraguay, and open to immigration and progress a territory of more than 242,000 square miles, watered by large rivers and of remarkable fertility. There are on foot other projects of railway construction of no less importance.

Progress is like oil, which spreads itself wherever it touches. Some years more of work and effort in preparing transportation facilities, and by the beneficial influence of steam, electricity, and immigration, the future greatness of Bolivia is assured.

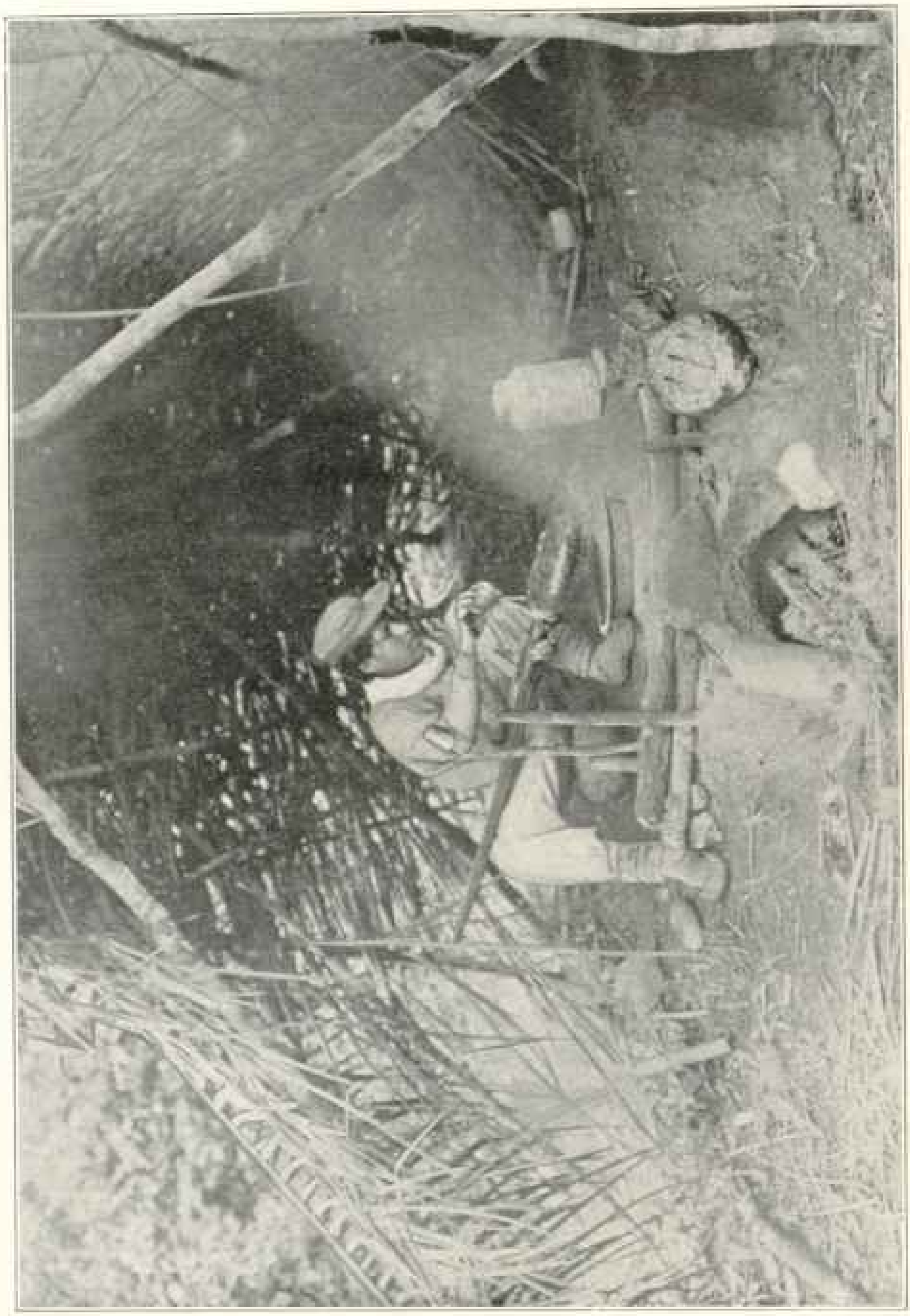
THE GLORIOUS FUTURE OF SOUTH AMERICA

Before concluding this already too long address, permit me to call your attention to the fact that what is being done in Bolivia is also in progress in the majority of the South American republics. Argentina, for instance, by receiving an increasing current of immigration, is rapidly developing her wonderful resources. If some of them have not yet succeeded in getting over the fatal disease of internal turmoil, it will not be long before they enter the road of order, and Mr Root's prophecy that the twentieth century will be South America's century will be fulfilled.

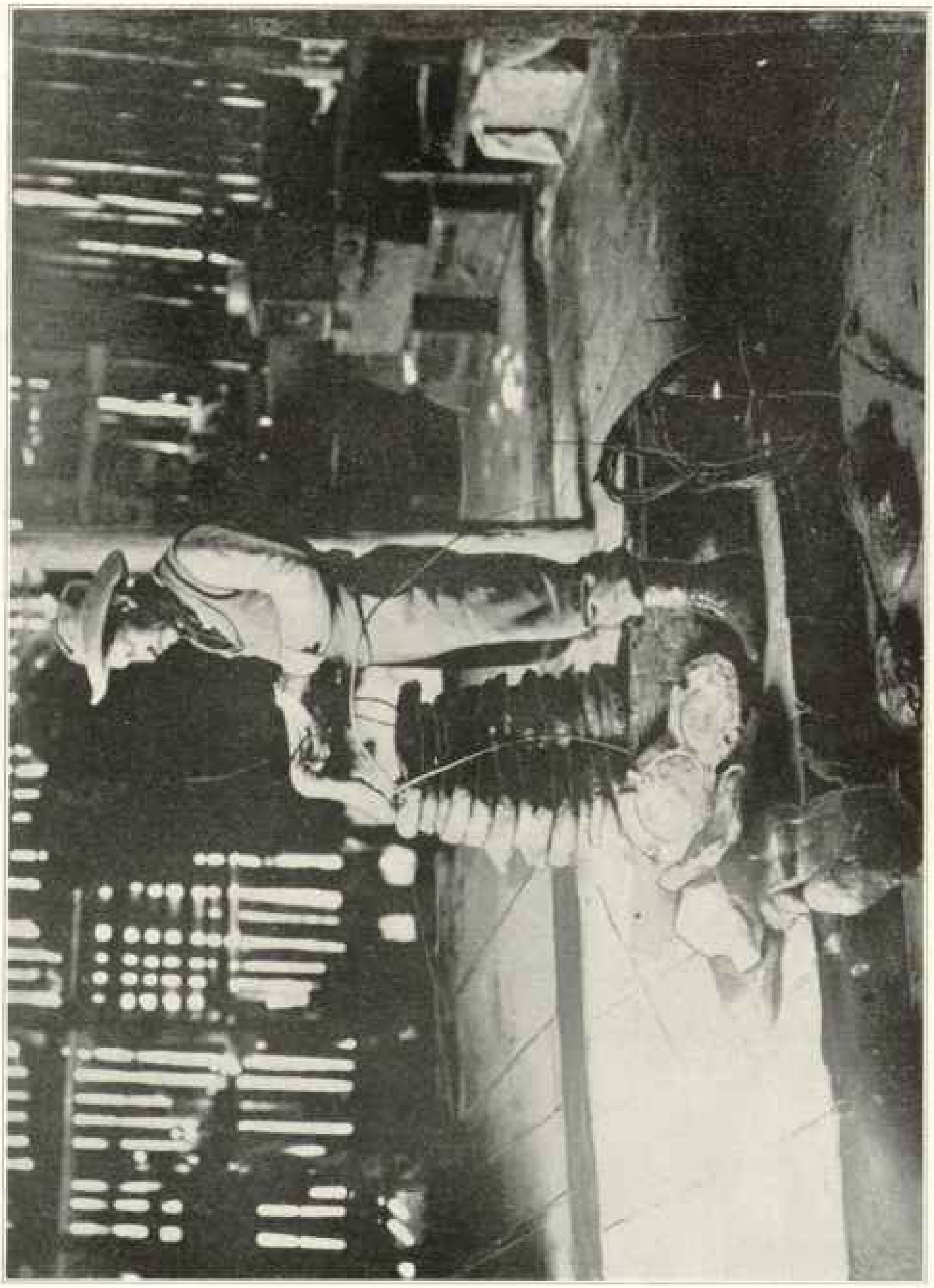
Slowly but surely the onward march of progress brings closer and closer the South American republics, guided by the eternal force of liberty and the broadest sentiments of universal fellowship, common origin, and interests. I venture the hope that in no distant future a confederation of Peru, Bolivia, Chile, Argentina, Uruguay, and Paraguay, as the United States of South America, will be established, and that Ecuador, Venezuela, and Colombia, reunited, and Brazil will form a trinity of nations that, with their sisters of the North, will be the beacon light of the world, shining with the undimmed brightness of human rights, peace, and happiness.

Asia is already populated with many hundreds of millions of people whose races, civilization, and traditions will never, perhaps, assimilate with those of Europe; Africa has been carved among the powers of Europe; this New World, then, remains, where the political traditions of the Old World are broken and democracy will be supreme.

Never was there proclaimed a more vital, lasting, or grander principle than the Monroe Doctrine, which, in its purest interpretation, is the consecration of all America to republican life; that is to say,



Curing Rubber by Smoking it, Bolivia



Packing-room of a Rubber House, Bolivia.

the dignification of man and the empire of justice and the right to work out his own destiny without the tutelage of kings or classes or any other sovereignty than that of citizen and ballot.

We are thankful and render our tribute of admiration to the history and civilization of Europe; we study the books of her thinkers; enjoy the magnificent works of her artists, of her poets, and of all those who have so highly elevated the intellectual level of mankind. We desire and solicit the concourse of her noble races; but in the political order the whole America is destined to be the throne of liberty and right, where mankind will advance to the highest ideals of his divine mission in the world. And when the barrier separating this grand Republic from her sisters of the South is removed by the completion of the Panama Canal, the two great oceans made one, it is necessary that the bonds of union and of mutual interest and respect be already established on the firm basis of peace and justice.

The Panama Canal will open a new horizon to commerce, and it might be said that it will be the material consecration of the Monroe Doctrine, which excludes conquest from America, where, under the inspiration of democracy, freedom, and justice, the Christian brotherhood of mankind will be perpetuated.

OUR HERALDS OF STORM AND FLOOD*

Being an Account of the Various Activities of the United States Weather Bureau in Saving Life and Property

By GILBERT H. GROSVENOR

WE Americans are always talking about our mountains of gold and coal and iron, of our fat fields of corn and wheat, but few of us ever realize that we have in our climate a great advantage over all other nations. In the cold wave which in summer and winter so often sweeps across the land and sends the thermometer tumbling thirty degrees in almost as many minutes, we have a constant, a never-diminishing asset of priceless value. The wave acts as a tonic, but, unlike any tonic made by man, it carries no reaction. No other land has cold waves like ours. To the cold, dry air of this periodic cold wave, which brings extraordinary changes of temperature, we owe much of the keen, alert mind, the incessant, unremitting energy of our American race. I had asked the Chief of the United States Weather Bureau, Professor Willis L. Moore, what was the most remarkable feature of our climate, and that was substantially his reply.

When the amazed European asks us what makes the sluggish mind of the immigrant to stir and waken in the United States, and then to climb, at first hesitatingly, but soon with vigor and confidence, to the top round in the ladder of success, we are accustomed to reply, "It's

* This article is reprinted from *The Century Magazine* by courtesy of the Century Co., and is here given as one of the series in the NATIONAL GEOGRAPHIC MAGAZINE describing the work of the scientific departments of the United States government, other articles in the series being "Millions for Moisture" (describing the work of the United States Reclamation Service), "Reclaiming the Swamp Lands of the United States," "Our Fish Immigrants," "Saving the Forests," etc., etc. The article and illustrations are copyrighted by the Century Co.

in the air;" and we are right. The spirit which fired our fathers to cross the wide Atlantic, and which in less or equal degree still animates the thousands annually seeking our shores, is fed and fanned by the cold winds from the northwest.

The cold wave is born in the heavens

scatters the foul, logy, breath-soaked atmosphere in our towns and cities, and puts ginger into the air. We fill our lungs with it and live. New waves are always coming, following each other in regular procession like the waves on a seashore.

From a photograph. Copyright by Chickering, Washington, D. C.

Willis L. Moore, LL. D.

Chief of the United States Weather Bureau since 1895, President of the National Geographic Society since 1905

miles above our heads, usually over the Rocky Mountain plateau. Suddenly a mass of bitterly cold air will tumble down upon Montana. It rushes down as though poured through an enormous funnel. As it falls it gains momentum, and, reaching the earth, spreads over the Mississippi Valley and then over the Atlantic states, covering them like a blanket. It

It is fitting, then, that meteorology, the science of the weather, should be a distinctly American product, and that the people of the United States should have the best weather service in the world. The United States government spends $1,500,000 a year on its Weather Bureau, which is more money than all the governments of Europe combined spend

Photo by H. C. Frankenfield

Wreckage at Kansas City, Missouri, after the Subsidence of the Kansas River Flood of 1903

for similar service. It has a staff of many hundred skilled experts and trained observers, who in all parts of the country are constantly on the watch to see what the heavens will bring forth.

A DIVIDEND OF TWO THOUSAND PER CENT

Probably ninety-nine men in one hundred judge the Weather Bureau by the weather forecasts which they read at the breakfast table in the morning paper. They execrate and ridicule the service when they are caught at their office or at the theater unprepared for an unheralded shower, and as likely as not unhesitatingly assume to themselves the credit when the forecast is right. Will it be fair or will it rain? How hot or how cold has it been today? They believe the Weather Bureau was created to answer these questions correctly, and always correctly, for their personal gratification. They do not know that the local weather forecasts are only a fraction of the work and a very small and unimportant fraction at that.

Some time ago a skeptical insurance company determined to investigate the amount of property saved in one year by the warnings of the Weather Bureau. It was a company of conservative men, whose estimate would be under rather than above the truth, but it found that on an average the people of the United States saved every year $30,000,000 because of their weather service. As the people contribute $1,500,000 every year to its support, this means that they get annually a dividend of 2,000 per cent on the investment. An investment in

which the original capital is paid back twenty times over in twelve months is extraordinarily profitable and well worth investigation. How does the Weather Bureau do it?

As it is impossible in one brief article to describe all the branches of the weather service, which reaches intimately about one-half of our population every day, I shall cite only a few of the more striking phases of its work.

WATCHING OUR TURBULENT RIVERS

The eagle watch kept on our turbulent rivers to see that they do not catch unprepared the people living on their banks, or on the low-lying lands near them, is one of the most dramatic phases of the work of the weather service. By long experience and close calculation, the weather-man has learned to read the symptoms predicting a rise or fall as accurately as a physician can count the heart-beats of his patient with his finger on the pulse; he has posted hundreds of rain-gages throughout the land feeding each river, which, like sentinels, tell him when the rainfall has been heavy and the exact number of inches of rain that have fallen. To find the amount of water that will pour into the river is then simply a matter of arithmetic, as he knows the number of miles drained by each river. He knows how much water the river bed can carry in a given time as nicely as his wife can judge the contents of her coffee-cup. He knows the strong and weak points of the river banks, so that if the skies send more water than the river bed can carry, he can predict where the waters will overtop or burst its banks and drown the farmer's cattle or flood the city streets.

One of the most remarkable cases of flood prediction on record was the warning of the disastrous floods of 1903. Twenty-eight days in advance of its coming, the forecaster at Washington announced the exact time when the crest of a flood would reach New Orleans, and said that the height of the flood would be 21 feet. Punctually to the hour the flood came, and its crest was 20 feet 7 inches, only five inches less than the height predicted. The immense ocean of water had started one thousand miles away. It had dropped from the skies over a territory six times larger than the State of New York (over 300,000 square miles); but the weather-man knew its rate of march as surely as the engineer, with his eye on the indicator, knows the speed of his locomotive. The people at Memphis were warned that the waters would rise to 40 feet and overtop their levees, and they were given seven days' notice. The people of Cairo were told to prepare for a height of 50 feet; but as they were nearer the starting point of the flood, they received only four days' notice. Such seasonable warning gave time to the people to prepare for defense. Thousands of men were set to work to raise and strengthen the levees and embankments, to clear the wharves and river banks, to remove women and children, to drive the cattle to places of safety. When the flood arrived, the people were ready for it. Comparatively few lives were lost, and the damage to property, while terrible, was millions and millions of dollars less than it would have been if the people had had no sentinel to cry out the march of the waters.

The devotion of the dike-watchers of Holland has been the theme of children's stories for generations, but the sleepless watch of the hundreds of Weather Bureau observers when a flood threatens the land passes unnoticed and unpraised. The scientific precision of American science has made the work appear so simple that it has been robbed of its romance.

FROST AND COLD-WAVE WARNINGS

Much of the care of the Weather Bureau has been devoted to developing a perfect system of frost and cold-wave warnings. A blighting frost or withering cold wave in early spring or autumn may leave behind blackened orchards, wilted vegetable gardens, and empty pockets. In a night it may destroy the

prospects and hopes of the year. The cunning and tireless perseverance of modern science has found some ways of thwarting the malicious designs of King Frost. The orange-grower of Florida has devised dresses to wrap around his orange trees; the cranberry-grower of Wisconsin has learned to flood his cranberry marshes and thus keep them warm; the truck-growers of Norfolk cover their early strawberries and late lettuce and celery with spreads of cheese-cloth or screens of slats; the grower of sugar-cane in Louisiana also has his methods of frost protection.

But all these shields against the biting of the frost are worthless unless the farmer is warned in time to prepare for the icy visitation. The Weather Bureau aims to give him this warning at least twenty-four hours in advance, and to this end it has developed one of the most perfect organizations in the world for distributing knowledge. When the weather-observer scents a frost in the air conditions of a certain region, or sees a cold wave marching to invade a certain section, he immediately telegraphs to the principal town or city in that region. Thence the warning is sent by special messengers, by telegraph and telephone, to every producer in the threatened region. Telegraph, telephone, and railroad companies join hands with the weather-man to help distribute the warning. More than one hundred thousand telegrams alone are sometimes sent within a few hours. Freight trains are placarded with giant signs which farmers can read far off; in some regions the farmers are warned by a code of whistles from the passing locomotive. In the cold wave of 1898, $3,400,000 worth of fruits was saved by the weather forecasts.

STORM WARNINGS

Undoubtedly the features of the Weather Bureau work which yield the highest returns on our investment are the storm warnings sent to masters of steamers and sailing craft in our ports. We who live in tight city blocks and but rarely venture on the ocean know little of the terrors of a storm. The wind that whistles down the street, snatching off our hats, or that rattles our blinds most provokingly at night, may mean a gale at sea of from forty to sixty miles an hour. Between October and April our coasts are swept repeatedly by mighty storms which are hungry for victims, while often during August and September a West Indian hurricane may tear up the coast. The captains of the hundreds of sailing ships, coal-barges, and coastwise craft that carry ice, coal, fruit, and lumber from port to port, know too well the dangers of being caught in such a storm, for our coast-line contains more than one Cape Fear, pointing like a dagger at every passing vessel. The Weather Bureau learns from its outposts as soon as a storm enters the horizon of the United States, and sends warning to the ports in the threatened region. Storm-signals are hoisted on the watch-towers. The seamen and ships keep snug in harbor while the tempest rages outside. An idea of the commercial value of the warnings may be gathered when we remember that during every year not less than 17,000 vessels, most of them small, and many of them easy prey for storms, leave our ports between Portland and New Orleans. These storm-signals are also posted in all the ports of the Great Lakes, which are noted for the fury and suddenness of their storms. Formerly 75 per cent of the loss in shipping on the Great Lakes was wrought by storms, whereas now, owing to the efficiency of the storm warnings, less than 25 per cent of our annual loss can be attributed to the work of storms. Forty-five minutes after the dictation of a storm warning by Chief Moore at Washington, the warning is placed in the hands of every sea captain in every lake and ocean port of the United States.

THE RECORDS—A MURDERER DISCOVERED

The records of the heat of summer and of the cold of winter kept by the Weather Bureau serve a useful purpose. Builders

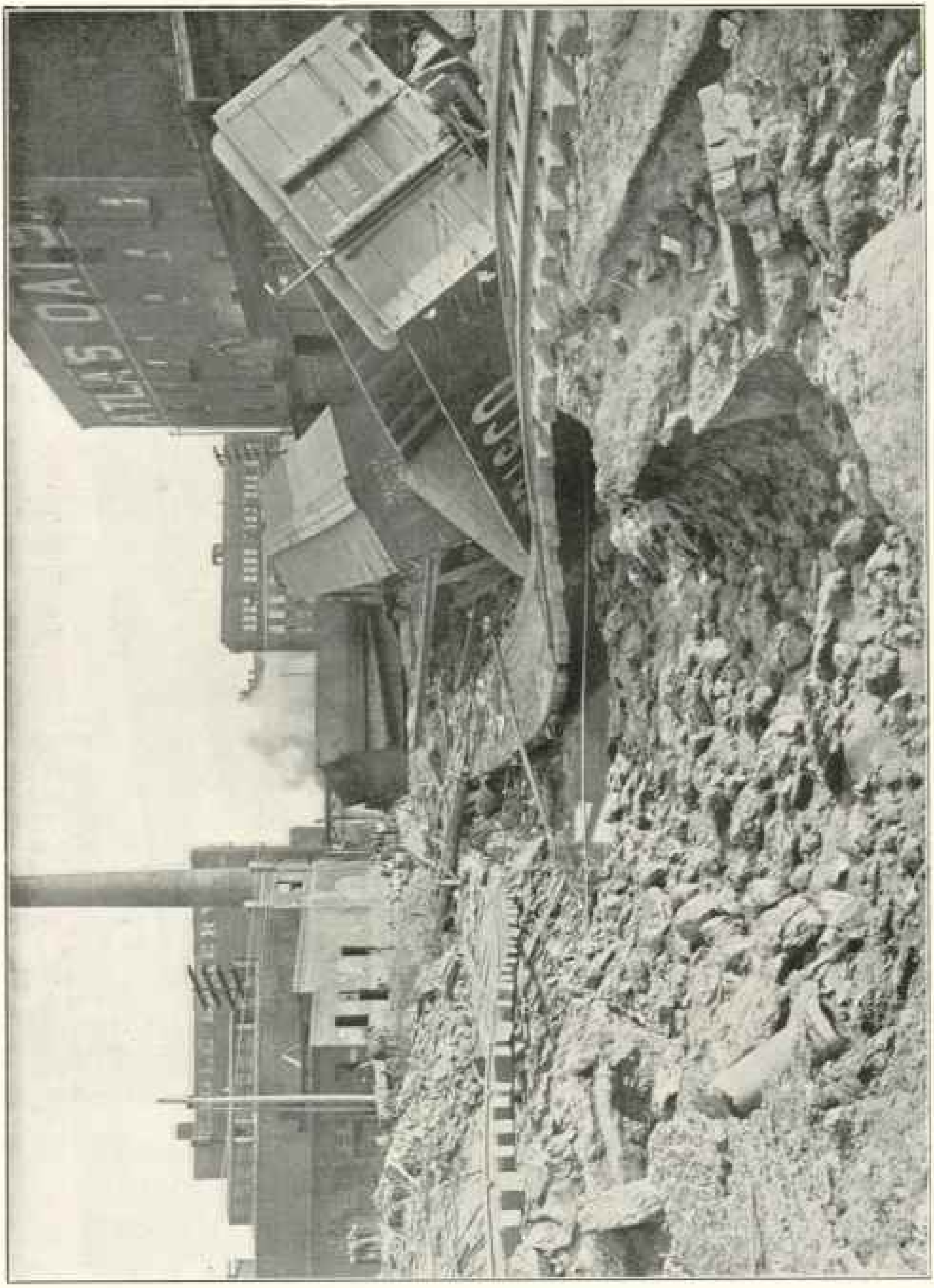
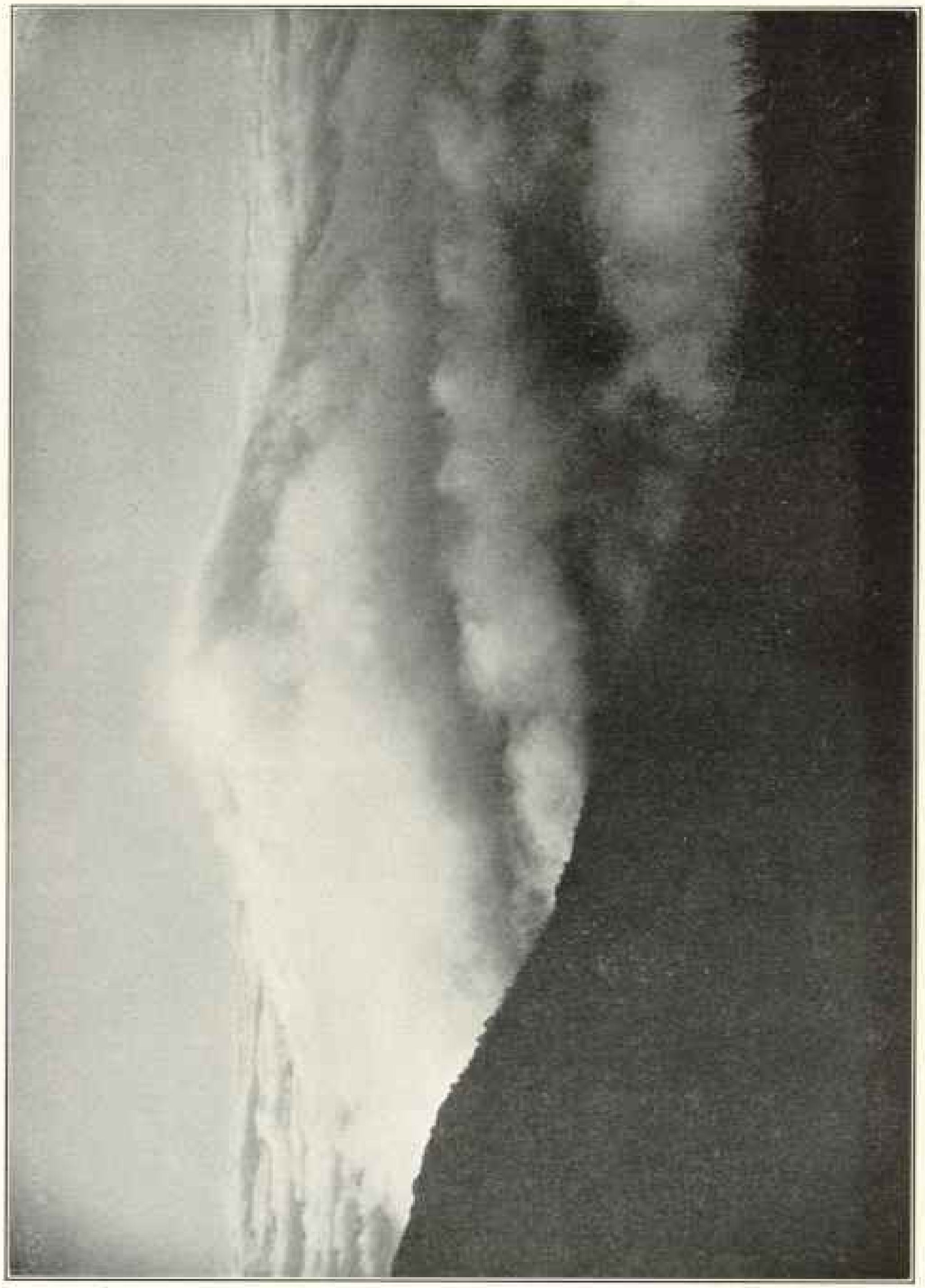


Photo by H. C. Frankenfeld

Scene in Railway Yard, Kansas City, after the Visitation of a Flood



A Fog Billow, San Francisco

Photo taken from U. S. Weather Bureau station, on summit of Mount Tamalpais, by Prof. Alexander McAdie

of giant steel bridges or steel sky-scrapers consult them to see how much they must allow for the expansion and contraction of the steel used. Lawyers consult them to establish or to break down a witness's testimony. Not long ago a man was on trial in Illinois, accused of murdering an aged woman. He was unable to prove an alibi, and it looked as if he would be convicted. The principal evidence against him was that of a laborer, who on the day of the murder had been digging a ditch opposite the house where the murder was committed. The laborer stated that he had climbed out of his ditch about eleven to take a drink from his bucket; he remembered the exact hour because he had looked at his watch at the same time to see how near it was to dinner-time. Glancing across the street, he was horrified to see, through the open window, the prisoner striking the woman. Before he could get to the house the assassin had fled, but his identification had led to the arrest and was now threatening to hang the man.

The evidence was straightforward and seemed conclusive. The prisoner's lawyer, however, shrewedly consulted the records of temperature kept by the weather station, and found that on the day of the murder there had been a cold spell of such severity that if the bucket of water had remained out all the morning, as it did, according to the witness's story, the water would have been a solid chunk of ice by eleven o'clock. This discovery led to the acquittal of the prisoner and subsequently to the arrest of the ditch-digger, who, it developed, was the real criminal.

CROP BULLETINS, BALLOON RECORDS, ETC.

The Weather Bureau is doing much work that there is not space to describe. It issues weekly crop bulletins, summarized from the reports of many thousand observers, telling how the rain or drought, or cold or heat, has affected the wheat, corn, and other crops. It issues snow bulletins in the West, telling how much snow has fallen in the mountains, and hence how much water may be expected during the summer for the irrigation works. It publishes special rain forecasts in the raisin districts of California, which give the farmer time to get his trays of dried raisins under shelter before the deluge. It has recently made plans for the exploration of the upper air by balloons. A self-recording instrument of extreme lightness, invented by Mr C. F. Marvin, of the Bureau, is attached to a small rubber balloon and set loose. The balloon shoots up four or five miles, getting larger and larger as the pressure of air diminishes, until it finally bursts. The fall immediately opens a parachute, upon which the instrument floats down very slowly, recording the character of the air as it descends. The plan is to liberate several hundreds of these balloons simultaneously in different parts of the country. As a reward is offered for their return, and as they make very conspicuous objects in the sky, the Weather Bureau hopes to recover most of the instruments, and thus obtain facts about the upper-air currents which are most important and little understood.

Chief Moore also plans, through the development of wireless telegraphy, to get weather reports from steamers in mid-ocean. He has for years urged the countries of Europe to take simultaneous international observations; for meteorology is not bounded by political geography, but is an international science. He also wages a ceaseless war against the so-called "long-range" weather prophets, the charlatans who are continually humbugging credulous people.

Professor Willis L. Moore, Chief of the United States Weather Bureau, entered the service in 1877. He began at the bottom. By hard work, study, and natural ability he won steady promotion, and in 1895 was appointed head of the service by President Cleveland.

We are more interested in, or at least we talk more about, the daily weather—the health of the earth, it might be called—than of any other subject. "It's rather windy today, isn't it?" is the salu-

tation of one gracious lady to another at the afternoon tea. "A fine morning," shouts one teamster to his fellow. The weather plays a most important part in our feelings, and is very often the key of our high spirits or our deep depression. All of us recognize this influence of the weather, and this is probably the reason why every one, of high or low degree, be he savage or civilized, passes a remark about the day to whomever he greets.

But though the weather is the most general subject of conversation every day in the year, though we hear more remarks about this topic daily than about any other, most of us are absolutely ignorant of this great, mysterious, fascinating force.

EVERY MAN HIS OWN WEATHER PROPHET

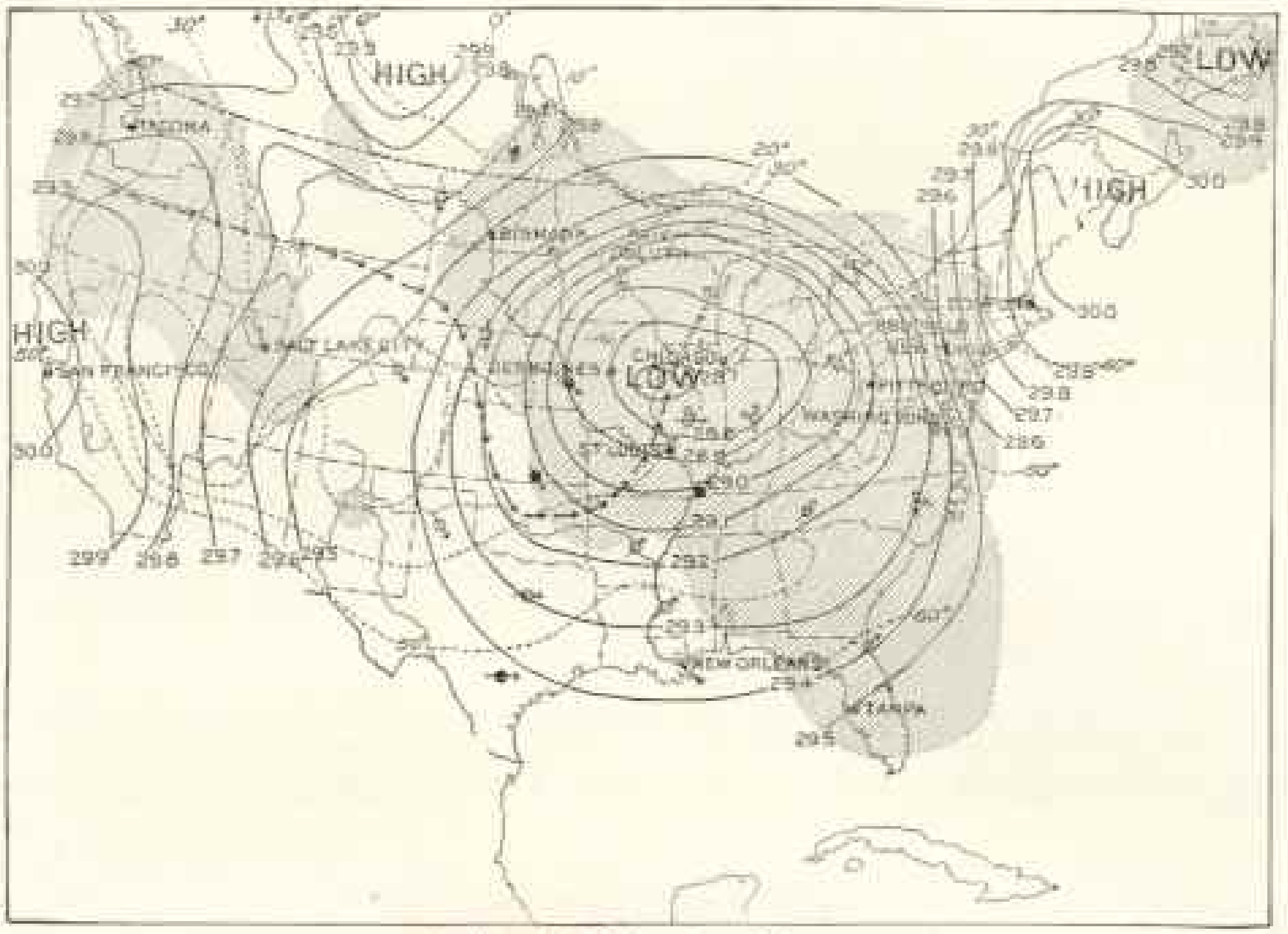
The Weather Bureau is educating the people to a better comprehension of the weather. It puts forth scientific treatises, of course, but it goes further, and publishes popularly written accounts and interpretations of the weather phenomena. These it distributes widely, as far as its appropriation will permit. One of the most valuable educational publications is the daily weather map. The map gives a picture of the snow, the sunshine, the heat, the winds, of the entire country. It tells who are shivering, who are mopping their brows, who are carrying umbrellas. By reading the conditions, the movements on the map, we can tell for ourselves when our turn to shiver or swelter will come.*

The weather map is an instantaneous photograph of the weather of the three million square miles of our United States. This photograph is taken every morning at 8 a. m. (75th meridian time) and every evening at 8 p. m. Precisely on the hour an observer at every one of the two hundred stations scattered over our states makes his barometric, thermometric, wind, rain, and other observations, and prepares his report for his section. By half-past eight all these reports are speeding to Washington, with right of way over all telegraphic business. The experts at Washington on receiving them, at once develop the photograph.

This map or photograph is the basis of all of the forecasts and of all of the work of the Weather Bureau, and knows no Sunday and no holiday. Washington is the central station from which all the principal forecasts are sent out. From six substations—Chicago, Boston, New Orleans, Denver, San Francisco, and Portland, Oregon—local forecasts are issued. The forecasts, made for thirty-six or forty-eight hours, are sent to all the daily papers, morning and afternoon, and are published in every one of our twenty-five hundred daily newspapers. They are also telegraphed to more than two thousand principal distributing points, whence they are again telegraphed or telephoned or sent on postal cards to thousands of business exchanges, post-offices, public libraries, etc., where they are posted in prominent places. In the middle West, from Ohio to Nebraska, 600,000 farmers obtain the morning weather forecast by telephone thirty minutes after it is issued. The experiment of sending the forecasts to farmers by rural delivery has been successfully begun. Already more than 100,000 farmers daily receive the weather reports in this way in less than six hours after the forecast is issued.

By studying the daily weather maps distributed by the Weather Bureau, any one can learn a great deal about the weather, and in a short while can become a fairly good weather prophet. Take the accompanying weather map as an example. The storm represented on this map was one of the most remarkable that ever swept across the United States. It was born and nursed in the mid-Pacific until

* The United States Weather Bureau has recently published an interesting little book entitled "Weather Folklore and Local Weather Signs," by Professor E. B. Garriott, which in simple language gives much information about the weather and the means by which the public may forecast the weather. It contains also a collection of weather proverbs. The book may be obtained from the Weather Bureau (Washington, D. C.) for thirty-five cents.



A Typical Weather Map

The solid lines are isobars; the broken lines are isotherms. The shaded portion of the map indicates the area over which precipitation has occurred during the twelve hours preceding 8 A. M., 75th-meridian time. The arrows point in the direction the wind is blowing.

it grew to immense proportion. Thence it dashed upon our western coast, almost simultaneously striking California, Oregon, and Washington. It swept over the Rocky Mountains as if they were a five-foot fence, dashed over Wyoming, South Dakota, Nebraska, Kansas, Oklahoma, Missouri, Illinois, and Wisconsin, and finally disappeared in the Great Lakes four days after its entrance. A storm like this revolves all the time it is advancing. It moves like a spinning plate flung across the room,* or like the top which the small boy shoots spinning across the sidewalk: in fact, the storm is a gigantic top about a thousand miles in diameter and several miles high.

This map illustrates perfectly the different kinds of weather that such a great cyclone will bring. As the storm advances, it brings a deluge of rain or snow, but it restores the sunshine before it disappears. The reason is as follows: The wind in the front half of the cyclone is from the south, and as this warm wind comes into colder latitudes, it cools, and the moisture in it is condensed, so that we have rain and snow-storms. The wind in the rear half of the cyclone is from the north, and is thus cold; as it comes into warmer latitudes, it grows warmer and is able to absorb the moisture in the air, so that we have clearing weather.

Such a cyclone may be generated by the clashing of two antagonistic currents of air, one current coming perhaps from the south and the other from the north. As the two currents wrestle, they are caught by the never-ending stream of at-

* The cyclone revolves in a direction opposite to the hands of a watch.

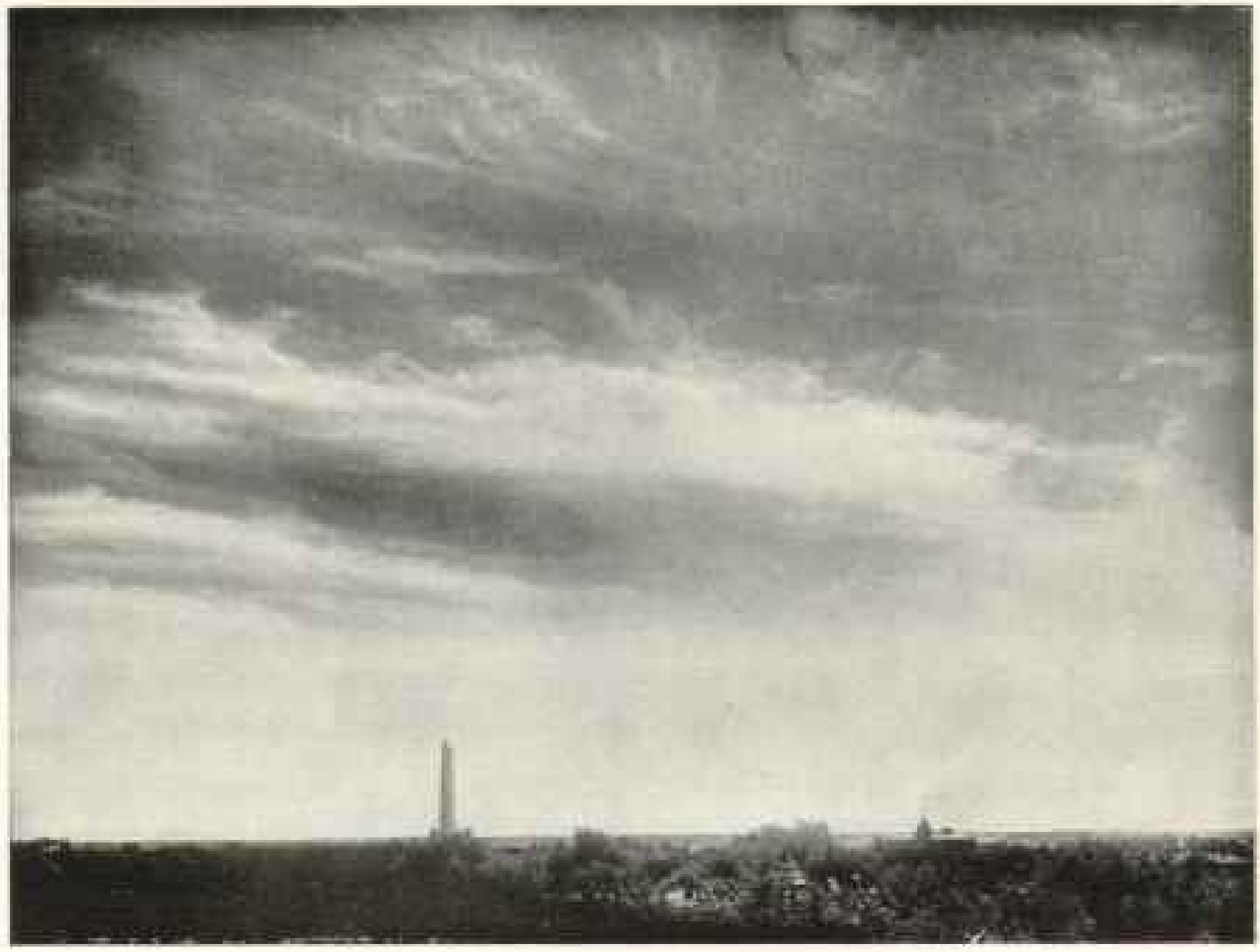


Photo by Prof. Alfred J. Henry

Cirrus Clouds Merging into Cirro-stratus

This is a transitional form often seen when rain or snow is approaching. The cloud layer gradually thickens until the sky is obscured

Photo by Prof. Alfred J. Henry

Broken Cumulus Clouds

These are signals of unstable atmospheric conditions

From a photo by Prof. Alfred J. Henry

Cirro-cumulus Clouds

These are typical fair-weather clouds, and are usually seen at an elevation of four or five miles

From a photo by Prof. Alfred J. Henry

Cirrus, the Highest-flying Cloud

Clouds of this nature float at an elevation of from four to ten miles. When they look like plumes with frayed and torn edges, increased cloudiness and rain or snow may be expected.

From a photo by Prof. Alexander McAdie

Ocean Fog Pouring in over the Hills upon San Francisco

mosphere, which is moving easterly miles above our heads, and are swept across the continent as an eddy is borne along on a river. The Weather Bureau is learning a great deal about these important upper-air currents by studying the different types of clouds, and by noting their altitude and rapidity of motion.

"STORM SIGNALS OF THE SKY"

It has been well said that "clouds are the storm signals of the sky." The

From a photo by Prof. Alexander McAdie

Sea Fog Lifting and Changing to Clouds, San Francisco Bay

amateur, by watching the clouds scudding or drifting miles above, can often make a pretty sure guess of the coming day. The pictures accompanying this article illustrate the principal kinds of clouds and their significance. They are very remarkable cloud photographs, and were taken by Alfred J. Henry, Professor of Meteorology of the U. S. Weather Bureau, and one of the most successful forecasters in the government service.

STUDYING THE SUN

Not a single storm has swept across the United States or up or down its coastline within many years that has not been heralded hours or days in advance by the Weather Bureau. Nor has the service allowed a cold wave or a flood to catch us napping. But the Weather Bureau is ambitious to do more than this. It feels that its present knowledge is too much like that of a man who sees a wild engine tearing down the track and telegraphs ahead for everything to keep out of its way. It desires to know why these great cyclonic storms are conceived and the processes of their conception. But before it can get this knowledge it must obtain a better understanding of the sun, which is the initiating cause of all movements of the atmosphere affecting the weather.

From a photograph

Buildings Burst Open by the Explosive Effect of a Tornado, Louisville, Kentucky—the Windows and Walls Flying Outward

From a photograph

The Jumping Characteristics of a Tornado, Louisville, Kentucky

The building in the center of the block is shattered, while the adjoining buildings are barely touched

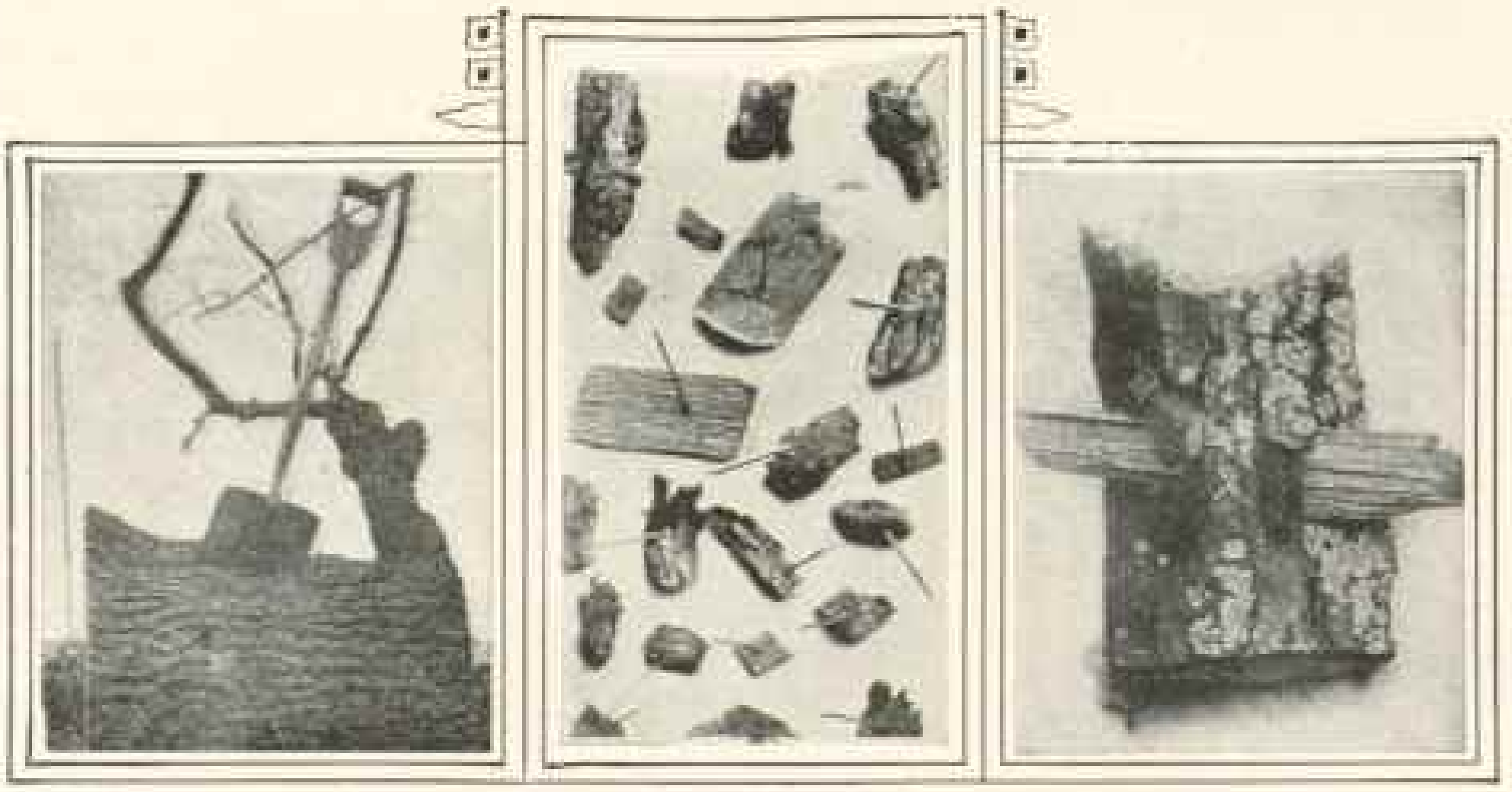
The sun is the prime cause of every change of weather. The sun determines whether the earth shall be hot or cold, just as our hands turns on or off the register. Absence of sun's rays makes the North Pole a continent of ice; plenty of sun's rays makes the Equator a furnace. The sun's rays, by heating one land more than another, cause winds, hurricanes, and cyclones. The heat in the

sun is so terrible that our iron ores, gold, silver, copper, and diamonds exist as gases there. The rays of this heat travel at the rate of 11,600,000 miles a minute and reach us in eight minutes. Such speed is inconceivable. The swiftest cannon-ball is motionless compared with such rapidity of motion. There are storms on the sun compared with which our Galveston hurricanes and Mont Pelée eruptions are like the breathing of an infant. Are the storms periodic? Do they follow some sequence, some law?

The sun is much brighter and hotter at certain periods than it is at others. According to Professor S. P. Langley, during 1904 there was a notable decrease in the amount of heat received from the sun. The same report came from Italy. Why the sun was so stingy we do not know; whether its generosity is periodic or incidental is a riddle to us. If we did understand its moods and their reaction upon us, we could predict the weather for a season in advance. Now, the sun is the creator of all life, of all force and motion on the earth except the tides. Every act of it is so orderly and systematic that we must believe that the processes going on within it are also systematic; that the changes we think we see in it follow each other in regular succession, as our spring follows winter, but probably at much longer intervals. Solve the order of the changes on the sun, and we can predict the character of the seasons.

Strange as it may seem, the sun has rarely been studied in its relation to weather. As a rule, astronomers have paid little attention to the weather, while meteorologists know little about the sun.

Realizing that the further development of our knowledge of storms and of weather generally depends in large measure upon a better understanding of the sun and its relation to the meteorology of the earth, Congress recently, on the recommendation of Secretary Wilson, gave the Weather Bureau a sum of money to found a meteorological solar observatory. The constant procession of storms that sweep across the United States makes our country a particularly good place to study the relation of sun and weather. The site chosen was an unnamed peak in the Blue Ridge, sixty-five miles from the national capital. The



From photographs

Freaks of Tornadoes

A spade driven into a tree—Straws driven into trees—A splinter driven into a log

Weather Chief christened the peak by the fitting name of Mount Weather. Substantial buildings are being erected there, equipped with telescopes, magnetic instruments, bolometers, and every appliance man's brain has yet devised to catch the secrets of the sun, and here the meteorologists will study the sun and try to find out how it governs our rain and sunshine. Speculators in wheat and cotton may find it to their profit to watch the observations of the Mount Weather Observatory and thus perhaps anticipate dollar wheat and sixteen-cent or six-cent cotton months ahead of the market.

The plan of the Mount Weather Observatory is probably the most important ever undertaken for the advancement of meteorological science. The sun holds the key to the weather. The Weather Bureau will search for this key, and with it, we hope, unlock the mysteries of cyclones, of droughts, and of torrential floods, and thus foretell the years of plenty and of famine.

THE WORK IN THE PACIFIC OCEAN OF THE MAGNETIC SURVEY YACHT "GALILEE"*

By L. A. Bauer

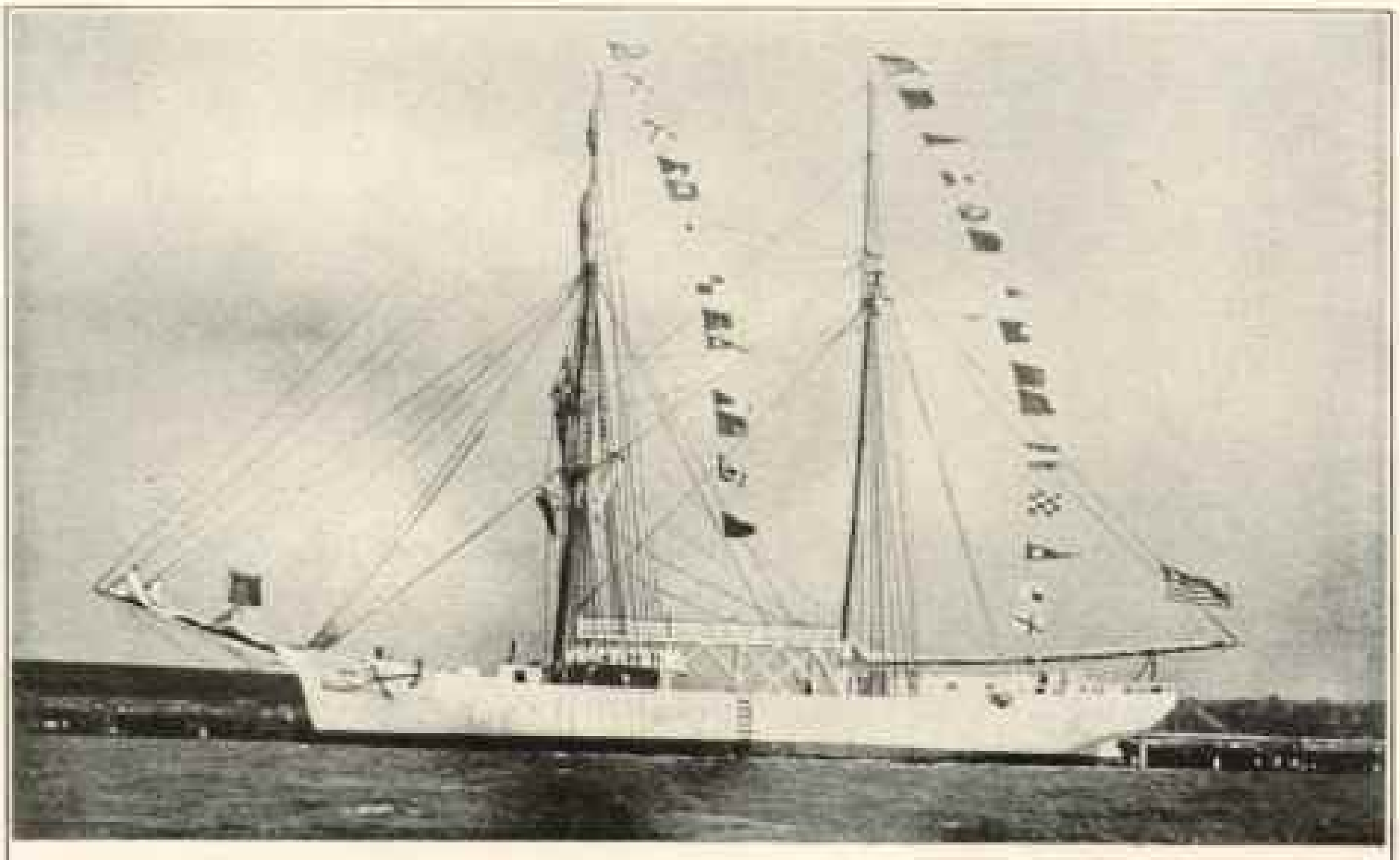
Director, Department Terrestrial Magnetism, Carnegie Institution

IN 1905 the Department of Research in Terrestrial Magnetism of the Carnegie Institution of Washington was authorized to undertake a magnetic survey of the North Pacific Ocean, in accordance with a plan submitted by Messrs L. A. Bauer and G. W. Littlehales, and the necessary funds were allotted.

Captain Creak, for many years Superintendent of the Compass Department of the British Admiralty, now retired, said some years ago: "The North Pacific Ocean is, with the exception to the voyage of the *Challenger*, nearly a blank as regards magnetic observations." Various eminent authorities in terrestrial magnetism have expressed their opinion that no material progress can be hoped for in the unraveling of many of the vexing questions that confront us in this most elusive and enigmatical field of research until we possess complete magnetic surveys of the oceanic areas as well as of the land areas. The area of the ocean exceeds that of the land by nearly three times, and, in conformity with general experience, magnetic observations made on oceanic islands or along the coasts are almost invariably more or less affected by local disturbing influences. It may therefore easily happen that some of our present ocean charts of the lines of equal magnetic variation, used by the mariner to guide him over the trackless seas, do not possess the accuracy required for even purely *commercial* purposes.

The reasons which actuated the authorities of the Carnegie Institution in undertaking the magnetic survey of the oceans and unexplored regions to satisfy both commercial and scientific requirements are thus made patent. Captain Creak's remark also shows why the beginning was made in the ocean so rapidly developing just now in commercial importance—the North Pacific Ocean. Here the mariners' charts of the compass direction have had to be based, until a few months ago, upon but a very small number of observations of the requisite completeness and accuracy.

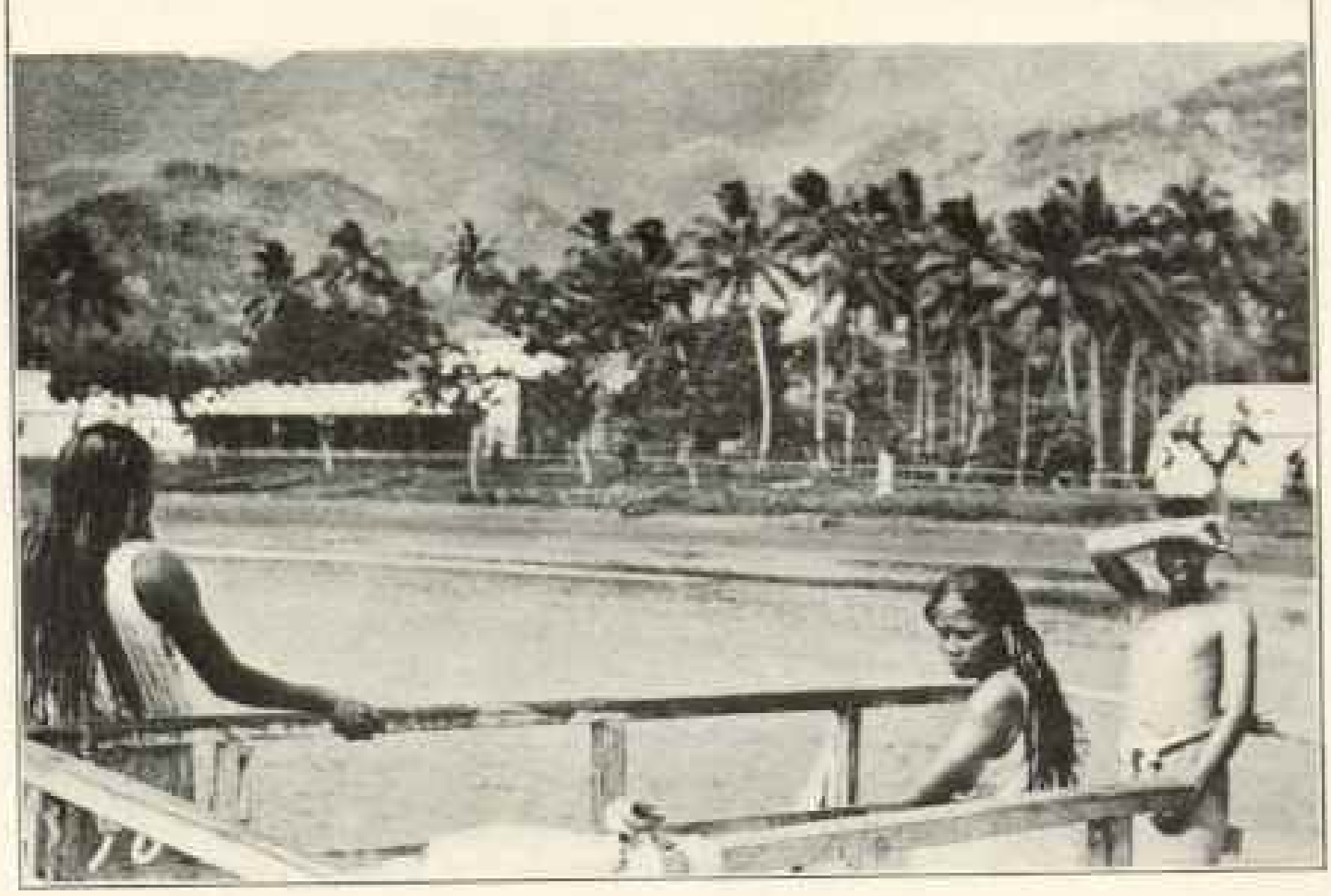
* An address before the Washington Society of Engineers, May 21, 1907.



The Yacht *Galilee* at San Diego Dressed in Honor of Washington's Birthday

Scene on Board the *Galilee* while Working near the Equator

Inhabitants of Fanning Island



A Scene on Nukahiva, Marquesas Islands

These and following illustrations are from photographs taken by members of the staff of the *Galilee* during the survey of the Pacific Ocean, and sent to this Magazine through the courtesy of Dr L. A. Bauer.

Women of the Marquesas Islands

Natives of Faaming Island

The Carnegie Institution work of the past two years has already yielded sufficient results to enable the United States Hydrographic Office, with the aid of these newly acquired data, to issue recently a new chart of the "Lines of Equal Magnetic Variation."

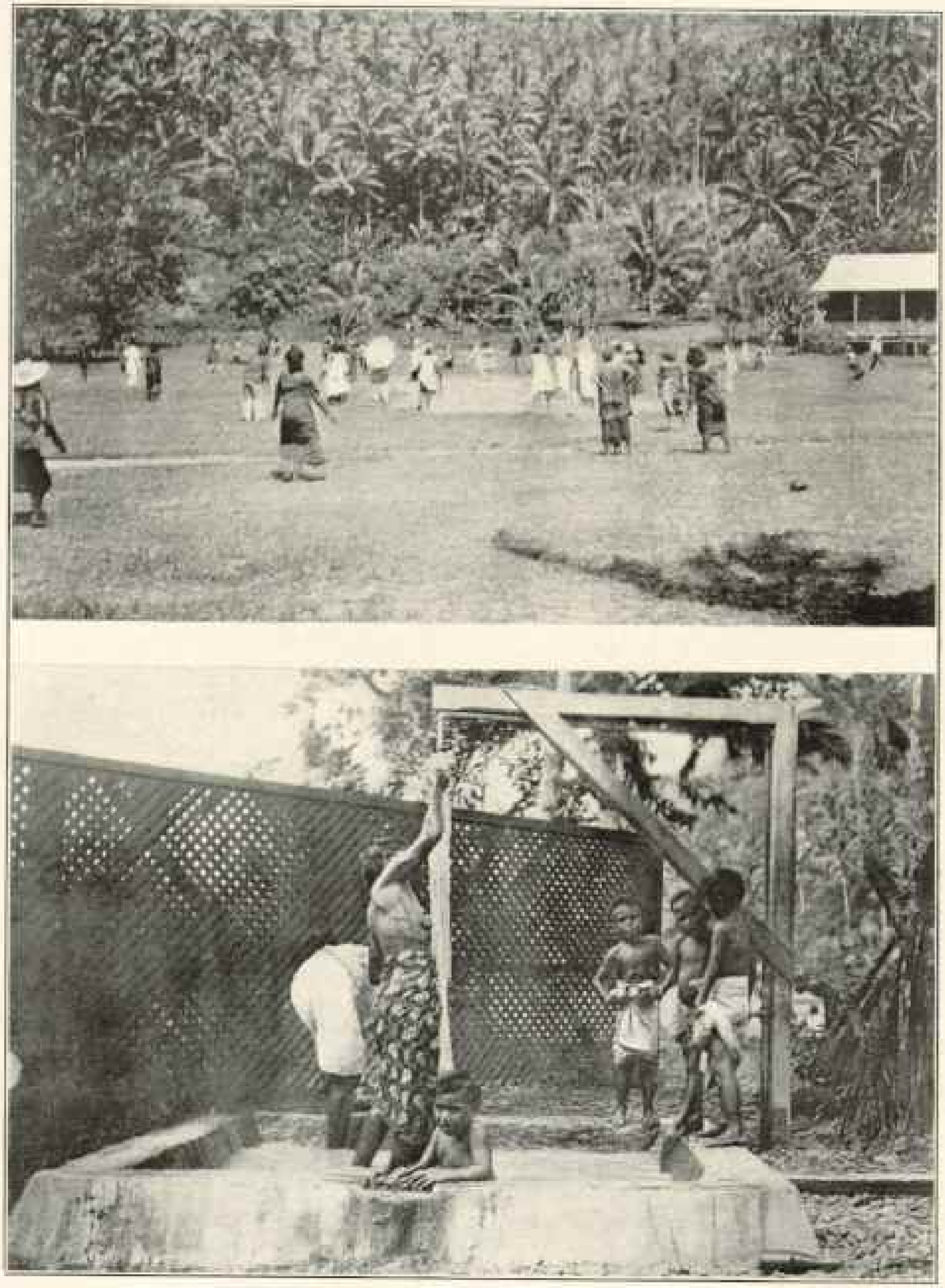
It was found that in the North Pacific Ocean previous charts were out 1° to 3°—amounts of sufficient importance to safe and rapid navigation, especially as it was found that the error was systematic over large areas. For example, in the region between San Francisco and Honolulu recent charts gave systematically too small a value of easterly variation (magnetic declination), so that the compass actually pointed 1° to 2° farther east than shown by the charts used in directing the course of a vessel between these ports. Since the distance is about 2,000 miles, and assuming an average systematic error of but 1°, it might transpire during a cloudy or foggy passage, when no sun or stars would be visible and sole dependence would have to be put upon the compass and the log, that the vessel at the end of her 2,000-mile voyage would find herself too far north by about 1/60 of the distance traversed (roughly, 35 miles)—sufficient to prevent a successful landfall!

It requires three sets of lines to completely map out the earth's magnetic lines of force:

1st. The Chart of the "Lines of Equal Magnetic Declination," or, as the mariner calls them, "Lines of Equal Magnetic Variation." These lines connect the places where the compass points the same amount; for example, 5° east or west of north, as the case may be. This chart is the one of prime importance to the mariner or to the surveyor who must rely upon the compass. Unfortunately but a comparatively few years suffice, on account of the progressive changes occurring in the earth's magnetism, to considerably destroy the value of such a chart. In certain parts—*e. g.*, in the vicinity of Rio Janeiro—six years are sufficient to produce a change of 1° in the compass direction; on the average, over the earth it requires about 20 years to produce an alteration of 1°. Hence it is necessary to reoccupy or repeat the magnetic observations at a sufficient number of points over the globe to keep "tab," so to speak, on these changes and thus keep magnetic charts up to date.

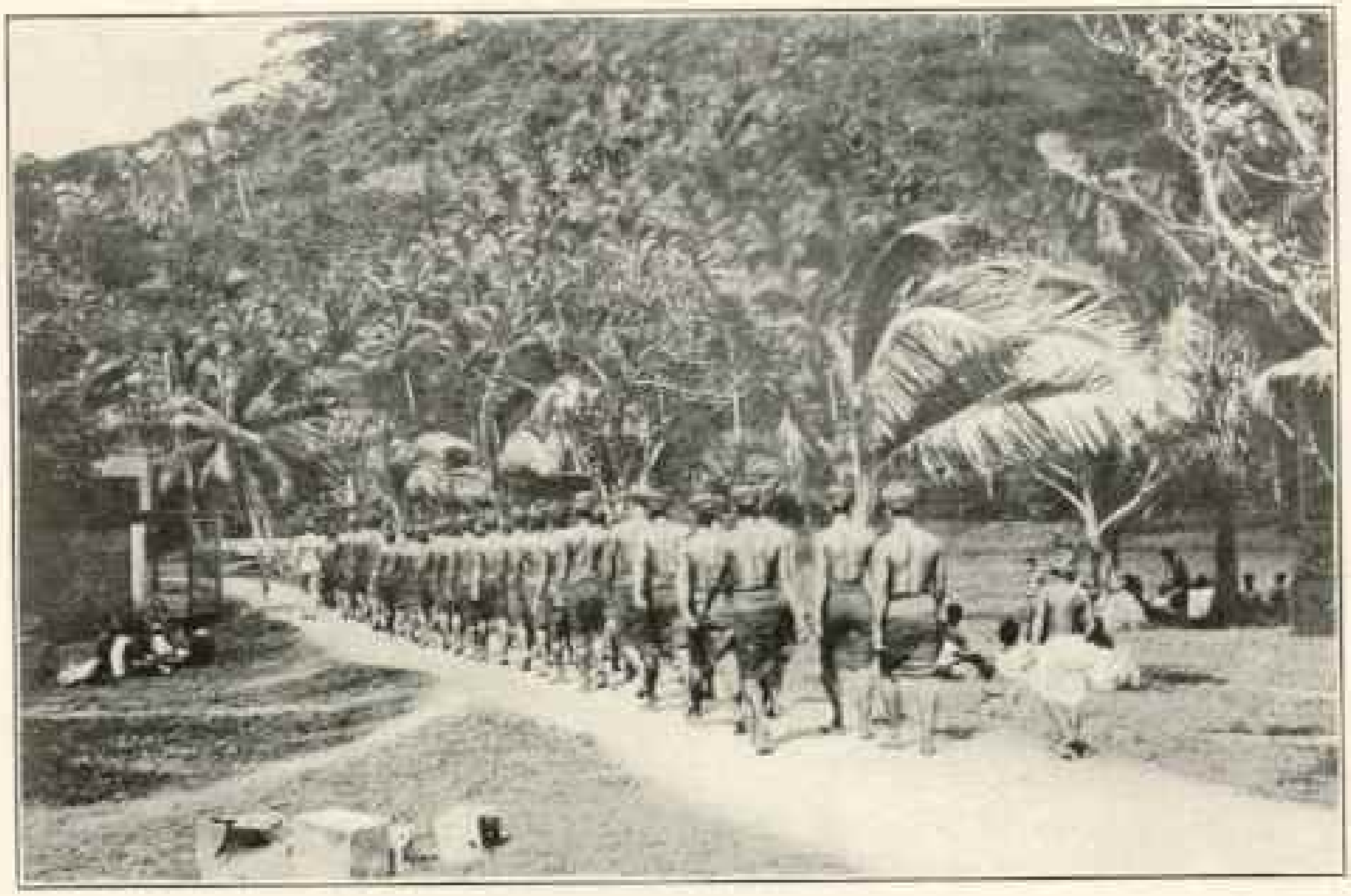
However, in terrestrial magnetism the stage of determinism has not yet been reached as it has in astronomy. Eclipses and other astronomical events can be predicted many years in advance with unerring precision. Though knowing the *precise* state of the earth's magnetism at any given time, it is not yet possible to predict what it will be but a comparatively short time later, with sufficient accuracy and in every locality, for even the purely *practical* purposes of life, to say nothing of purely scientific demands. While it may be that the problem of magnetic predictions is a far more difficult one than that of astronomic events, it certainly does not appear as complicated as that of long-range weather forecasts. I believe that the prime reason for the backward stage in terrestrial magnetism is to be ascribed to the general lack of means hitherto available for the accumulation of the necessary data. We are but *beginning* to appreciate that the physical phenomena of the earth demand equal attention with the study of celestial phenomena, and that the solution of some of the vexing questions pertaining to the physics of the earth undoubtedly will be accompanied with results of the highest importance not only to science but to man as well.

Next, it is necessary for a complete delineation of the earth's magnetic forces to construct the "Chart of Lines of Equal Magnetic Dip" and the "Chart of Lines of Equal Magnetic Force." These two charts, as far as the mariner's purposes are concerned, do not require to be quite as accurate as that of the "Lines of Equal Magnetic Variation," since they are used only in determining how much a compass, disturbed by the iron in a modern vessel, must be corrected. However,



Native Women Playing Cricket at Pago Pago, Samoan Islands

Natives Bathing at Pago Pago



Fiti Fiti Guard, Samoan Islands

science requires an accurate set of these latter charts as well as of the first one, if any progress is to be made in the solution of some of the questions above raised. You will therefore be interested to know that the work of the Carnegie Institution has already shown that the values of dip given by the latest charts were found to be out from 1° to 3° and more, being in general too small, and that the chart values of horizontal magnetic force were in general too high by about 1/25th part.

So much for a brief statement of the general results already achieved; now a few words as to the vessel, personnel, methods employed, and the cruises.

After considerable advertisement, we chartered the brig *Galilee*, a wooden sailing vessel built by Matthew Turner, of California, in 1891 and engaged in freighting in the Pacific Ocean. Her length is 132.4 feet; breadth, 33.4 feet; depth, 12.6 feet, and her displacement about 600 tons. She has the record of being one of the fastest sailing vessels of her size in the Pacific Ocean. Besides the scientific party, consisting at present of Mr W. J. Peters, commander of the expedition; Messrs J. C. Pearson and D. C. Sowers, magnetic observers, and Dr George Peterson, surgeon and recorder, the *Galilee* carries a crew of ten men and sailing master, Captain J. T. Hayes. (Members of the National Geographic Society will recall that Mr Peters, the energetic commander of the *Galilee*, was their representative on the Ziegler Polar Expedition of 1903–'05 as second in command and in charge of the scientific work.)

Through the courtesy of the Secretary of Commerce and Labor the *Galilee* has been classified as a yacht, thus greatly facilitating her passages between foreign and domestic ports, as far as compliance with the usual custom-house formalities are concerned.

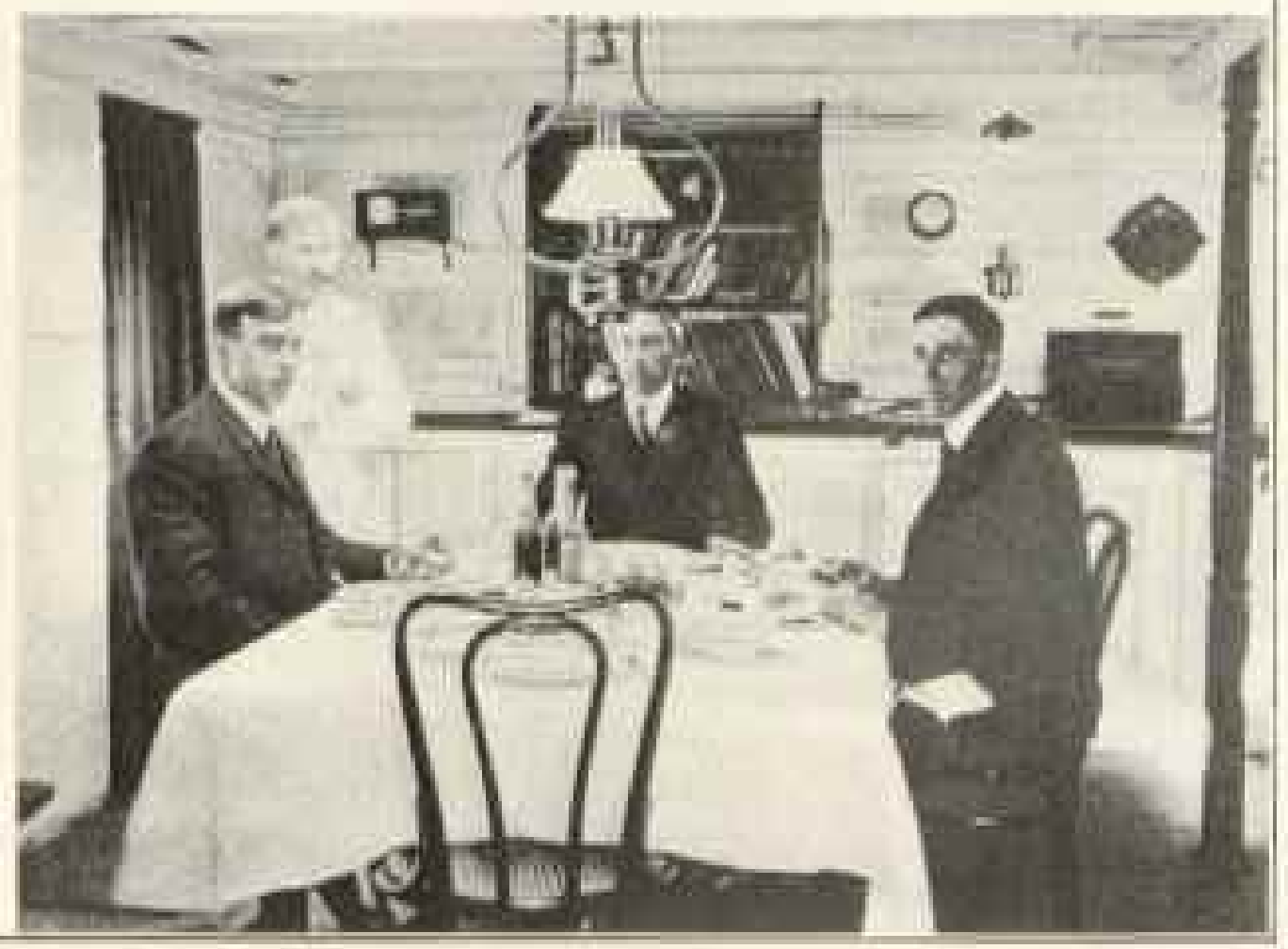
The principal changes required to adapt the chosen vessel to the work undertaken were the substitution of the steel rigging by hemp, the replacing as far

Photo from "Le Tour du Monde" (Paris)

A Fiji Islander

Scene in the Fiji Islands

Photo from "Le Tour du Monde" (Paris)



The observers en route to the observing station near Yokohama.

View of the special observing bridge, showing the observers and the four instruments used (from left to right, Lord Kelvin Dry Compass, Negus Liquid Compass with Horizontal Deflector, Ritchie Standard U. S. Navy Liquid Compass with Azimuth Circle, and L. C. Dip Circle). Each magnetic element is determined in two totally different ways by different observers and at different parts of the bridge.

On August 24, 1906, the *Galilee*, not having any auxiliary power, was blown on the breakwater at Yokohama by a typhoon and such damage sustained that she had to be dry-docked for the necessary repairs. Fortunately the damage was not very serious.

View of the scientific party taken in the cabin of the *Galilee* by J. C. Pearson, magnetic observer. The leader of the expedition, Mr W. J. Peters, is in the center.

as possible of the iron in the blocks and tackle by non-magnetic metal, and the building of a special observing bridge, running fore and aft between the masts and placed about 15 feet above the deck. The instruments mounted on this bridge were, on the average, about 25 to 30 feet from the remaining masses of iron, consisting chiefly of the iron bolts in the sides of the vessel.

While, then, it was not possible to convert the *Galilee* completely into a non-magnetic vessel, as would have been desirable, the changes made resulted in reducing the corrections due to the disturbing influences of the iron to such an extent that the so-called "ship's magnetic constants" turned out to be smaller for this vessel, on the average, than those of any vessel thus far engaged in oceanic magnetic work.

However, the corrections are still large enough so that they require to be taken into account to satisfy the requirements of the work. These corrections must be determined by special observations, consisting of swinging ship in port and at sea as often as circumstances will permit, which necessarily cause more or less delay in both the field and office work. Unfortunately, experience during the past two years has also repeatedly shown that these corrections do not strictly follow the physical laws prescribed by the analysis of the deviations, namely, the corrections arise chiefly from the magnetic induction in the soft-iron parts of the vessel, and hence are subject to various accidental conditions, such as length of time pursued by the vessel along any one course or the amount of buffeting the vessel has been exposed to from the waves, etc.

It would be more economical all around were it possible to secure an entirely non-magnetic specially built vessel. The construction of such a vessel presents no mechanically unsurmountable difficulties. It seems a pity that in the very regions where the disturbances due to local magnetic masses are a minimum we should introduce an extraneous source of disturbance by not having an entirely non-magnetic vessel.

It is hoped that the necessary funds—about $75,000—may soon be secured for the construction of a vessel suited to the importance of the work undertaken. The new vessel would be again a wooden sailing vessel, built somewhat along the same lines as the one at present employed, except that no material whatsoever having a magnetic influence would be used. This would mean the exclusion of all iron and steel except such as would come at a distance far enough away as not to affect the magnetic instruments.

An all-sailing vessel, however, does not permit the magnetic survey to be undertaken with the completeness and success demanded, since with such a vessel it is more or less dangerous to investigate the magnetic irregularities almost invariably shown to exist near land masses. The mapping of these irregularities is of the greatest importance to the mariner, as in many cases they are sufficient, if not allowed for, to land a vessel on the rocks. For such close shore-work it is essential that the surveying vessel be provided with some auxiliary motive power in addition to that derived from the sails. This auxiliary power would be supplied by a gas or gasoline engine, in which but a very small amount of steel is required, the engine being furthermore at such a distance from the instruments as not to have an effect.

Besides greatly facilitating the acquirement of the magnetic data and reducing the running expenses, the new vessel would materially add to the safety and comfort of those on board who are devoting their lives to such arduous work. Let us therefore hope that the day is not distant when the magnetic survey of the oceans can be undertaken with the completeness, the expedition, and safety that its importance demands!

HUNTING THE GRIZZLY IN BRITISH COLUMBIA

By Joseph Wendle

HUNTING the grizzly in its natural wilds may be termed an exhilarating pastime, but before the bear is finally captured many things are apt to occur which make the oldest and most experienced hunter put forth his best efforts. To the observer it may seem as easy to kill a score of bears as so many deer, but when you happen across a grizzly that has never been compelled to leave its own trail, it is advisable to think twice and then feel your pulse.

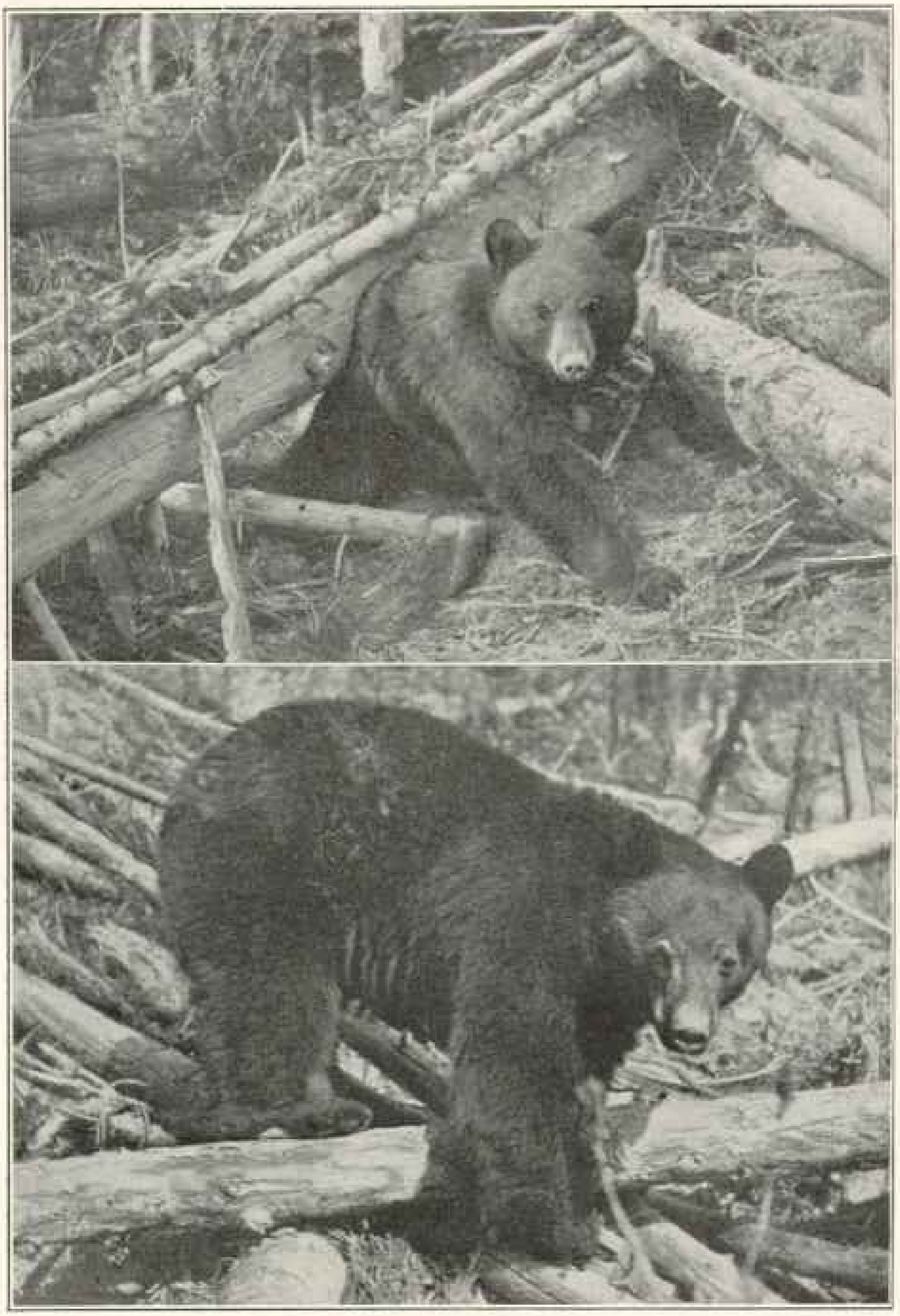
On approaching the feeding grounds of the grizzly, much care must be taken by the hunter. If the game is disturbed quietly, it will give you the slip and get away; but if you come in contact with it suddenly, at short range, you may get into serious trouble.

When on a hunting trip not long ago and passing through an unexplored section, we suddenly came across three grizzly cubs. Being to windward, we managed to get quite near, and while watching and admiring, without a thought of hurting them, we were suddenly charged by their mother, and, not having guns for such large game with us at the time, we were forced to run, and were chased into a small lake near by, the close proximity of which doubtless saved us. In this stampede my position by accident was in the rear. With the bear thundering along with its mouth wide open, at times running in an upright position and only a few feet behind, I certainly felt that I would be knocked into the "great beyond" at every step, so close behind me came her bearship.

At one time, while camping in a high pass, a large grizzly could be seen about two miles away and up a steep mountain side. After a short discussion, it fell to my lot to supply the camp with fresh meat.

It was late in the evening, and I had to hurry to get within shot of the game before dark. After much hard climbing I reached the spot, only to find my bear had gone. Resting for some minutes after the climb, I heard a disturbance below me and immediately saw the bear following my tracks up the steep mountain side. Being above the timber-line and in a rocky spot, all seemed easy; and as the bear came within shooting range, he grew larger and larger, until it looked like an impossibility to miss him. My first shot took him by surprise, and with loud roars of rage he rolled over and over; but in an instant he was standing upright again and started up the hill so rapidly that I realized things were getting serious. With an angry grizzly closing up fast and an exploded shell jammed in the breech of my rifle, I had to think quickly, and instantly made up my mind to take my chances on a passage down a snowslide almost at my feet on the steep incline. Once having started, there was no stopping, and I made the fastest trip of my life, had the good fortune to land safely, and reached camp in a few minutes, being very glad to be alive. For the following few months I felt I had lost no bear.

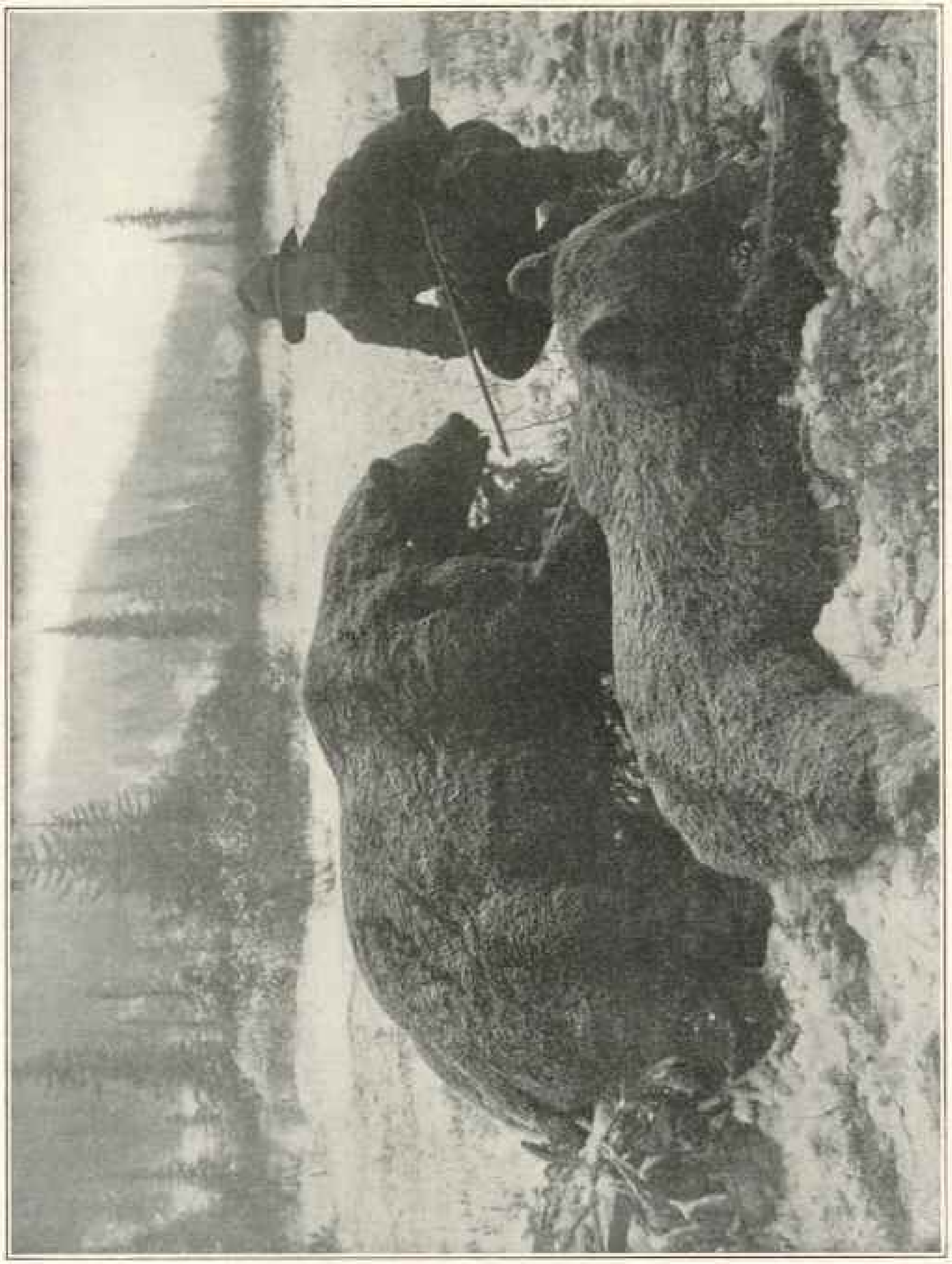
On one occasion while on horseback I came across a grizzly while he was feeding on the carcass of a young deer he had pulled down, and as he made no attempt to get away I had little trouble in getting a shot. The ball carried away a considerable portion of his face, and his roars caused my horse to take fright and run away. My dogs in the meantime took up the fight and drove the bear back into the thicket, and when I finally got the horse under control the bear had departed. Shortly after this I again came across him, just at dusk, and after firing several shots he again disappeared in the



Photos from Mrs Charles Schaffer, of Philadelphia

A Grizzly Caught by a Fallen Log—a Cruel Trap

A Black Bear Trapped



Two Grizzly Bears Shot by Joseph Wendle, of British Columbia

thicket. The next morning, nearly a mile from the spot, I found him dead, and discovered that one of the bullets had passed horizontally through the largest diameter of his heart.

On following a bear trail into a thicket on another occasion, I found that to continue I must crawl on my hands and knees, and as I passed under fallen trees and undergrowth the daylight was turned into darkness. I came upon a swampy piece of ground, and as all seemed quiet I let my dog follow the trail. He made a considerable disturbance ahead of me, while the bear, who had taken fright, was trying to get away, slightly on my right. Being in no position to shoot, for the longest unobstructed range could have only been ten or fifteen feet, and seeing by the disturbed bushes that everything seemed to be coming my way, I lost no time in getting up a tree well above the ground, and while I was still scrambling to gain my equilibrium, the game passed below and went on.

I have been told by responsible parties of many lives that have been lost hunting grizzlies and know personally of two cases of men who never returned from bear hunts, and later remnants of clothes and pieces of their skeletons were found. In one instance the searching party, as it approached the spot where the fight took place, were attacked by a large grizzly, who managed to get away.

In the photograph are two grizzlies killed by myself and friend.

SCENES FROM NORTH AFRICA

THE renewed disturbances in Morocco lend special interest to the illustrations from North Africa contributed to this number of the NATIONAL GEOGRAPHIC MAGAZINE by Mr David Fairchild. Morocco and Abyssinia are the only countries of Africa that have not yet been subjugated or politically annexed by a European power. Morocco has a population of from 4,000,000 to 15,000,000, or whom two-thirds are Berbers or of Berber descent. These Berbers are the aborigines. They are a purely white race, and Mr Ion Perdicaris has described them (NAT. GEOG. MAG., 1906, p. 118) as a very energetic and vigorous people. They antedated Phœnician, Carthaginian, Roman, Gothic, Byzantine, and Arab occupation by centuries and form one of the oldest living races and there are certain ethnologists of the present day, at the head of whom is an Italian writer named Sergi, who maintain that the theory of the successive invasions of Caucasians, which are generally believed to account for the origin of the races of southern Europe, did not furnish the main part of the population of the Mediterranean basin, but that the latter was derived from these Berbers, a white race which has many resemblances to the ancient Etruscans. They are also quite like the pictures of some of the ancient Egyptian dynasties.

The Berbers have always opposed any attempt to control them, and have never been held in subjection for any great length of time. They dislike any more authoritative rule than that of their own village elders.

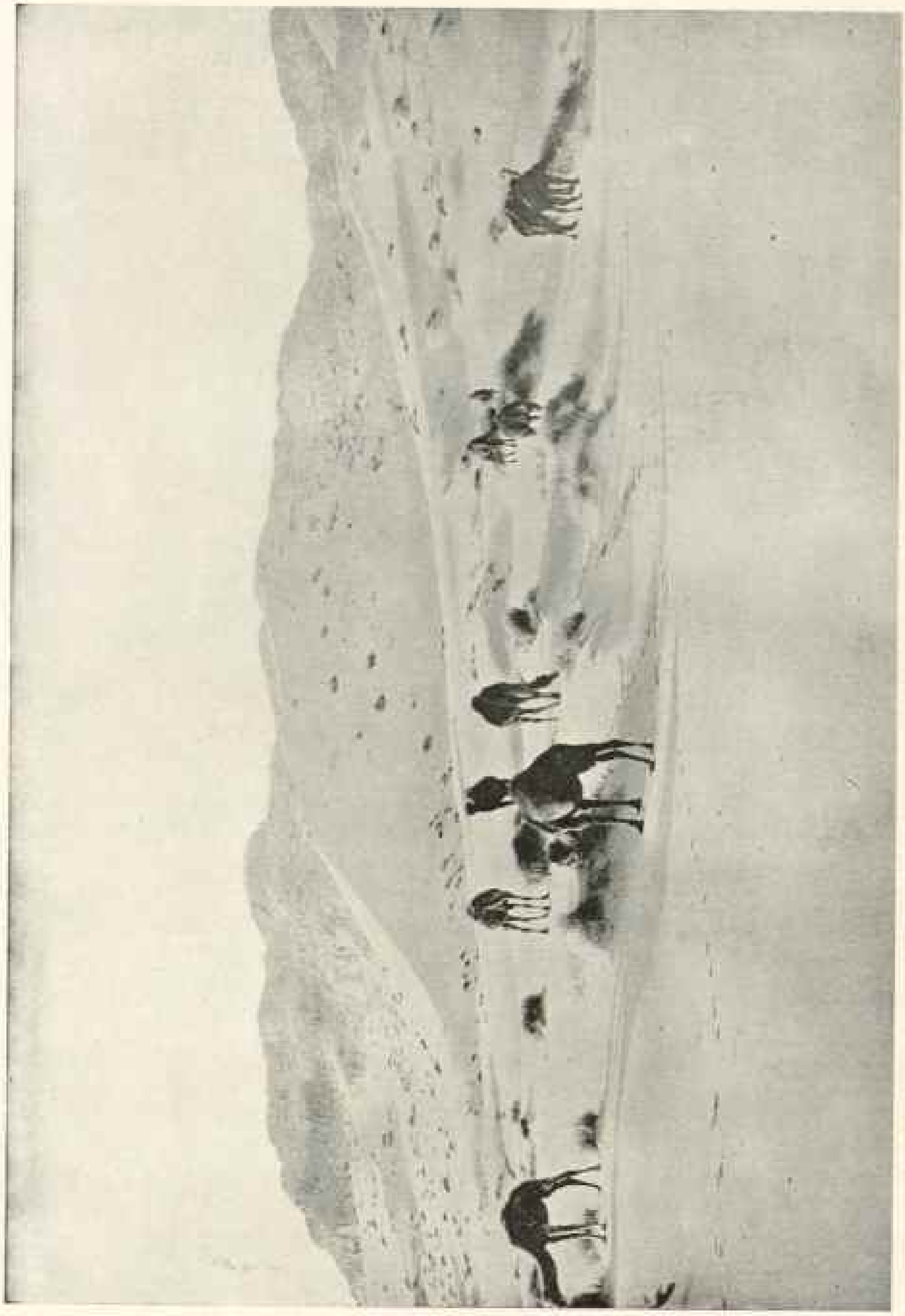
There are two other important factors among the population—the Jews and the negroes. The Jews are mostly exiles from Spain and Portugal, having been driven out after the Moors had been expelled from Spain. The Jews were driven out by the Inquisition, and a great many of them came over to Morocco and settled there. Others went as far east as Turkey. Still others visited other countries. Those who settled in Morocco were almost all confined to a special quarter of the towns, entitled El Mellah. This word Mellah means salt, and it comes from a very curious feature in the customs of the country. Whenever rebellions break out—and they are very frequent occurrences—the soldiers in Morocco have instructions to bring in as many heads as possible. These heads have to be preserved and salted, and nobody likes to execute this commission; consequently the Jews were compelled to undertake this revolting task.

Photo from David Fairchild, U. S. Dep't of Agriculture

Moorish Girl, Tangier, Morocco

Photo from David Fairchild, U. S. Dep't of Agriculture

Moorish Girl, Tangier, Morocco



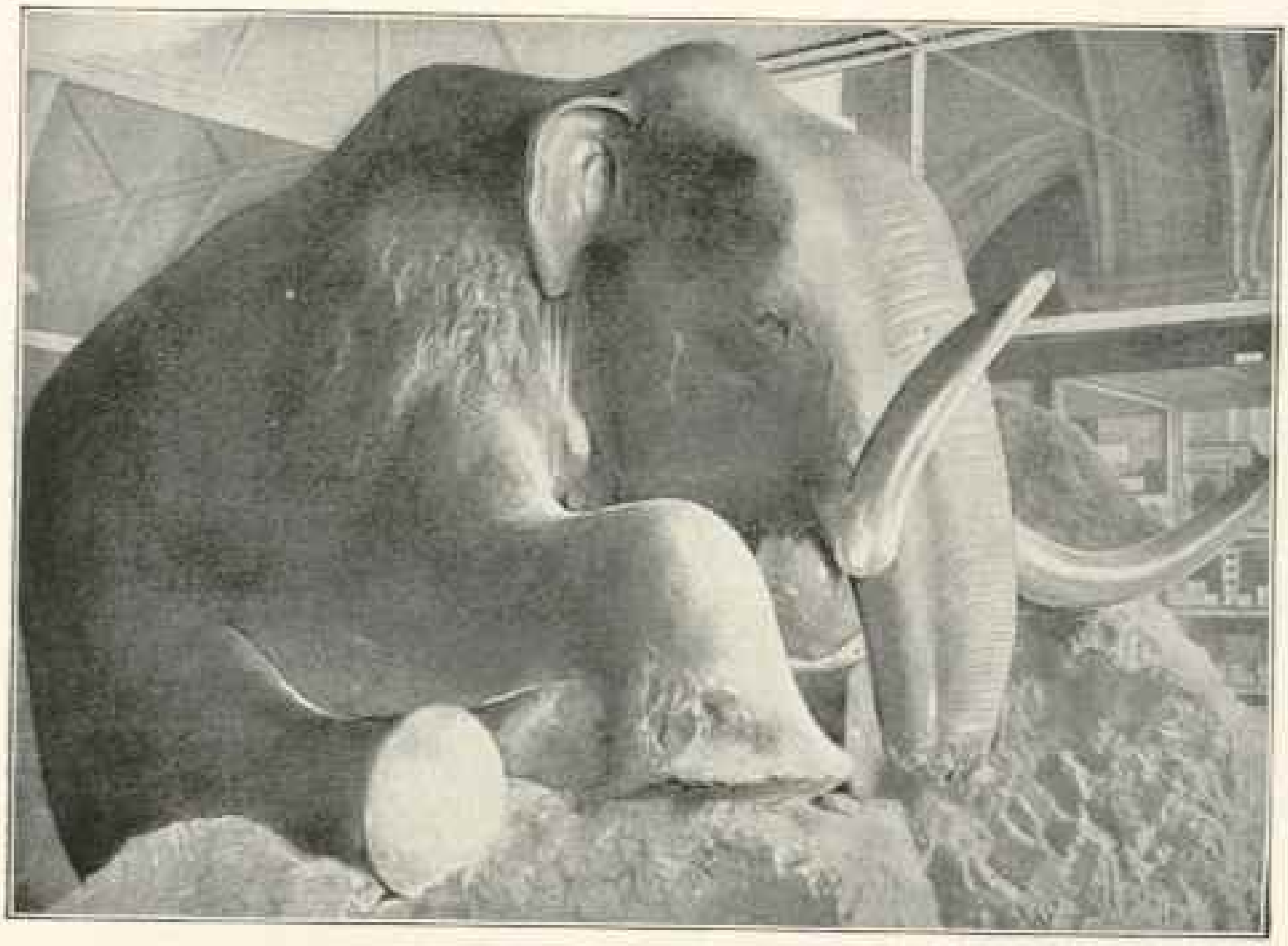
In the Sahara Desert

Photo from David Fairchild, U. S. Dep't of Agriculture

Photo from David Fairchild, U. S. Dep't of Agriculture

Jewish Girls of Tunis

The Jewish girls of Tunis eat the seeds of the fenugreek, a leguminous plant, to make them fat. No young Jew of that region would think of marrying a girl until she had increased her weight to the fashionable figure of 250 or 300 pounds



Mammoth Recovered from Northern Siberia

A STRANGE AND REMARKABLE BEAST

THE mammoth shown in the accompanying illustration had been preserved in the frozen soil of the tundra of Siberia so perfectly that after countless centuries the flesh and hair appeared almost as fresh as if the animal had been dead only a few hours. The average size of the mammoth appears to have been about the same as that of the existing species of elephants, but nature had provided it with a dense clothing of long, coarse, outer hair and close, under, woolly hair of a reddish brown color, in order that it might be equipped for the cold climate of its habitat.

The geographical range of the mammoth was very extensive. There is scarcely a county in England in which some of its remains have not been found, either in alluvial deposits of gravel or in caverns. Its remains have been found throughout central Europe, northern Asia, and the northern part of the American continent, though the exact distribution of the animal in the new world is still undetermined. The mammoth belongs to the post-Tertiary or Pleistocene epoch of geologists, and was undoubtedly contemporaneous with man in many places. It probably existed in Britain before, during, and after the Glacial period.

Many remains of this huge beast have been found in Siberia, and it is stated that for a very long period there has been a regular export of mammoth ivory from that region for commercial purposes. Nordenskiold, who had special opportunities for studying the subject of the mammoth during his northeast passage, states that more than 100 pairs of mammoth tusks have come into the market yearly during the last 200 years. The Siberian shore between the mouth of the Obi River and Bering Strait and the Arctic islands to the north were reported by him to contain the relics of many thousands of mammoths.

Photo from S. A. Knapp, U. S. Dept. of Agriculture, in the Nat. Geog. Mag., p. 248, 1903

TAMIL GIRLS PICKING TEA, CEYLON

SCENES FROM EVERY LAND

By GILBERT H. GROSVENOR
Editor of the National Geographic Magazine

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