The NATIONAL GEOGRAPHIC MAGAZINE

Vol. XVIII MARCH, 1907 No. 3

CONTENTS

THE MAORIS OF NEW ZEALAND

	PAGE
Archæology in the Air. By Eliza R. Scidmore, Foreign Secretary of the National Geographic Society. Illustrated	151
Railway Routes in Alaska. By Alfred H. Brooks, of the U. S. Geological Survey. With a Summary of the Remarkable Mineral Development of the Territory. Illustrated	164
The Maoris of New Zealand. Illustrated	191
The Great Natural Bridges of Utah. By Col. Edwin F. Holmes. Illustrated	199
A Recent Report from the Doubtful Island Region. By James D. Hague. Illustrated	205
The Possibilities of the Hudson Bay Country. Illustrated	209
The High Sierra. Illustrated	213
Motor Sledges in the Antarctic	214

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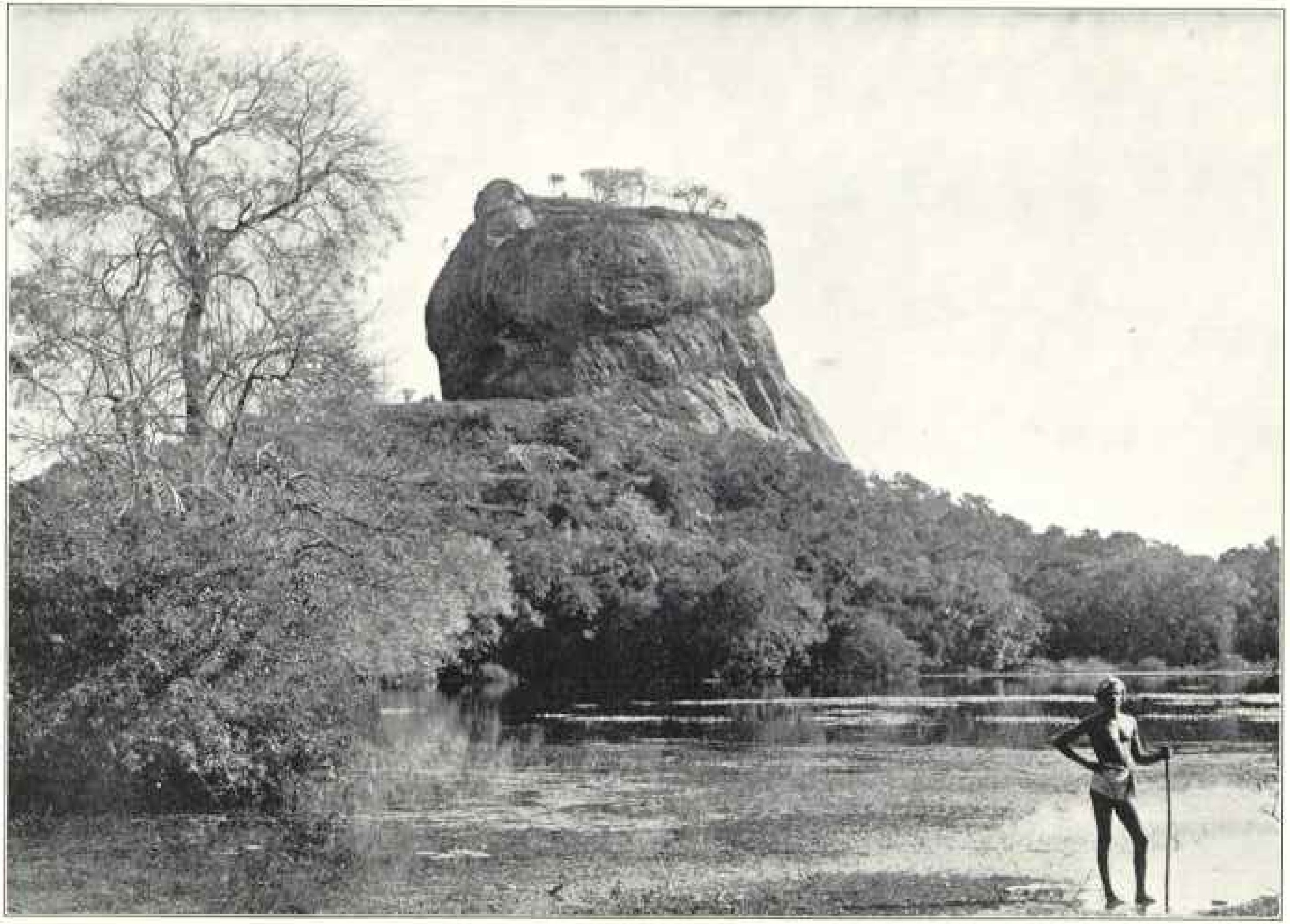


The Sigiri Rock in Ceylon

The guard-house terrace from which the ascent by ladders is made is shown on the left

VOL. XVIII, No. 3 WASHINGTON MARCH, 1907

THE NATIONAL GEOGRAPHIC MAGAZINE

ARCHÆOLOGY IN THE AIR

BY ELIZA R. SCIDMORE

AUTHOR OF "JAVA—THE GARDEN OF THE EAST," "WINTER INDIA," ETC. ETC.

WHEN I was first in Ceylon and had driven the seventy miles down to Anuradhapura and seventy miles back again to Kandy, the archæologists had not taken Sigiri in hand, and no tale of its wonders tempted us from the straight and smooth post-road. Ten years later every one talked of Sigiri, and its fame was in the very air. Copies of wonderfully preserved frescoes, done on Sigiri's rock walls fourteen centuries ago, met one in the Colombo Museum, and driving parties came into Kandy and urged me to go to Sigiri by all means; but none of these talkers had "climbed the Rock," whatever that might mean.

Ceylon, in its natural beauties, is a fair pattern for Paradise, second only to Java—the most beautiful country on earth—and one appreciates this paradise the more if he takes long driving trips over the perfect roads. The short drive of sixteen miles from Kandy down to Matale is renowned as the finest drive in Ceylon and is an unbroken panorama of ideal, cultivated tropical beauty. For another ten miles the road is arched over with tamarind trees, festooned with pepper vines, and sentinelled here and there with splendid banyans and talipot palms, with the blue Matale mountains in the background. After that, cultivation lags, a few miles of rice fields follow, and one jogs along past the unending jungle of the abandoned lowlands, where scant rains fall only during three months of the year. This region was once the richest and most fertile in Ceylon, a vast rice plain abundantly irrigated from tanks and lakes that stored water beyond all need. This rich plain and Anuradhapura, a city of fabulous wealth, tempted the Tamils of the Indian mainland to many raids, and after a last invasion the marauders destroyed all the tanks and canals before they retreated to the Continent. Drought, disease, and famine swept away the few remaining inhabitants, jungle overran the territory, and wild elephants trumpeted there undisturbed. Their paths and the pilgrim's path through to the sacred Bo-Tree at Anuradhapura were the only roads in the wilderness, until coffee culture on the Matale hills tempted Tamil coolies over to Jaffna, whence they made their way on foot to Kandy and the plantations.

For this last half century, British governors have tried to redeem this rich country and repopulate it. A post-road, with rest-houses, was built through to Jaffna and to Trincomalee, the old tanks were cleared out and walled round again, and a railway projected from Colombo around through the lowlands to Anuradhapura and Jaffna. The archæological survey found work to do far beyond the limits of the appropriations, but the wonders of ancient art they have uncovered at Anuradhapura,* Mihintale, and Sigiri furnish attractions to the winter tourists, who are a very certain source of revenue to Ceylon.

ON THE ROAD TO SIGIRI

Breakfasting by candle light at Matale rest-house, one may start at six o'clock and drive through the very tolerable substitute for Eden that the tropical world can present in that clearest, freshest hour of day. Mina birds sang from tall trees and cocoa trees, and that grotesque home friend, the woodpecker, drummed on all sorts of strange tree trunks. The woodpecker and the cocoa palm tree are not associated ideas with us of temperate America, to whose minds the rolling notes and scolding chatter of a woodpecker conjures up any other picture.

The road dropped away between great plantations, where the long-leafed, hybrid, Assam tea bushes striped the red earth in endless lines and feathery grevillea trees shaded the bushes in as precise rows. One tea plantation bordered for three miles along the road, where great arks of bullock carts—prairie schooners with thatched roofs—creaked their way, hung over the outside with bunches of fodder and cooking pots, and bursting open with their freight of women and children and household effects. Gay young planters pranced by on Arab horses or sped along in dog carts. Strings of spindle-legged Tamils came on from Jaffna seeking plantation work and carrying all their possessions tied in a bundle on their heads, including even the sun umbrella. Hedges of aloes, hibiscus, and lantana, rows of tall tamarind trees festooned with pepper vines, and always the graceful plumes of cocoa palms against blue sky, made the common highway like the ideal scenes of a theater drop-curtain. Groups of Tamil women in white and brilliant red head draperies seemed posed beside the brilliant green tea bushes, and to be tossing tea leaves over their shoulders into cylindrical baskets on their backs, only while they waited for the photographer or the sketch class to arrive. When the kodak did arrive before one black beauty, with jeweled rings in her nose and a mite of a black baby astride of her hip, she pulled her veil over her face and set up a howl. Promises of a money reward did not seem to reach her ear, but they reached the ears of a few dozen others, who came running, and with whoops and shrieks precipitated themselves upon the tea bush my kodak pointed to. Then the black overseer came, with black looks on the blackest face ever seen, and with his big walking stick cleared the magpie mob away and made the young mother stand up and look pleasant in the act of picking tea. For this she, or rather the baby, received the promised tiny silver piece, which the pickaninny quickly swallowed, and there was uproar again as we drove away.

A few rows of shops now and then constituted the village bazars, where the estate coolies are tempted to dissipate, to spend for bananas and cocoanuts, red peppers and curry stuff, or for brilliant calicoes and gay teapots. Three shining figures of black bronze sat under a thatched roof molding red clay on the potters' wheel, and a yellow bronze Arab baby ran out, clothed only in coral beads and bits of hammered silver. A bearded Cingalese patriarch, nearly air-clad, rested under a banyan tree, and a bronze Cupid leaned lovingly against him. Then estates and busy village bazars ceased, rice fields began, and the cool white gov-

*See November, 1906, National Geographic Magazine for description of ruins at Anuradhapura.

Country Carts, Ceylon

Picking Tea

ernment rest-house at Nalanda, in a compound shaded by enormous tamarind trees, marked the end of the hill country. After that was only the flat plain, covered with jungle, the white road running between a double wall of uninteresting foliage and underbrush, as monotonous as anything in Illinois. Nothing tropical appeared save the millions of butterflies that fluttered over the road, and the gor-

geous clusters of plumy red and yellow *Gloriosa superba*—the most splendid wild flower in the world, fully worthy of its superlative name.

THE RED MONOLITH

Dambool rest-house received and revived us after the twenty-mile drive, and from Dambool rock, the red monolith of Sigiri rises squarely and sharply from over the ten-mile level of tree tops—an enchanted mesa that burned blood red and purple in the sunset and seemed impossible of attainment by any two-footed climber. The bare red rock, bulging at the top and overhanging its base all around, without crevice or chimney to give access, gave us forebodings for the morrow.

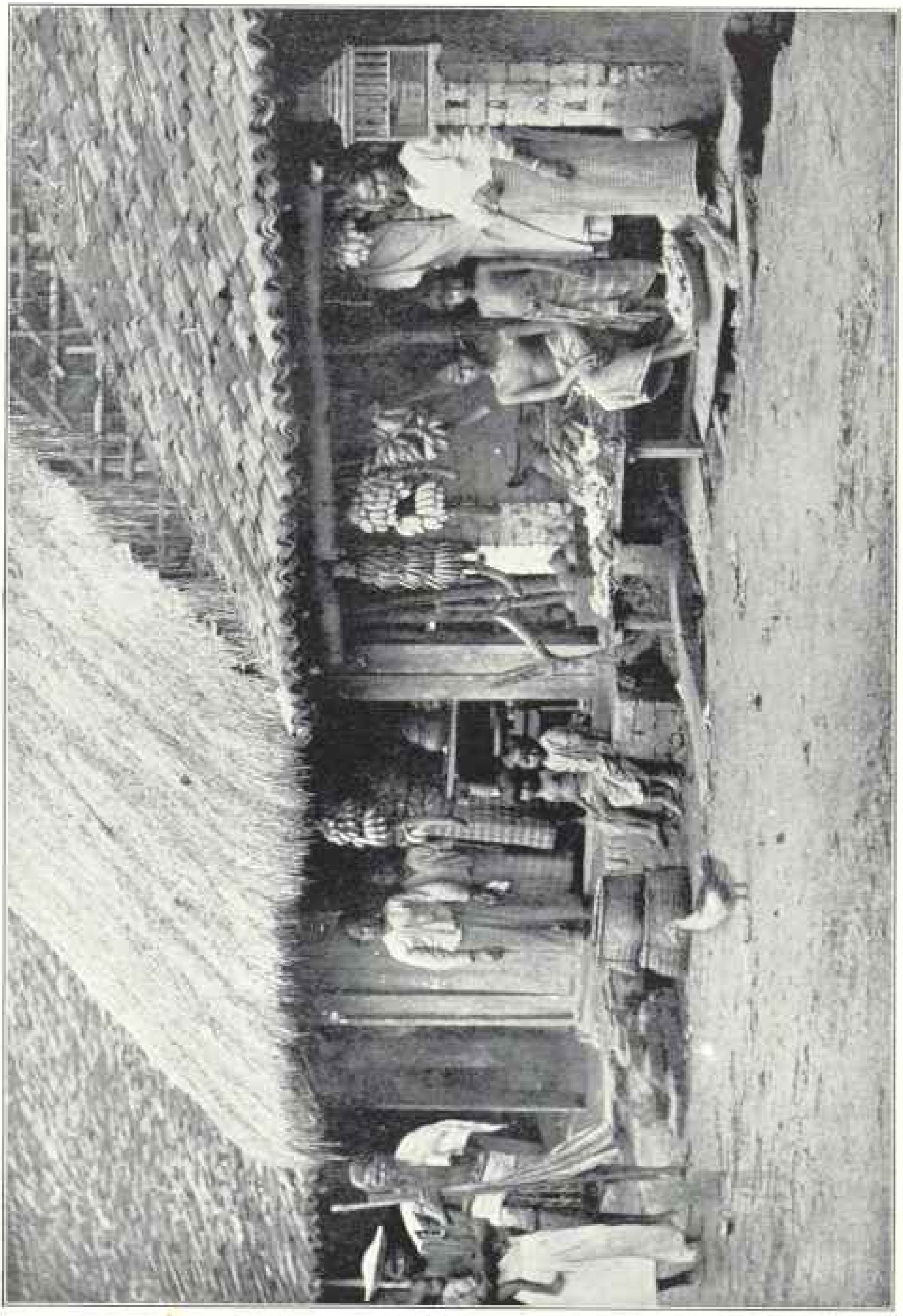
At the rest-house dinner table tales were told of travelers who drove over to climb Sigiri—and drove back again; of heroic ones who climbed the first quartz staircases airily, but sat down at the guard-house terrace, and wept hysterically at sight of the scaling ladders hanging in air, when it was time for them to climb and cling by foot and hand, by tooth and nail. They told of others who arrived on high, but sat there half a day, until hunger nerved them to a blindfolded descent: two coolies with a rope, and four coolies, each to tend and place a hand or a foot, assisting the descent, for a day's wages apiece. This archæology in the air seemed rather too sensational for any one but Santos-Dumont, and there was a profound wish that we had kept Sigiri to ourselves until the deed was done—or declined unknown. What was Sigiri to us, anyhow? Who had ever heard of it in America?

We left the Anuradhapura road two miles out from Dambool and followed the Trincomalie road for three miles before turning off into a jungle path that led for six miles through the leafy wilderness to the lone Lion Rock—a drive of enchantment through the azure air of the earliest morning.

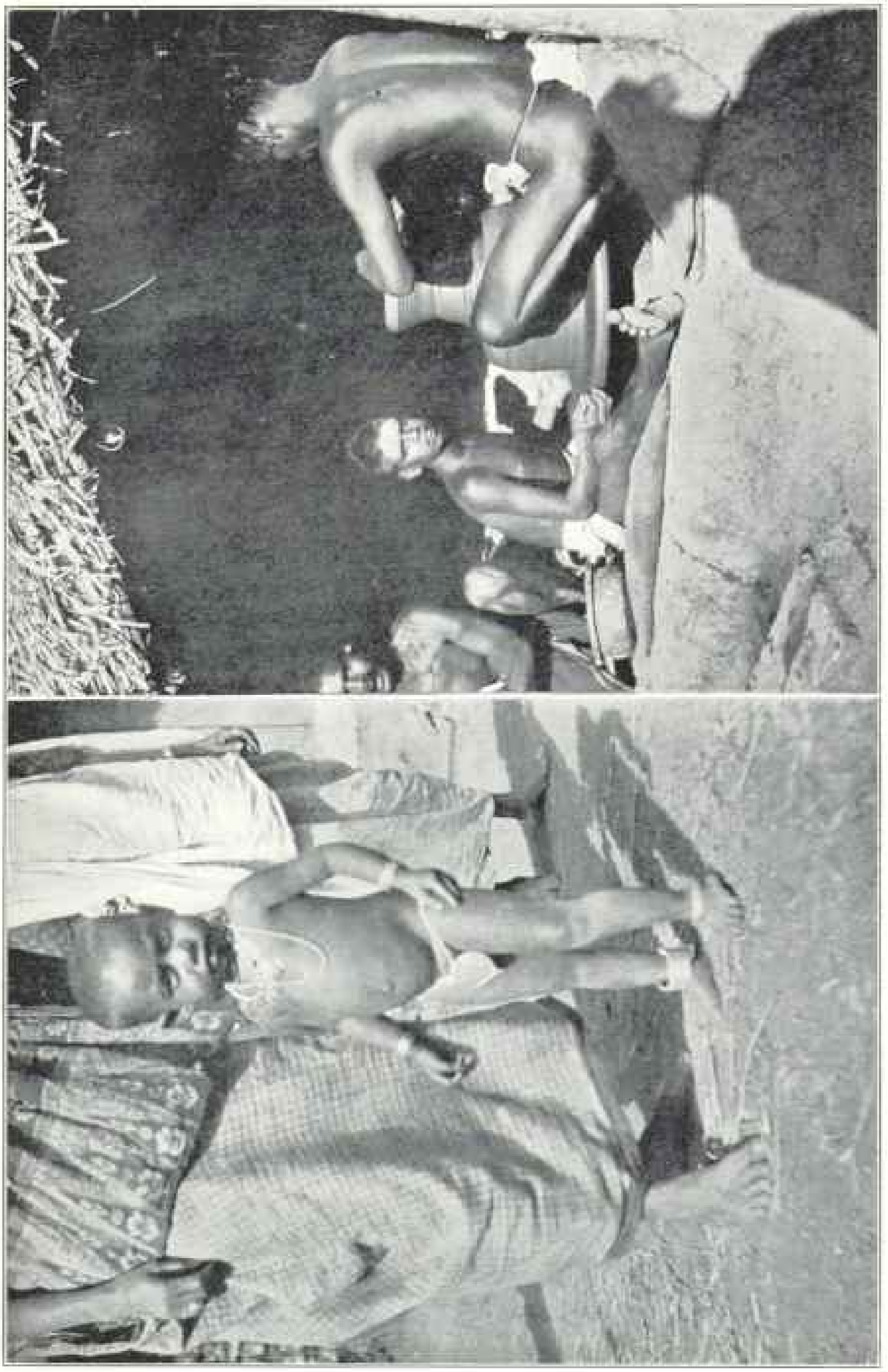
THE LAIR OF A WICKED KING

Few countries have so clear and complete an historical record as Ceylon has in the *Mahawanso*, or "Genealogy of the Great," which was scrupulously kept from the fifth century B. C. down to 1815, after the English had expelled the Dutch. The *Mahawanso* relates how King Kasyapa, having murdered his father by entombing him alive, and half murdering his brother, who fled to the Indian mainland, had thereafter an uneasy head and a bad conscience. Fearing to remain in unprotected Anuradhapura, on the open plain, he built a fortress around and a palace on top of Sigiri rock and brought a great city to its base. All the jungle round has yielded proof of the splendid structures that once stood there. The lines of tanks and canals have been traced, and the tank nearest the rock has been cleared and walled again and made useful for the little settlement that has grown around the archæologist's camp.

The government has built a small rest-house in a clearing, at just the right distance and point of view to show the boldest outlines of the tremendous monolith, and if one were seeking the ideal spot for peace and quiet, for world-forgetting, and for absolute repose, Sigiri rest-house would meet the requirements—a Nirvana, with the few necessary comforts of life. It stands at the edge of Kasyapa's viceroy's camp, which defended all access to the causeway leading across the tank to the rock and it had dependencies in the way of audience halls, halls of justice, temples, and barracks. The camp walls are of cyclopean masonry, and laid in lines of boulders that match the walls of Mycenæ and rock-girt Tiryns. Across the tank the jungle is cleared away and a confusion of bare boulders, slopes, and mounds of débris immediately surround the rock. A first stone staircase, a terrace, an iron ladder, and a second staircase brought us to the passageway between a high parapet of chunam that re-

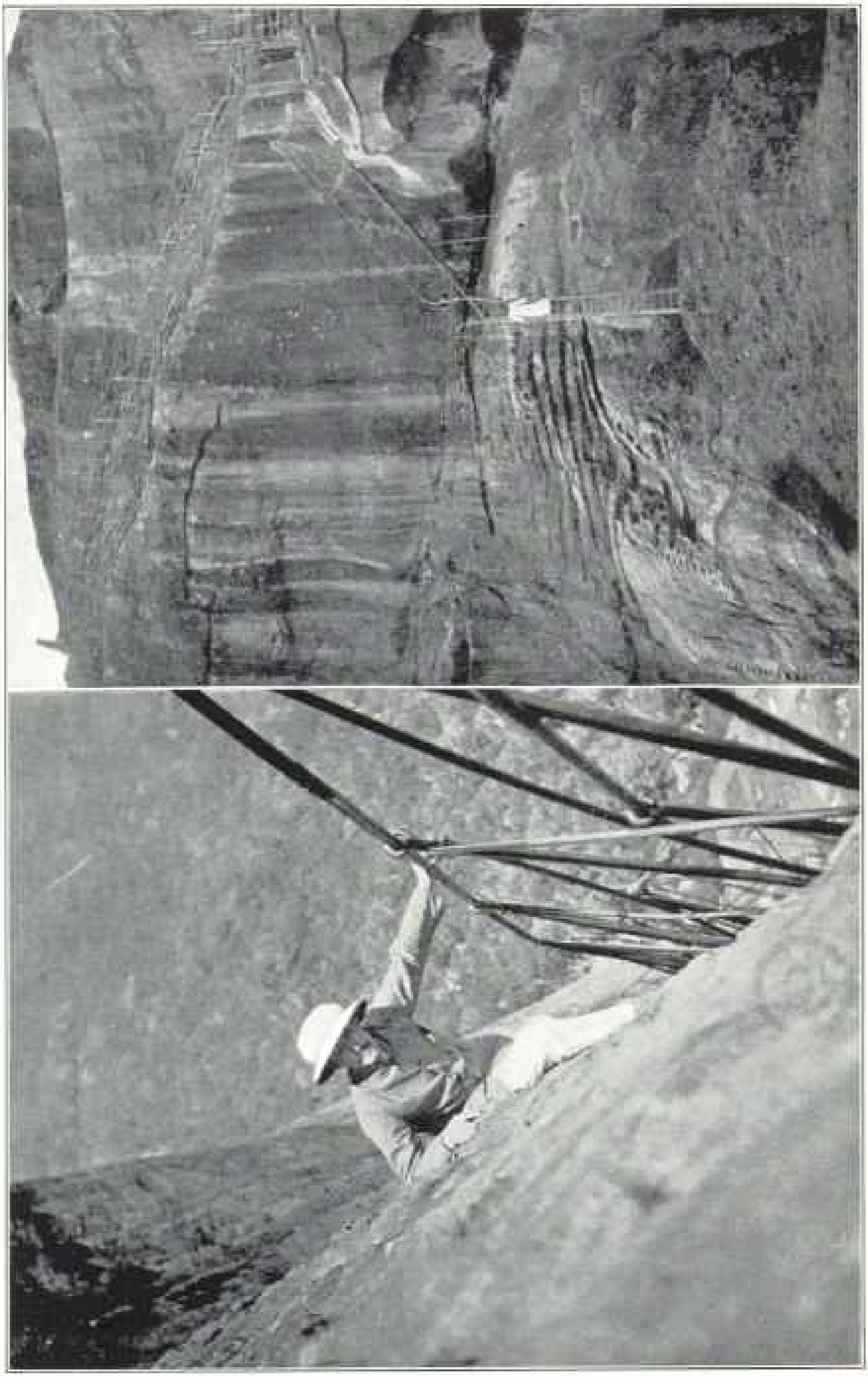


Village Bazaar on the Road to Sigiri



The Village Pottery

The Arab Baby



Climbing to Sigiri's Summit

The Archeologist in the Air

mains from Kasyapa's time. Chunam, the universal building material of the tropic East, is a cement composed of lime, cocoanut milk, and Para tree juice. It hardens and takes a polish like marble, and where even slightly protected, as this wall has been by the overhang of the rock, will last for all time. Such a chunam screen wall once protected all these lower staircases and galleries, so that Kasyapa and his train could pass up and down, in safety, unseen from the plain. Patches of highly colored, well-preserved paintings decorate the overhanging roof of this gallery—a queen's procession, bearing flowers and offerings to the temple—similar in design and execution to the paintings on the walls of the Ajanta caves. One sees them contentedly from below, although there remain still the dizzy scaffoldings and skeletons of poles by which the archæologists reached these pockets or arches on high, to hang in mid-air while they sketched and photographed these pre-Raphaelite paintings—frescoes on the living rock, in clear yellow, green, and red, that Puvis de Chavannes might have done in an earlier incarnation, when art was pure and strong, fresh and young, and fog and smoke were not a necessary part of his palette's setting.

Another long rock staircase, hugging the side of the rock, brought us up to the broad shoulder or terrace on the north face of the mesa, where foundations show the extent of the large guard-house or barracks that defended the upper staircases of the Lion Rock. The wind blew fresh and cool over far levels of tree tops, and every prospect pleased us save that of steep overhanging Sigiri, the spidery lines of iron scaling ladders and hand rails that we had seen the black blacksmith bending from iron piping in his forge far below.

And we had brashly said, from Kandy to Dambool, that we were going to Sigiri! "And climb the Rock"? other tourists asked. Of course. Silence for a little longer would have been as gold or radium in our pockets, for we were as the most microscopic of ants about to climb the stem of a gigantic mushroom, and to crawl up over its curving, umbrella edge.

The name of Lion Rock for long had no especial significance, until on this guard-house terrace the archæologists descried three claws and the dew-claw of the feet of the gigantic lion, whose head, moulded on to the rock front, gave the name *Sinha-giri*, lion rock. Deep grooves were cut in the face of the rock as steppings for walls of masonry and the whole mass coated with chunam, and painted to the semblance of a lion's head resting on his extended paws. The king's train, passing between the paws, ascended a staircase and disappeared in the lion's mouth. The series of concealed staircases reached to the summit, where the king could emerge safely to the open air. There is trace of a portcullis half way up, the perpendicular grooves cut true and smooth, and in his palace in air Kasyapa might defy his enemies to reach him.

The lion's claws measured four and five feet across, and passing between them was the original staircase of glittering quartz, and then a long, iron ladder laid against the wall, as ladders are generally laid. The wind blew fresh from northeast and eddied up from underneath, as we mounted the rungs and looked down on dizzy vistas of far green jungle space. Then the ladder ran at right angles out in the air, parallel with the face of the rock, the gas pipe rungs driven into sockets drilled in the rock. Lizards *chuck-chucked* and ran derisively away as we advanced, the very flies kicked their heels in scorn as we clung with death grips to rails and stanchions. As we stopped to rest, and to look upward only, there were perpendicular hand rails and iron loops of steps driven in the perpendicular rock, as on the side of a ship's hold or mast. A Zermatt climber might have reveled in the prospect, but not I. On foot and knee, on all fours fairly, a solid rock slope was negotiated; and then came the gymnast's feat

up the straight steps between the grooves of the old porteullis, lifting one's weight by main force, and the worst was over. We had rounded the mushroom's lip and had only to tread in the grooves in a long, smooth rock slope, with a comforting hand rail on the side of dizzy space, as we followed around the curving rim to a final long, quartz staircase that reached the summit.

THE RUINS OF THE SUMMIT

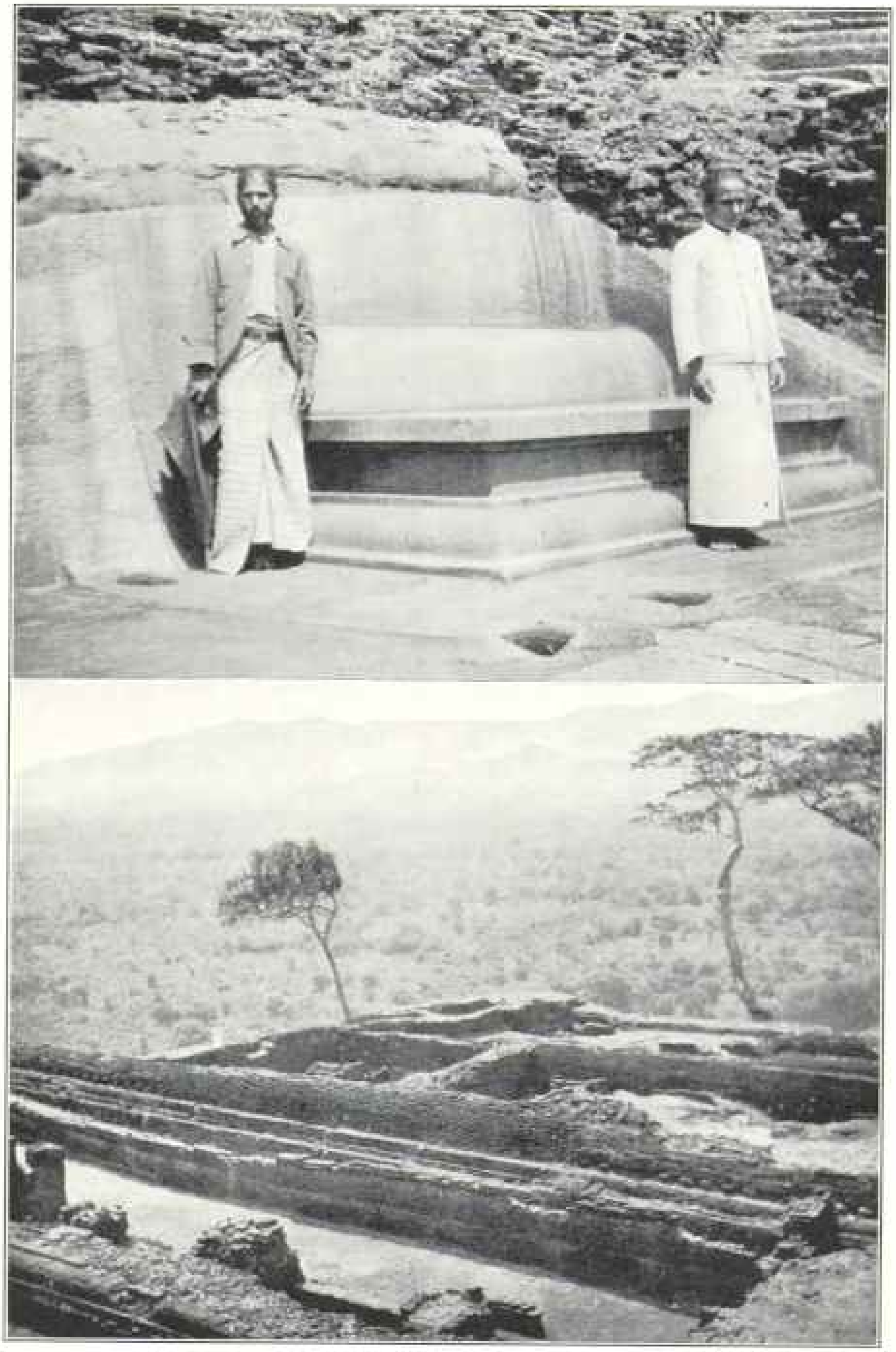
There is a space of level terraces up there quite three acres in extent, and the trees that look like saplings from below, mere tufts, few and scant as the hairs on Bismarck's head, are spreading banyans that give grateful shade from the too radiant sun. Walls and walls, lines of stone foundations and lines of crumbling bricks ran here and there, with quartz and carved stone steps in short flights, and platforms happening everywhere. The whole ground-floor plan of the king's palace has been scraped down to bed rock, hard and clean. The top-dressing of trees and bushes was burned, and then the archaeologists threw the débris and rubbish over the side, and the monsoon rains washed the place clean, and they studied out the plan, as clearly as from an architect's drawing. There are wells and cisterns, and a bathing tank, thirty feet square, cut from the living rock; and a square throne or divan hewn on the eastern rim, where the king could lounge in the afternoon shade and survey his populous domains far below. There are sockets in the rock showing where the supports of a wooden pavilion roof, or the staffs for a silk canopy were set, and the seat for the umbrella-bearer behind the king's cushion is also intact. The coarse rock glitters with garnet crystals and is a natural "Jeweled Throne" that any jeweled personage of the East might envy.

Now that the foundations are all traced and cleared away, the Archæological Survey has only to maintain the staircases and ladders, and keep the place free from weeds and vegetation. The archæologist directed a coolie toward a bank of débris, just to show how rich the place was in remains of former occupancy, and the first stroke of the pick loosened a shard. Another deft stroke brought to light half of a plate, and while we marveled a coolie came up over the edge of space, as only Mahatmas are supposed to appear. He had been weeding along the dizziest edges, a rope fastened to his waist lest the suction tread of his bare feet should fail when the weed patch became vertical.

RETRIBUTION

When Kasyapa had taken his treasure and gone on high, he tried to gain peace of mind and acquire merit by pious deeds. He summoned priests around him; the rocks below were honeycombed with hermits' cells; he built temples and dagobas; he built a monastery in the air beside his palace, and was rigorous in his penances, mortification, and religious offices—but fortifying the approaches to the Lion Rock all of the time, so as to take no chances. Then retribution came over from the mainland in the train of his avenging brother, and fate had it that foolish Kasyapa, instead of sitting still and holding tight to his throne in mid-air, should come down from his high-perched palace and give battle on the low-lying plain in the commonplace way. His elephant stepped aside to escape a marshy spot and his troops, taking it as a movement of retreat, threw down their arms and ran. And the wicked king was slain by his avenging brother, as he stood, alone in an oozy swamp, after all the years of security on his wind-swept rock.

Then Sigiri was given over to the priests entirely. All the summit palace became a monastery and the uncle of Kasyapa, who began the Mahawanso, continued it there, and the abbotts of Sigiri added to the record in that ideal retreat, which is a literary landmark identified with the Mahawanso in every Cingalese mind. With time and Tamil invasions, with the wear of centuries of sun and monsoon rains, cement and ma-



The King's Throne on Sigiri

View from Sigiri's Summit

sonry crumbled and the splendor of Sigiri dwindled. When the plain was devastated and depopulated and the approaches had suffered some sudden and complete ruin, the priests abandoned the monastery in the air, and as the Mahawanso does not make any mention of this withdrawal, it is believed that it had been abandoned for all of six centuries when the archæologists began work. In three seasons they uncovered the rock and put in the scaling ladders and hand rails to make it accessible, and fought off swarms of bees with fire balls. They long had hopes of uncovering treasure in the palace ruins, and dug through débris beds fifty feet deep, hoping for some precious spoil; but the Malabar marauders or the departing priests had swept it clear of valuable things before the last staircase crumbled.

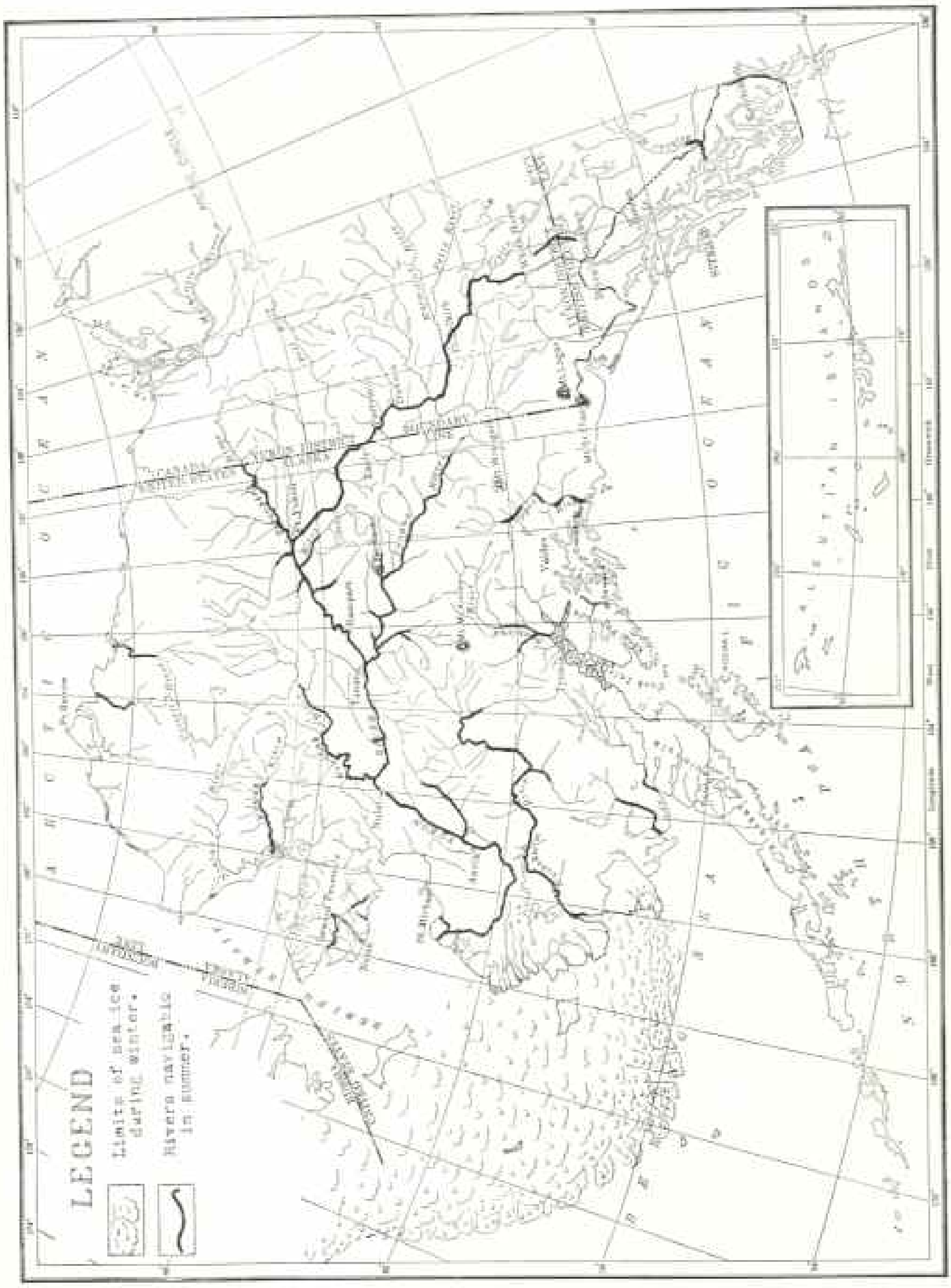
Perched on that pinnacle peak, overlooking half that north end of Ceylon, as it seemed, the air was fresh and cool in spite of the overhead sun, and the place was inspiring. When the descent began and one looked down and off into vistas of space and diminishing perspectives over each boot tip, all sense of exhilaration was gone. The archæologist skipped like a chamois and walked securely as a fly, in his rope-soled tennis shoes, over the dizzy rock slopes. He left the grooves and the hand rails to the strangers, who sat down on the rock and abjectly crawled, feet foremost—"swarmed," in fact—down, along the slanting, curving rim of the mushroom's top, gripping the rail with a drowning man's thoroughness.

"No. We have not lost any tourists yet. None slipped off, none blown away, so far—and no suicides. Why, I often go up three and four times a day, to watch the work. It is quite safe. See?" and the archæologist side-stepped off on the perpendicular wall and danced a tarantelle with his own free foot flourished over six hundred feet of empty air, until we begged him to remember the future of archæology in Ceylon—a future that never can hold anything so unique and sensational as Sigiri.

The little Tamil horse boy sat on his heels flicking the noonday flies from the ponies when we reached the level lowland and its steaming, greenhouse atmosphere. He grinned at us, and we knew the black imp had seen our abject crawling on Sigiri heights.

"Did he go up?" and the coachman answered, "Yes; and it was very nice, he says, but the get-downing was awful. He has prayered and been saved."

Artist Copying Frescoes on the Rock Wall


LEGEND
Limits of pack ice during winter.
Rivers navigable in summer.
Compiled by Alfred H. Brooks
Map of Alaska Showing Navigable Waters and Railroads

RAILWAY ROUTES IN ALASKA*

By Alfred H. Brooks

Geologist in Charge of Alaskan Division, U. S. Geological Survey

TRANSPORTATION is the first essential element to the industrial advancement of a new land. Therefore, though the subject of railway location may be of no great academic interest, there lies a justification for its discussion in the fact that it is of such vital importance to those who are developing the resources of Alaska. Moreover, the matter is timely because of its relation to a broad question of public policy, for many efforts have been made in recent years to obtain financial support from the federal government for Alaskan railway projects.

Popular interest in this subject appears to be only excelled by popular ignorance of it—an ignorance, too, which is constantly being augmented by misstatements in current literature. Some years ago the assertion was made in a magazine article that some parts of Alaska were being rapidly gridironed by railways. To those familiar with the primitive condition of transportation maintaining throughout the territory, such a statement can appear little short of ridiculous. This misleading article has, however, evidently been regarded as authoritative, for it has found place in a popular encyclopædia.

Though the aggregate mileage of railways in Alaska is less than 200, but little more than that of Porto Rico, this is divided among eight different lines. Of these, four are along the Pacific seaboard, three on the Seward Peninsula, and one in the Tanana Valley (see map, page 164). All of these railways have been built to supplement water transportation.

RAILWAY LOCATION

In the discussion to follow of the principles governing railway location, I will confine myself entirely to commercial lines, for obviously railways built for military or scenic purposes will follow routes determined by entirely different conditions.

The controlling factors of railway location fall into two important groups, here termed (1) commercial and (2) geographic, while in regions lying close to international boundaries a third, namely, political, becomes operative. Each of the first two groups resolves itself into several subordinate factors, one or more of which may dominate in any given province, to the practical exclusion of all the others. The following table is an attempt to present a terse analysis of the problem of railway location:

I. *Commercial control:*
   1. Developed resources (statistics of production and commerce).
   2. Undeveloped resources.
      Mineral (economic geology).
      Agricultural (climate, soils, and botany).
      Timber (distribution, quality, and quantity).
   3. Population.
   4. Competitive or supplementary lines of transportation (navigable waters and existing railways).

II. *Geographic control:*
   1. Position (terminals and connecting lines of transportation).
   2. Distances (comparison of distances of different routes).
   3. Relief (mountain ranges, passes, and valleys, as affecting gradients).
   4. Water-courses (depths and width of rivers, as affecting construction of bridges or ferries).
   5. Climate (precipitation, etc., as affecting cost of construction, operation, and maintenance).

III. *Political control:*
   1. Political boundaries.

Before analyzing this table I will forestall possible criticism by stating that certain elements which must of necessity

* Published by permission of the Director of the United States Geological Survey. Read at the third annual meeting of the Association of American Geographers, New York, January 1, 1907.

have an important influence with a locating engineer are here entirely omitted because they do not appear to be germane to the subject. In this I refer more specially to the financial backing to any given project. Obviously the choice of a railway route may have to be governed by the low cost of first construction rather than by consideration of the ultimate economy in construction, operation, and maintenance. I believe, however, that the question of financing of a railway project should find no place in a scientific discussion of railway location. The available sources of material for construction have also not been included in this analysis, for this is, after all, a local problem and will not affect the general choice of routes.

COST PER MILE

Though it is not the purpose of this paper to discuss the more purely engineering aspect of my subject, yet it may be well to devote a few words to the question of the cost of construction because of the many current misconceptions regarding it. It will be pointed out below that the watersheds to be crossed by Alaskan railways (see profiles, page 179) vary from about 2,000 to 3,000 feet, which are low compared with the altitudes of 8,000 to 11,000 feet attained by many railways in the western states. It will also be shown that the routes of approach to the divides have as a rule low gradients, and that much of the region to be traversed by railways is one of only moderate relief. On the other hand, most of the proposed routes will demand bridging of many streams and rivers. This feature will possibly be the most difficult for the engineer to contend with, because of (1) the winter ice and (2) the spring floods.

The chief factor which will much enhance the expenditures for railway construction in Alaska is the distance of the coastal terminal to the centers of population, for this increases the cost of all labor and materials. Shortness of the summer season and adverse climatic conditions will also enhance the cost. It has been estimated by a competent engineer that the same class of construction will cost 75 to 100 per cent more in Alaska than in the western states. The same engineer has stated to the writer that in many parts of the interior, where valleys and rolling uplands are followed, the cost of a standard-gauge railway will probably not exceed $30,000 per mile, but through the coastal mountain ranges may be more than twice as great. Where detailed surveys and estimates are wanting, it will probably be safe to count on an average cost of at least $35,000 per mile for a standard-gauge railway from the Gulf of Alaska to the Yukon.

What I have termed commercial control is simply another name for tonnage, the great dominating element in railway location. This, in turn, is dependent in a large measure on resources, developed or undeveloped. In settled regions the distribution of population may wield a decided influence, but population again is often merely an evidence of developed resources. The amount of tonnage will also be affected by competitive and supplementary lines of transportation.

Five subdivisions are recognized under geographic control. The first is position, which pertains chiefly to location and character of terminals and their relation to other transportation systems. Under the second, distances, the different routes are compared in length. Under relief is included the influence of topography, while larger water-courses must be considered because they necessitate bridges or ferries. The influence of climate on cost of construction, operation, and maintenance is obvious. Heavy snowfalls, river floods, and the closing of waterways by winter ice are elements that deserve consideration. Political control obviously refers to international boundaries alone.

I have intentionally emphasized the commercial control of railway routes, for it is evident that without adequate tonnage railways cannot be built economically On the other hand, given the re-

sources to warrant the cost of construction and operation, and the modern engineer will build a railway almost anywhere. In this I do not intend to indorse the policy, too often followed, of railway location which is not preceded by comprehensive geographic investigation. Many railways have been based on routes chosen by the old adage: "The Indian followed the buffalo, the white man the Indian, and the locomotive the white man." As a consequence, nearly every transcontinental line has made or is contemplating changes of routes involving the expenditure of millions of dollars which might have been avoided by proper exploration and survey. The lesson has not yet been learned, however, for recently a corporation proposing to build a railway in Alaska, after spending several hundred thousand dollars in construction, abandoned the chosen route for another. In this case a tenth part of the money spent on what proved to be worthless construction would have more than paid for the necessary explorations and surveys.

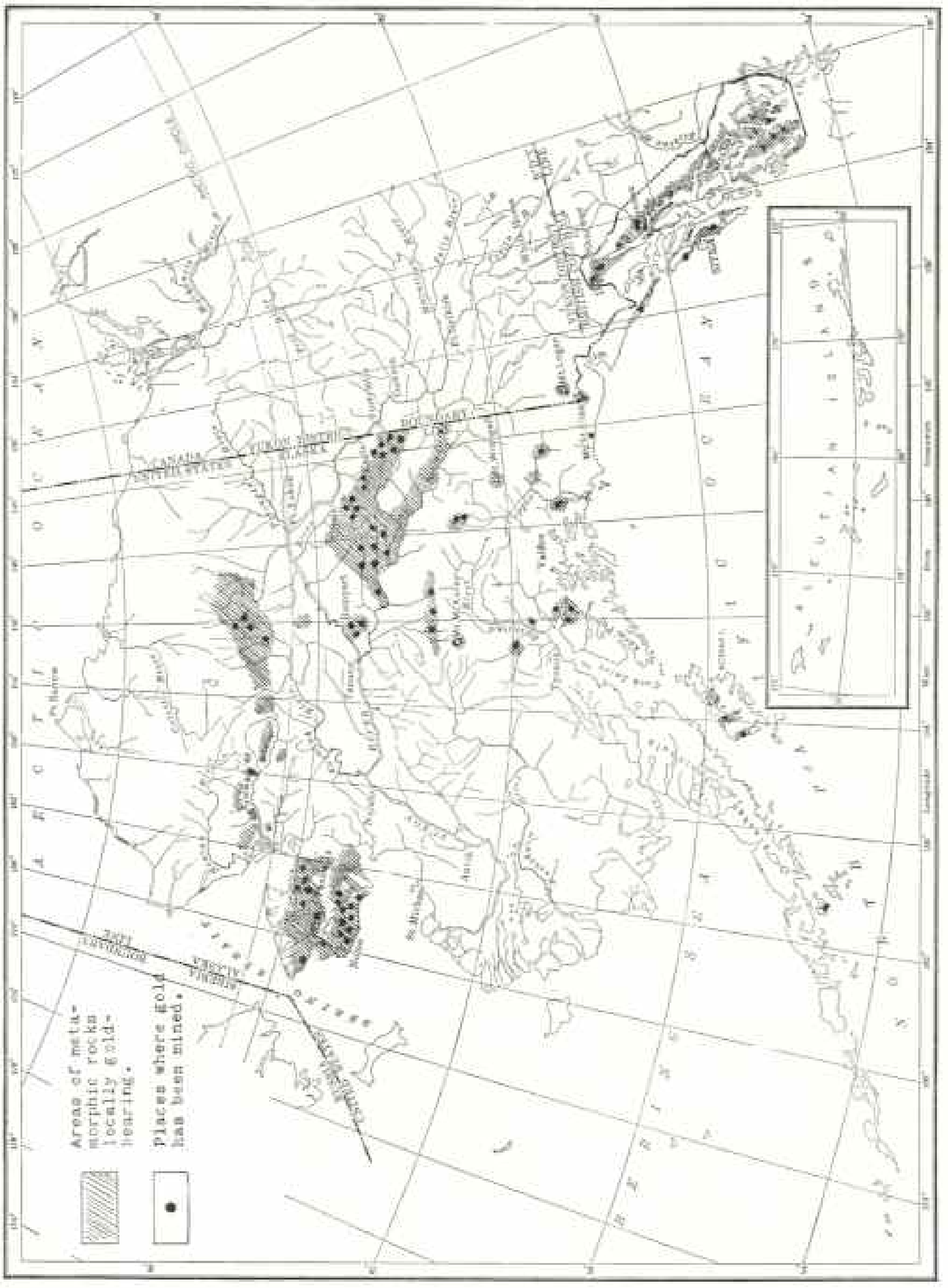
It follows from the above that while the demand for transportation between certain localities may be such that a railway will be built in spite of the physical obstacles, yet economic location demands the most careful adjustment to the topography.

RESOURCES TO BE DEVELOPED

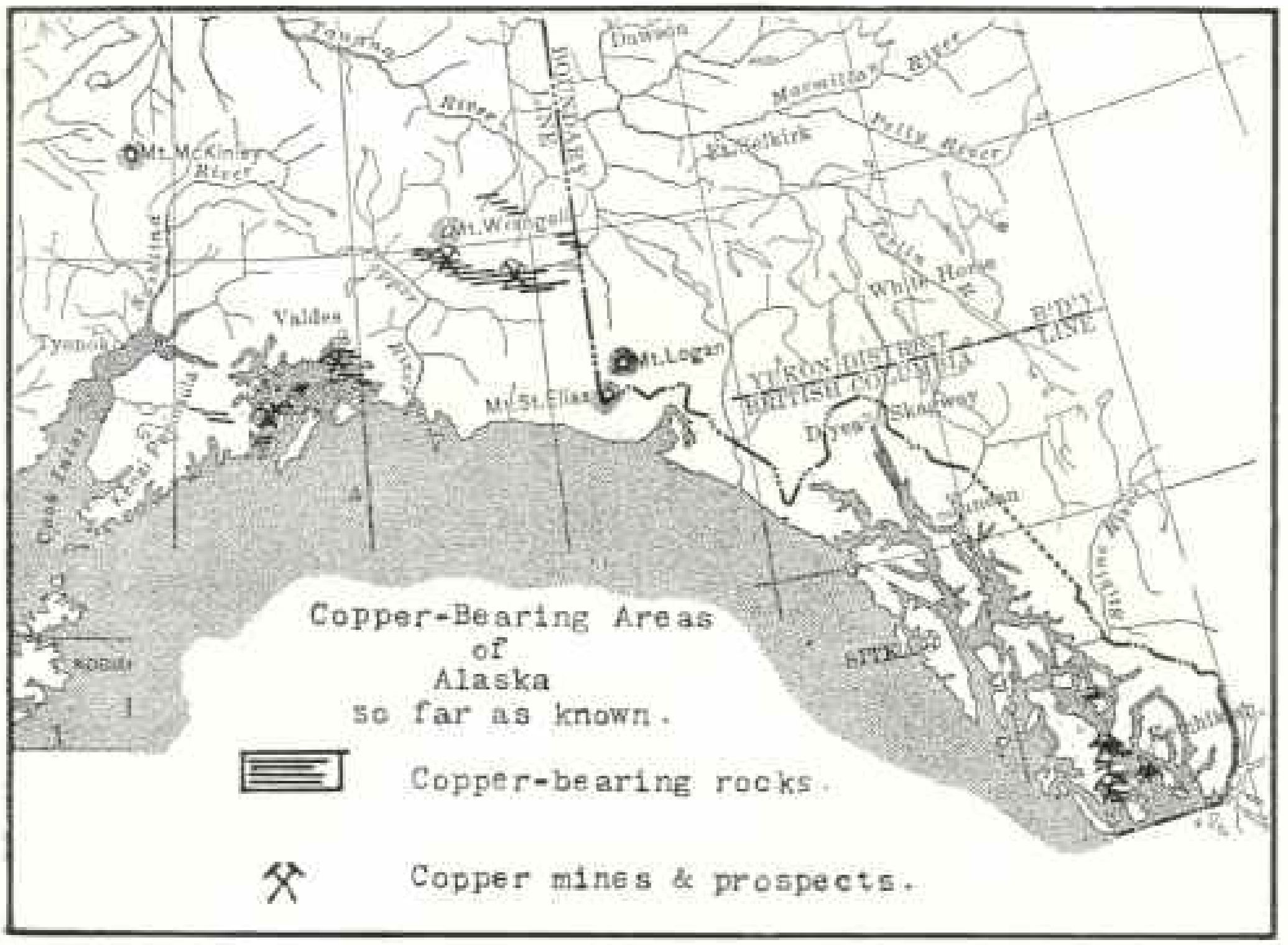
It is evident that a discussion of railway routes must consider the resources of the territory as well as its physical features; that is, on one hand, the possibilities of traffic must be discussed; on the other, the routes of approach. The question of traffic again resolves itself into statistics of existing commerce and the foreshadowing of that to come from undeveloped resources.

In Alaska the problem is simplified by the fact that the immediately available resources to be developed by railway construction are all of a mineral character. I do not by this mean to decry the agricultural possibilities of certain parts of the territory, but I do believe that these may be almost neglected in the present discussion, for the reason that these arable lands are too remote from centers of population to yet compete with the more accessible and fertile lands in the states. The capitalists will certainly look to the mines of precious metals and of coal to recoup themselves for outlays on railway construction. With the mining development some agricultural progress will unquestionably be made and eventually be a source of traffic for the road. There is no timber for export except along the Pacific seaboard (see page 183). In fact, much lumber is annually taken into the interior, and this consumption is likely to become greater, if the present ravages by forest fires in the Yukon Basin continue.

The discussion of resources to be developed by railways, therefore, resolves itself into a consideration of the mineral wealth and its distribution. In other words, it is a geologic problem. Though the basal facts are very incomplete, yet some salient features of the economic geology are known, and these bear directly on the problem of mineral resources. It is not my purpose to describe the geology of the territory, but I will call your attention to the distribution of certain terranes which carry minerals of economic value. The rocks grouped together as undifferentiated Paleozoic, including the gold-bearing horizons, occur in three belts, one running parallel to the Pacific seaboard, a second lying centrally in the Yukon Province, and a third forming the country rock of the major part of the Seward Peninsula (see map, page 168). Of the $100,000,000 which represents in round numbers the total mineral production of Alaska, over 98 per cent has been taken from areas underlain by these rocks. In southeastern Alaska there is a well-defined contact between a broad belt of intrusives and these metamorphic terranes, and this has been proved to be the general locus of auriferous lodes. It should be noted that the northern extension of this contact lies in



Map of Alaska, Showing, so Far as Known, the Distribution of Metamorphic Rocks, and the Localities where Gold Has Been Mined



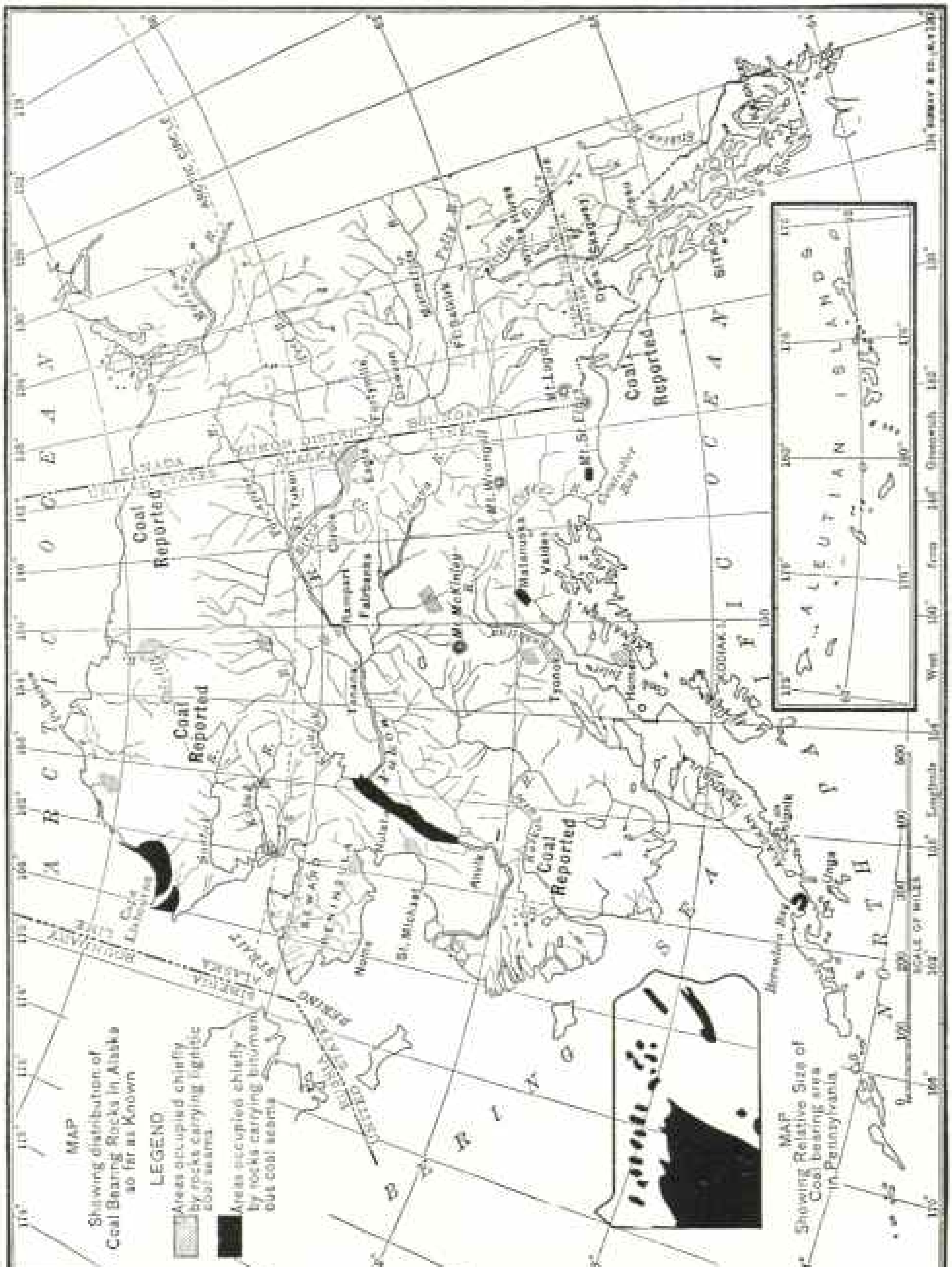
a little-known region, as will be shown later; it is close to one of the proposed railway routes into the interior. Another fact bearing on the mineral resources can be interpreted in terms of geology. On either side of the Wrangell Mountains is a belt of Devonian rocks which are copper-bearing (see map, page 169). These are, indeed, the outcrops of the same terrane along two areas of a syncline and form the objective points of several railway projects.

The map on page 168 shows the distribution of the auriferous terranes of the territory so far as determined. It emphasizes the fact that there is an extensive gold-bearing area lying well within the heart of the territory and 400 to 500 miles from tidewater.

COAL AND COPPER

The total area of the known coal-bearing rocks in Alaska is approximately 12,000 square miles (see map, page 170). Unfortunately, much of the coal in the northern province is of a lignitic character, and though it will eventually find local use, cannot now be regarded as an important source of tonnage for railways. There are two coal fields, however, the Controller Bay and Matanuska, aggregating at least 120 square miles, which carry high-grade bituminous and some semi-anthracite coal. This coal is superior to any mined on the Pacific seaboard of the continent and is suitable for metallurgical purposes. Both fields are objective points of railways now under construction and are expected to furnish local tonnage for these roads, to be eventually extended into the interior. Bituminous coals also occur on the Yukon and at Cape Lisburne, on the Arctic Ocean.

Only the copper deposits of the inland region are important to this discussion, and these include two different districts lying north and south of the Wrangell Mountains, on the two arms of a syncline



Compiled by Alfred H. Brooks

Map of Alaska Showing the Distribution of the Coal-bearing Rocks so Far as Known

(see map, page 169). The southern belt, to which a railway is being built, has been sufficiently developed to indicate a large tonnage.

AGRICULTURAL POSSIBILITIES

I have shown that the resources which promise to yield a tonnage are gold, copper, and coal. The forests, except along the seaboard, have no value for export (see map, page 172). Inland the heavy timber, of which the largest trees are not over two feet in diameter, is closely limited to the river courses. Though there are sawmills in every placer camp of the Yukon, that these do not even supply the local demand is made evident by the fact that in 1905 upward of $30,000 worth of lumber was brought to the Yukon from Puget Sound. The timber map can also be used to indicate the general distribution of arable lands, for the areas marked as timber embrace practically all the lands which may possess future agricultural value. A region lying adjacent to and north of Cook Inlet appears to be best adapted for agriculture, but in the Copper and Tanana basins, too, there are considerable tracts of agricultural and grazing lands. It should be borne in mind that beyond the coastal barrier the subsoil usually remains perpetually frozen and the climate is semi-arid. These conditions, combined with the shortness of the growing season and the liability of frosts, do not invite agricultural pursuits. Nevertheless, the conditions are no more adverse than those existing in some European countries which support a thrifty agricultural peasantry and export agricultural products. The richness of the soil is attested by the many gardens found throughout the inland region. These are specially successful where hot springs have thawed the soil. One of these is shown in the illustration on page 183.

4 TONS OF COAL AND 30 TONS OF GOLD EXPORTED IN 1905

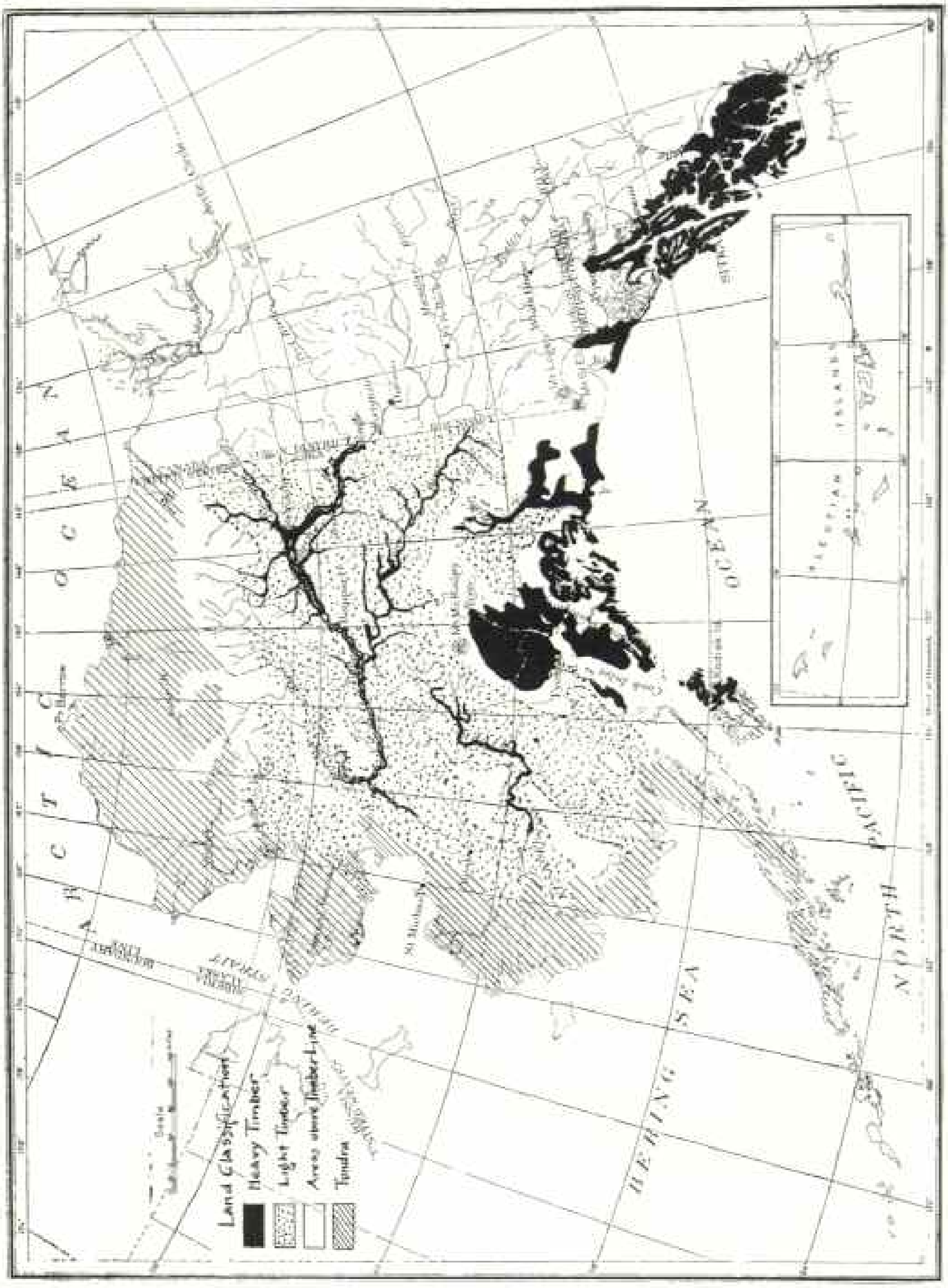
As regards the developed resources, little can be added to what has already been presented. The rapid increase in gold production is shown in the diagram on page 175. Including 1906, the total output of gold is about $100,000,000, only about one-quarter of which has come from the inland districts, as shown in the following table:

Gold Production of Alaska, with Approximate Distribution

Year.	Pacific coastal belt.	Copper River and Cook Inlet region.	Yukon Basin.	Seward Peninsula.	Total.
1880	$20,000	.....	.....	.....	$20,000
1881	40,000	.....	.....	.....	40,000
1882	150,000	.....	.....	.....	150,000
1883	300,000	.....	$1,000	.....	301,000
1884	200,000	.....	1,000	.....	201,000
1885	275,000	.....	25,000	.....	300,000
1886	416,000	.....	30,000	.....	446,000
1887	645,000	.....	30,000	.....	675,000
1888	815,000	.....	35,000	.....	850,000
1889	860,000	.....	40,000	.....	900,000
1890	712,000	.....	50,000	.....	762,000
1891	800,000	.....	100,000	.....	900,000
1892	970,000	.....	115,000	.....	1,085,000
1893	838,000	.....	200,000	.....	1,038,000
1894	882,000	.....	400,000	.....	1,282,000
1895	1,569,500	$50,000	709,000	.....	2,328,500
1896	1,542,000	120,000	800,200	.....	2,461,000
1897	1,709,500	175,000	451,000	$15,000	2,439,500
1898	1,892,000	150,000	400,000	75,000	2,517,000
1899	2,152,000	150,000	500,000	2,800,000	5,602,000
1900	2,606,000	160,000	850,000	4,730,000	8,166,000
1901	2,072,000	180,000	550,000	4,130,700	6,932,700
1902	2,540,600	375,000	800,000	4,561,800	8,283,400
1903	2,843,000	375,000	1,000,000	4,465,600	8,683,600
1904	3,195,800	500,000	1,300,000	4,164,600	9,160,400
1905	3,430,000	500,000	6,900,000	4,800,000	15,630,000
1906	3,500,000	400,000	10,000,000	7,300,000	*21,200,000
Total.	37,450,400	3,135,000	25,081,000	37,062,700	102,749,100

*Production for 1906 is estimated.

The copper production, which in 1905 was valued at $750,000, has so far been only from the coastal zone, and therefore does not affect this discussion. In 1905 4 tons of coal were exported from Alaska, as compared with 30 tons of gold, which strikingly indicates that the coal fields have not yet been exploited. Several thousand tons are, however, mined annually for local use. It is worthy of note that both the Controller Bay and Matanuska coal fields (see map, page 170) carry some excellent coking coals, and, if made accessible by railways, the mining of this character of fuel for smelting of the copper ores is likely to become an important industry.



Map of Alaska, Showing Distribution of Timber

Compiled by Alfred H. Brooks

The custom-house statistics show that $3,272,411 worth of goods were carried to the Alaska Yukon from the United States in 1905, which probably represents between 15 and 20 thousand tons of freight. The cost of the freight on this tonnage amounted probably to over $1,200,000 to the consumer. This sum, allowing three-quarters for operating expenses, would pay probably 5 per cent interest on the cost of constructing 200 miles of railway, or half the distance from tide-water to the Yukon placer camps. I call attention to this to show that, even with the present condition of development, railway projects are not entirely visionary.

The important mineral-bearing area of Alaska falls into four provinces, most of which are undergoing rapid development (see map, page 181). These are (1) the Pacific littoral, (2) the Seward Peninsula, (3) the Sushitna-Copper River province, and (4) the Yukon-Tanana region. The Pacific littoral lies for the most part on tide-water (see map, page 164), open throughout the year, and needs no railway system to develop it, though there are many places where short lines will eventually be built. The Seward Peninsula, which in 1906 produced about $7,300,000 worth of gold, is accessible to ocean-going vessels for fully a third of the year. These, with the 100 miles of railway already in operation and other projected lines, afford means of communication which, while it leaves much to be desired, yet is sufficient to enable large mining operations to be carried on.

THE NEW YORK TO PARIS RAILWAY

Plans for the construction of the so-called New York to Paris Railway, across Alaska and Siberia, have found some earnest advocates during the past few years. Though this project rather falls outside of the present discussion, yet it deserves mention, if for no other reason than for the publicity it has received. Alaska can obviously not be connected with the United States by rail except by a line through Canadian territory (see map, page 176). When the new Canadian transcontinental railway, known as the Grand Trunk Pacific, which is to reach to the Pacific coast in latitude 54°, is completed, a branch could be extended northward, which could reach Fairbanks with 800 to 1,000 miles of track. While such a line would not encounter any serious obstacles, yet many watersheds would have to be crossed, and as it would run transverse to the larger drainage channels, there would be heavy expense for bridges. A railway from Fairbanks to Cape Prince of Wales would require at least 600 miles of track. It is proposed to tunnel Bering Strait, which is 54 miles from headland to headland, but is broken by the Diomede Islands, lying about half way between (see map, page 176). While tunnels of the length required are probably not an impossible engineering feat, they are so far beyond anything of the kind as yet attempted that it must be a bold group of capitalists who would undertake it. Ferriage across the strait, difficult in summer because of the strong northerly setting current, is impossible during seven or eight months in the year because of the ice floes. As the strait seldom freezes over, communication without a tunnel would be entirely interrupted.

This intercontinental railway project, divested of its glittering generalities, amounts to this: The first 1,000 miles of track would parallel the Pacific seaboard and reach a point less than 500 miles distant from tide-water by a more direct route. An additional 600 miles of track would be needed to reach Bering Strait, and this, too, would be in direct competition with deep-water navigation for at least a third of each year. Furthermore, to connect the two sides of the strait, as proposed, would require two tunnels more than twice as long as any hitherto constructed. The Siberian part of the route would appear to have even less justification, for here 1,500 to 2,000 miles of unsettled and unproductive territory would have to be traversed.

URGENT NEED OF RAILWAYS IN COPPER RIVER DISTRICT

Whatever the future may bring forth leading to a demand for railway connection with Seward Peninsula, it is certain that there is at the present moment an urgent need for railways between the Gulf of Alaska and the inland region lying to the north. Only by such railways can the copper and gold deposits of the Sushitna and Copper rivers and the placer fields of the Yukon reach their full development. Here is an area about 400 miles square, bounded on the east by the international boundary, on the north by the Arctic Circle, on the west by the 154th meridian, and on the south by the Pacific, which contains, as has been shown, valuable copper deposits, the best of the known Alaskan coal fields, as well as extensive areas of auriferous gravels. Good grass land is abundant and cattle-raising can probably be profitably carried on to supply the local market, which is sure to arise with mining developments. The agricultural values, though of interest to the economist, will probably be disregarded by the capitalist, who will look to the development of mines for returns on his venture. Certainly without the ore and coal deposits there would be no railways, and without these there will be no agriculture until more accessible regions are settled.

Though now the annual mineral output of this province is only about $10,000,000 in gold, there appear to be great possibilities in the way of mining developments, provided it can be made accessible to commerce.

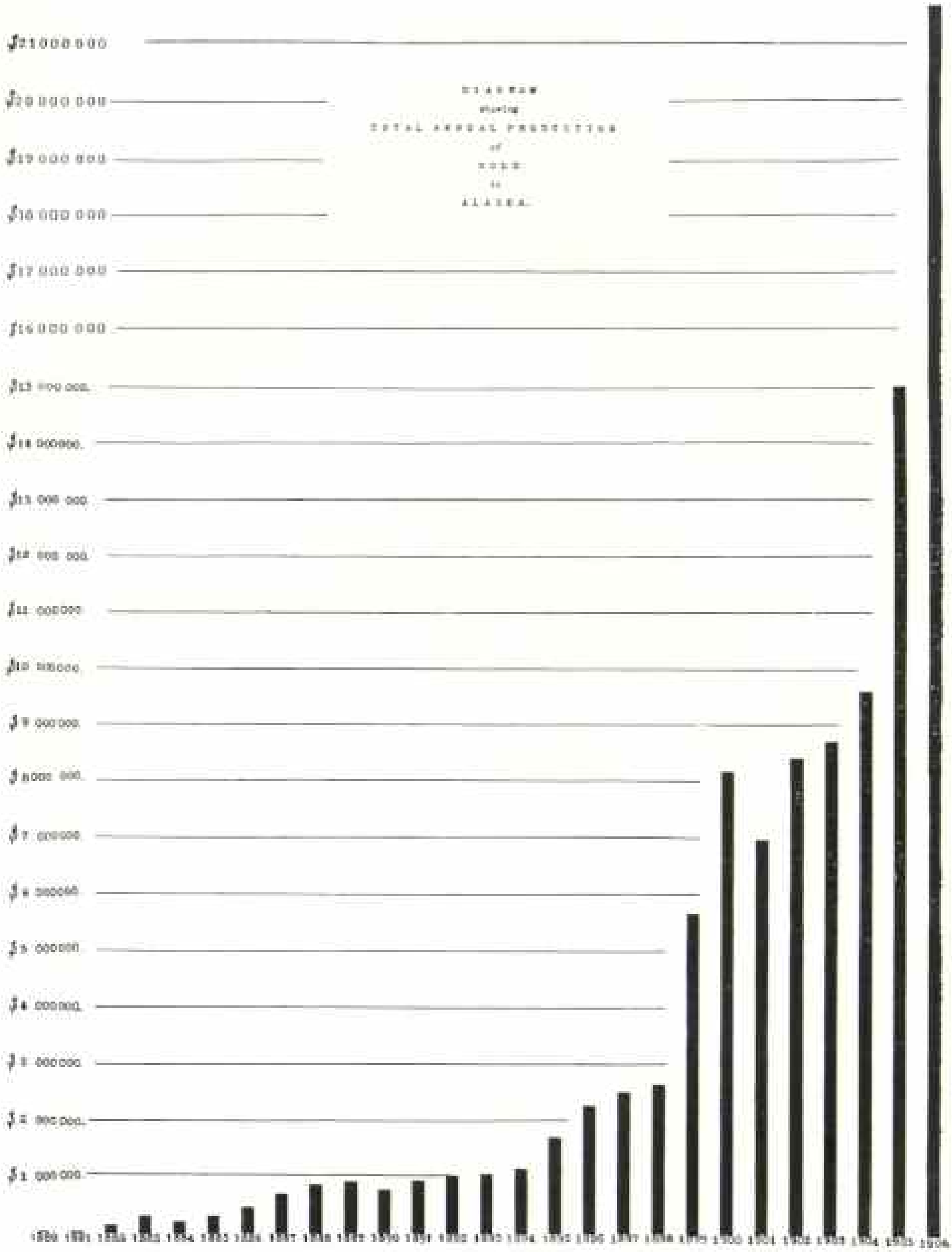
The mining districts of the Sushitna-Copper River province are only accessible by an overland journey of 100 to 300 miles, for the rivers which empty into the Pacific are for the most part torrential in character and but few are navigable. All the supplies for these districts have to be sledded in during the winter months, at a cost of 10 to 20 cents a pound. The charges for summer transportation by pack-horse are from 30 cents to a dollar a pound.

PRESENT LONG WATER-ROUTE TO FAIRBANKS DISTRICT

In the Yukon Basin conditions are somewhat more favorable, because of the extensive system of navigable waters (see map, page 164). Before the freight reaches the Yukon, however, it has to make a circuitous route to the mouth of the river, open to navigation only from the end of June to September. During summer months Yukon River steamers can deliver freight to points 20 to 100 miles distant from the placer districts. This freight must await the winter snow before it can be finally sledded to its destination, unless the summer charges of 20 to 25 cents a pound are to be paid. Under these conditions, freight which is moved by the cheapest form of transportation (by steamer in summer and sleds in winter) costs the miner from 5 to 10 cents a pound, delivered at his mine. Translated into terms more familiar to the average man, this means that the mine operator may have to pay a rate on all his heavy machinery equivalent to the charges for express between New York and San Francisco. In fact, I have known mining enterprises to be carried on in localities to which the transportation charges were greater than letter-rate postage. Under such conditions it is evident only deposits of extraordinary richness can be exploited, and that most extensive mining operations must await the reduction of costs that can be brought about only by the construction of a railway.

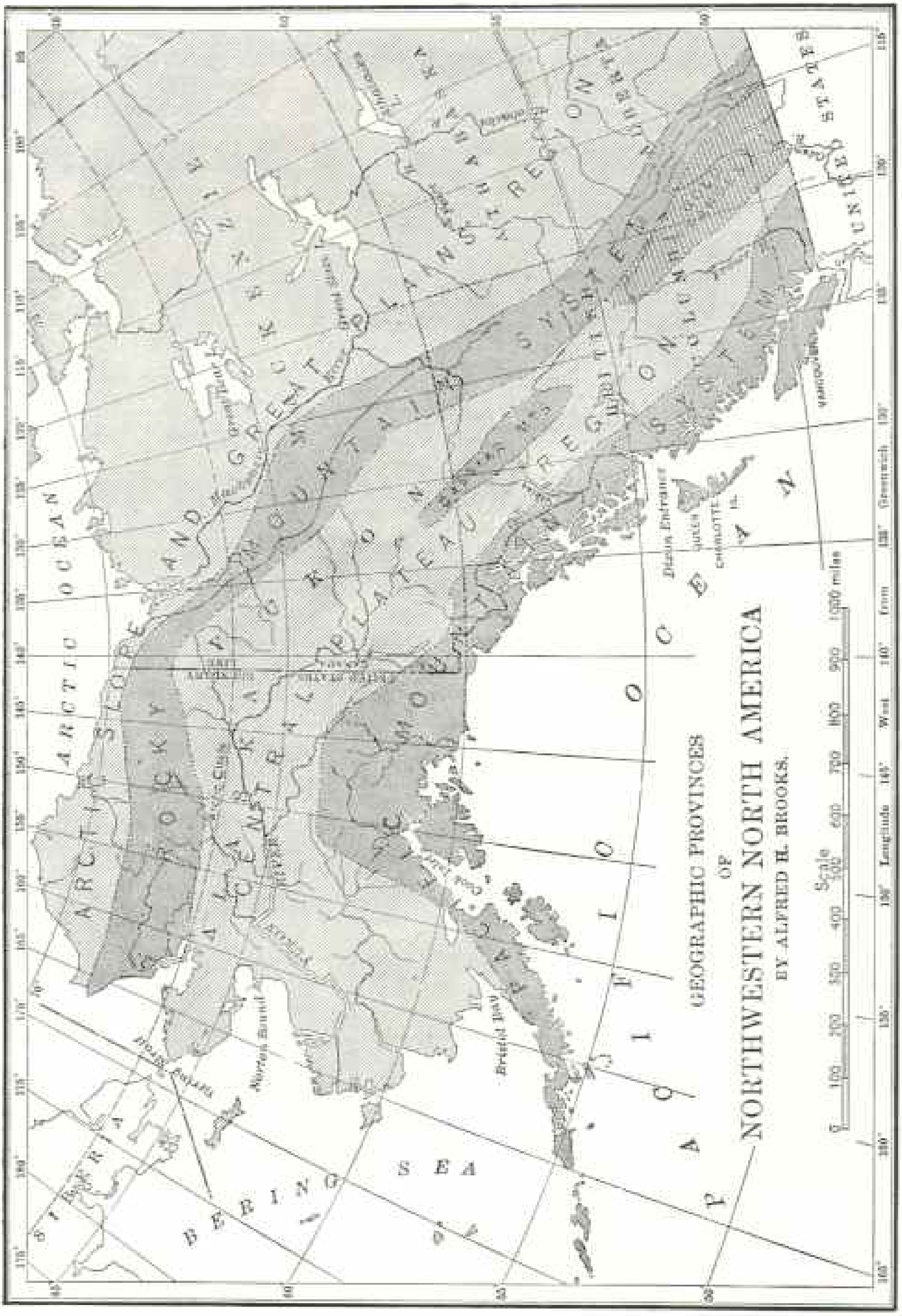
GEOGRAPHIC CONTROL

Having set forth the facts which go to indicate that the resources of central Alaska are sufficient to warrant the construction of a railway, it is in order to consider the question of geographic control of routes. It has been shown that the present demand for transportation facilities is in the province lying between the international boundary and the 154th meridian, and this district will here alone be considered. The rugged mountain mass skirting Alaska's southern border



Annual Production of Gold in Alaska Since 1880

The total amount is considerably over $100,000,000


GEOGRAPHIC PROVINCES
OF
NORTHWESTERN NORTH AMERICA
BY ALFRED H. BROOKS.
ARCTIC OCEAN
BERING SEA
Scale
1000 miles
Greenwich

presents a serious barrier to inland travel (see plate, page 184). This zone, including a number of parallel ranges forming the Pacific Mountain system of Alaska, but 50 miles in width at Lynn Canal, broadens out to the northwest, and at Cook Inlet attains a width of over 200 miles. Inland of this system lies another province of far less relief, which has been termed the Central Plateau region (see map, page 176). The drainage of this central region is carried, for the most part, to Bering Sea through the Yukon River, while the waters of the Pacific Mountain province flow southward and through the Chilkat, Copper, Susitna, and smaller rivers to the Pacific. One river alone, the Alsek, finds its source in the Central Plateau region, and traverses that entire Pacific Mountain system on its way to the sea. Obviously the valley of the Alsek is from a topographic standpoint the only logical railway route into the interior. It will be shown, however, that the commercial and political factors are so adverse in case of the Alsek Valley as to appear to rule it out.

Besides the valleys of the larger rivers, already mentioned as flowing into the Pacific, there are a number of low passes breaking through the mountain barriers. Among the most important for the present discussion are the White Pass (2,800 feet), a break in the Coast Range north of Lynn Canal, across which a railway has already been built. At the head of the Chilkat River, whose valley separates the Coast and Saint Elias ranges, there is an unnamed pass about 3,100 feet high (see profiles, page 179). West of Lynn Canal the coastal range represents an almost unbroken front, except for the Alsek and Copper River valleys. At the inland front of the Saint Elias Range the Alsek Valley has an altitude of about 2,000 feet, and is connected with the drainage basin of the White River to the west by a pass but 2,400 feet high.

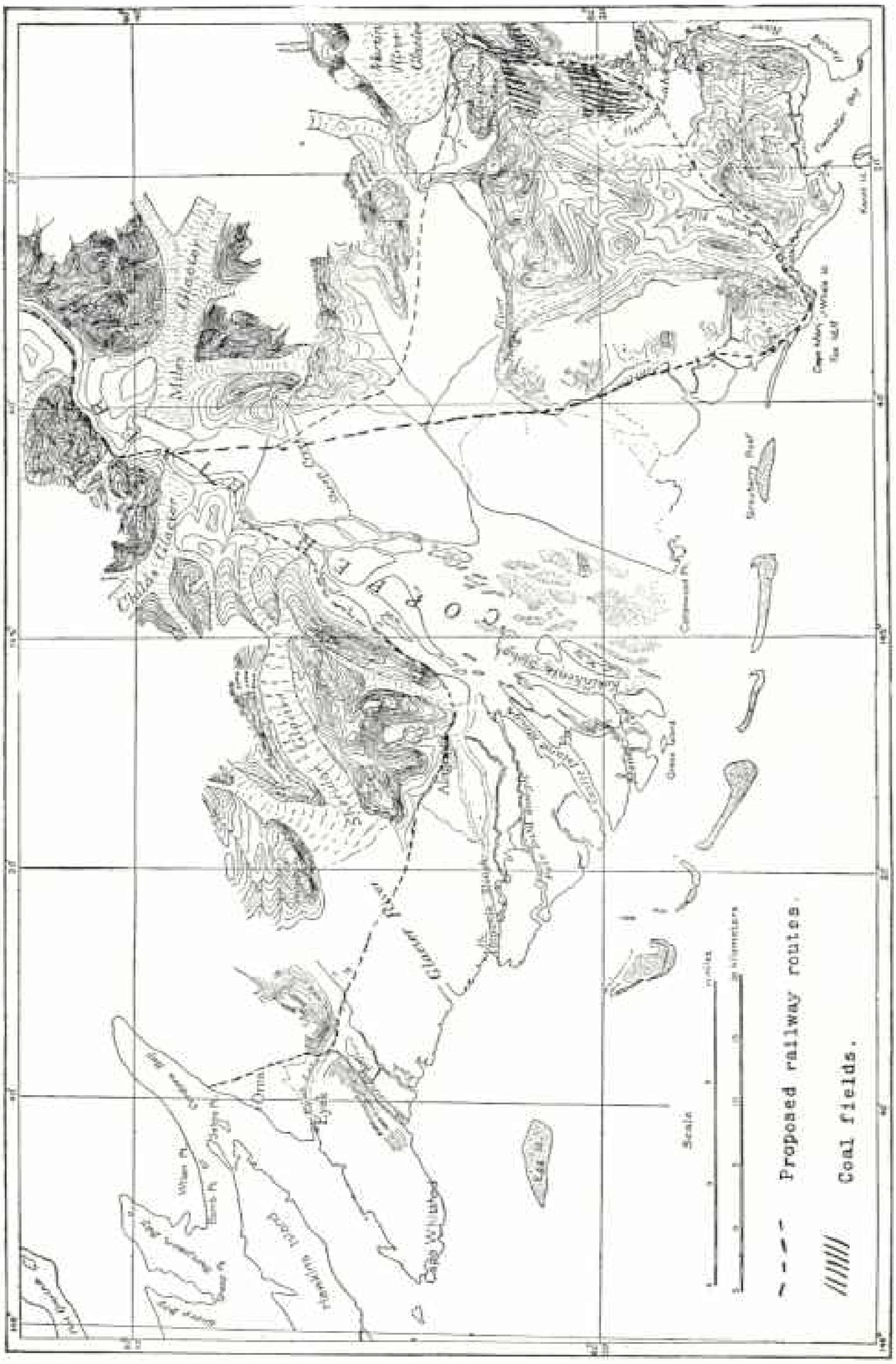
Low River, which empties into Valdez Inlet of Prince William Sound, is separated from the Copper River by Marshall Pass, about 1,900 feet high. At the head of the Copper there are several passes leading into the Tanana Valley, of which the lowest is called Mentasta (3,000 feet), and the next, which is unnamed, connects the Gulkana and Delta valleys. Both of these passes are through the eastern end of the Alaska Range, and one or the other will be used by any railway built from the Copper Basin into the Tanana Valley.

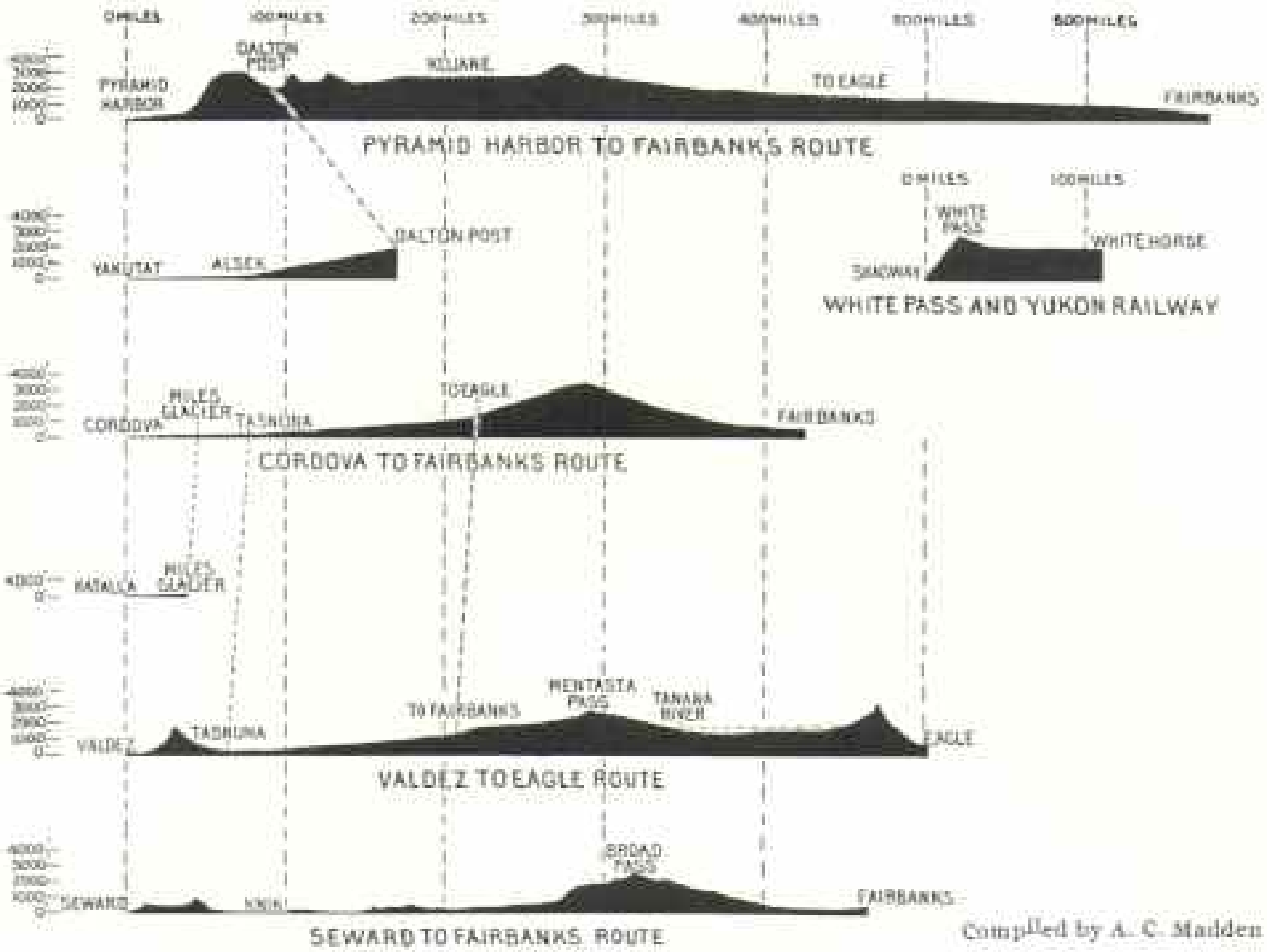
It will be evident from the matter presented that commercial control limits the choice of inland railway routes to the region lying between Lynn Canal on the east and Cook Inlet on the west (see map, page 181). Topographic control, furthermore, limits the choice to four general zones, which may be named after the chief rivers, whose valleys determine the location. These are named from south to north: (1) the Chilkat basin, (2) the Alsek basin, (3) the Copper basin, and (4) the Susitna basin.

The first requisite for an inland railway from the Gulf of Alaska is an adequate coastal terminal. This means not only a deep-water harbor, but also opportunity for construction of wharfs, as well as a townsite near at hand. Other desirable, though not absolutely necessary, conditions are available timber, water power, and a favorable climate. If possible, the harbor should be accessible to sailing as well as steam vessels, and the routes of approach should be devoid of dangers to navigation; but, beside all these desirable attributes, the distance of the coastal terminal to the points of shipment on the west coast of the United States is of first importance.

HARBORS

The recent geological history of the Pacific shore-line of Alaska is favorable to the formation of harbors, for it is a glaciated region, and, as many have shown, glaciation produces fiorded coast lines. This is, however, only true where sedimentation subsequent to glaciation has not silted up and smoothed out the coast line. The first condition prevails


Topographic Reconnaissance Map from Controller Bay to Prince William Sound
Proposed railway route
Coal fields.
Scale
Miles
Kilometers
Copper River
Valdez
Cordova
Orca
Latouche
Knight Island
Hinchinbrook Island
Montague Island
Green Island
Port Wells
Unakwik Inlet
Port Fidalgo
Port Gravina
Port Etches
Port Valdez
Valdez Arm
Valdez Glacier
Lowe River
Tasnuna River
Tasnuna Glacier
Klutina River
Klutina Lake
Klutina Glacier
Chitina River
Chitina
Copper River
Miles Glacier
Childs Glacier
Heney Glacier
Scott Glacier
Allen Glacier
Martin River
Martin Glacier
Bering Glacier
Bering Lake
Bering River
Controller Bay
Katalla
Eyak Lake
Eyak
Alaganik
Alaganik Slough
Chilkat Inlet
Chilkat Pass
Chilkat River
Chilkoot Pass
Chilkoot Inlet
Dyea
Skagway
Skagway River
Taiya Inlet
Lynn Canal
Pyramid Island
Pleasant Island
Douglas Island
Juneau
Gastineau Channel
Admiralty Island
Chatham Strait
Peril Strait
Sitka
Baranof Island
Kruzof Island
Salisbury Sound
Hoonah
Icy Strait
Cross Sound
Glacier Bay
Muir Glacier
Muir Inlet
Geikie Inlet
Tarr Inlet
Johns Hopkins Glacier
Johns Hopkins Inlet
Wood Canal
Disenchantment Bay
Haenke Island
Nunatak Fiord
Nunatak
Hidden Inlet
Yakutat Bay
Yakutat
Ocean Cape
Kayak Island
Kayak
Kayak Island
Kayak Island
Kayak Island
Kayak Island



Generalized Profiles of Proposed Railway Routes

in southeastern Alaska and on Prince William Sound, where the coast is characterized by deep fiords with many tributary embayments (see map, page 176). In the intervening region the retreat of the larger ice-sheet left many large glaciers on the coastal slope of the Saint Elias Range and in the Piedmont belt, and these, having access to bed rock along their margins, have contributed a large amount of sediment. This sediment has been deposited as extra-glacial material and has buried much of the fiorded coast line. Therefore the physiographic features make southeastern Alaska or Prince William Sound the most favored locality for coastal terminals.

Other factors have to be considered. Lynn Canal is a superb deep waterway, but its funnel shape causes it to be subject to severe wind-storms, and it is therefore not favorable for sailing vessels. The same holds true, in a less degree, of the upper part of Prince William Sound. Resurrection Bay, which penetrates the mainland to a much shorter distance, affords an almost ideal harbor. Though the shore-line between southeastern Alaska and Prince William Sound is not favorable for harbors, yet two indentations, Yakutat Bay and Controller Bay, furnish some protection for vessels (see map, page 178).

In the comparison of distances it will be convenient to use Puget Sound as a reference point (see map, page 176). Lynn Canal is less than 1,000 miles (statute) from Puget Sound, as compared with 1,150 for Yakutat Bay, 1,350 for Cordova Bay, 1,400 for Valdez Inlet and Resurrection Bay. The route to Lynn Canal is by an intricate and somewhat dangerous inland waterway, and the

actual time consumed in the voyage is not very much greater to the western harbors than to Lynn Canal. As regards climate, there is little to choose between the various coastal terminals. Throughout the Pacific seaboard there is a heavy precipitation, varying from about 90 inches on Lynn Canal to about 125 inches in Prince William Sound. Heavy storms are usually from the southwest, and more commonly occur from October until May. As soon as the mountains are entered, very heavy snowfalls are to be expected. The coastal belt is usually heavily forested with timber which can be used in construction.

It remains to describe the individual routes and compare their respective advantages. For this purpose the general location of the different routes has been indicated on the map (see page 181), together with their relation to the mountain barriers and to the distribution of the known mineral resources. Profiles (page 179) have also been constructed of the more important projects, and these have been grouped together for purposes of comparison. It should be distinctly stated, that while in the construction of these profiles the best available data has been assembled, yet this is so incomplete that the results must be regarded as an approximation. Many of the distances and altitudes here presented will undoubtedly be found inaccurate when detailed surveys are made.

PYRAMID HARBOR, TANANA RIVER

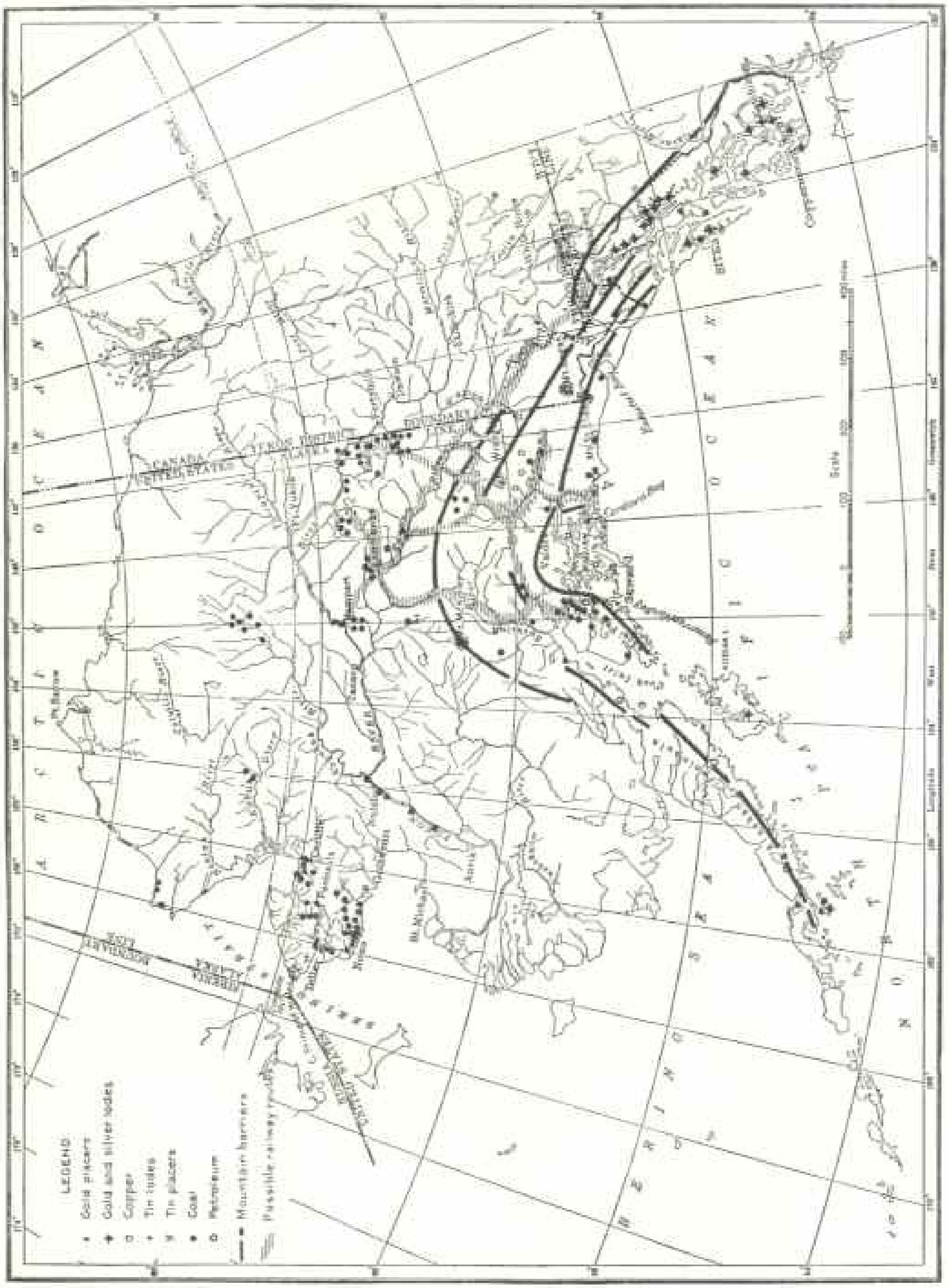
Chilkat River debouches into a western arm of Lynn Canal, called "Pyramid Harbor," and its valley separates the Saint Elias Range on the west from the Coast Range on the east. A broad pass about 3,000 feet high, 50 miles from the coast, separates its headwaters from inland-flowing streams. Beyond this pass the route would enter the Alsek basin and follow the inland front of the Saint Elias Range. Two forks of the Alsek will have to be crossed, but present no serious engineering difficulties. A series of depressions, part of a system of abandoned valleys, affords an ideal railway route beyond the west fork of the Alsek. The route would probably skirt the south shore of Lake Kluane 2,400 feet above sea-level and enter the White River Valley near the international boundary. After crossing White River at the canyon the line would be extended through a broad, flat depression to the Tanana Valley, which would be followed to Fairbanks. As indicated in the profile, there are no very heavy grades to be overcome in this route. Branch lines could be built to the copper deposits of the White River and to the Fortymile, Birch Creek, and Rampart placer districts.

Pyramid Harbor, which affords shelter for vessels and opportunities for wharf construction, can be reached by a 1,000-mile journey from Puget Sound, entirely within sheltered waterways. The Chilkat basin is well timbered (chiefly spruce and hemlock) (see map, page 172) and contains some auriferous gravels, though the producing district lies somewhat off the proposed railway route. The copper deposits of Rainy Hollow, which are undeveloped, lie about 20 miles off the main route. In the inland region there are no developed mineral resources except a small placer district. However, the meager knowledge of the geology indicates that there may be here a continuation of the mineralized belt of southeastern Alaska, and that workable ore deposits may yet be found.

There can be no doubt that this is a natural route into the interior, and it was long used by the natives in their intertribal intercourse. It has one grave disadvantage, namely, that for about 300 miles it traverses Canadian territory, and would therefore not afford an all-Alaskan route. Under the custom laws, international railways are always at a disadvantage. Moreover, it would not help to develop the resources of the Copper River and Sushitna River basins.

YAKUTAT BAY-ALSEK-TANANA RIVER ROUTE

The lower Alsek River valley, which is transversed to the Saint Elias range, affords a possible route into the interior.



Map of Alaska Showing Railway Routes and Known Occurrences of Economically Important Minerals

Compiled by Alfred H. Brooks

The line would run southeastward from Yakutat Bay for about 50 miles, to the mouth of the Alsek. A narrow-gauge railway has already been built for about 10 miles of this distance, for the purpose of bringing fish to the salmon cannery at Yakutat. The Alsek Valley is almost unexplored, but no doubt a railway could be built through it. It would intersect the Pyramid Harbor-Tanana route about 200 miles from the coast, and would there attain an altitude of about 2,400 feet (see profile, page 179).

Yakutat Bay, which is about 1,150 statute miles (1,000 nautical miles) by sea from Puget Sound, is only a fair harbor, and, so far as known, the proposed railway would not tap any mineral deposits, though such may exist in the unexplored Saint Elias Mountains. At 170 miles from Yakutat it joins the Pyramid Harbor route, and is open to the same objection, inasmuch as it passes through Canadian territory.

CORDOVA BAY, OR CONTROLLER BAY, COPPER RIVER

Cordova Bay, an eastern arm of Prince William Sound, lies about 30 miles west of Copper River. A railway, now in construction, is to follow a route skirting the coastal margin of the mountains to the Copper River, and then, turning northward, to traverse the Chugach Mountains through the valley of that river. A distance of about 200 miles will bring it to the mouth of the Chitina, and with 100 miles more of track it will be able to tap the copper belt, which skirts the southern margin of the Wrangell Mountains. The route to the mouth of the Chitina follows the river grade, and there are no serious engineering difficulties, with the exception of the two bridges, 800 and 1,200 feet in length, which will have to be built across the Copper to avoid the Miles and Childs glaciers (see illustration, page 190).

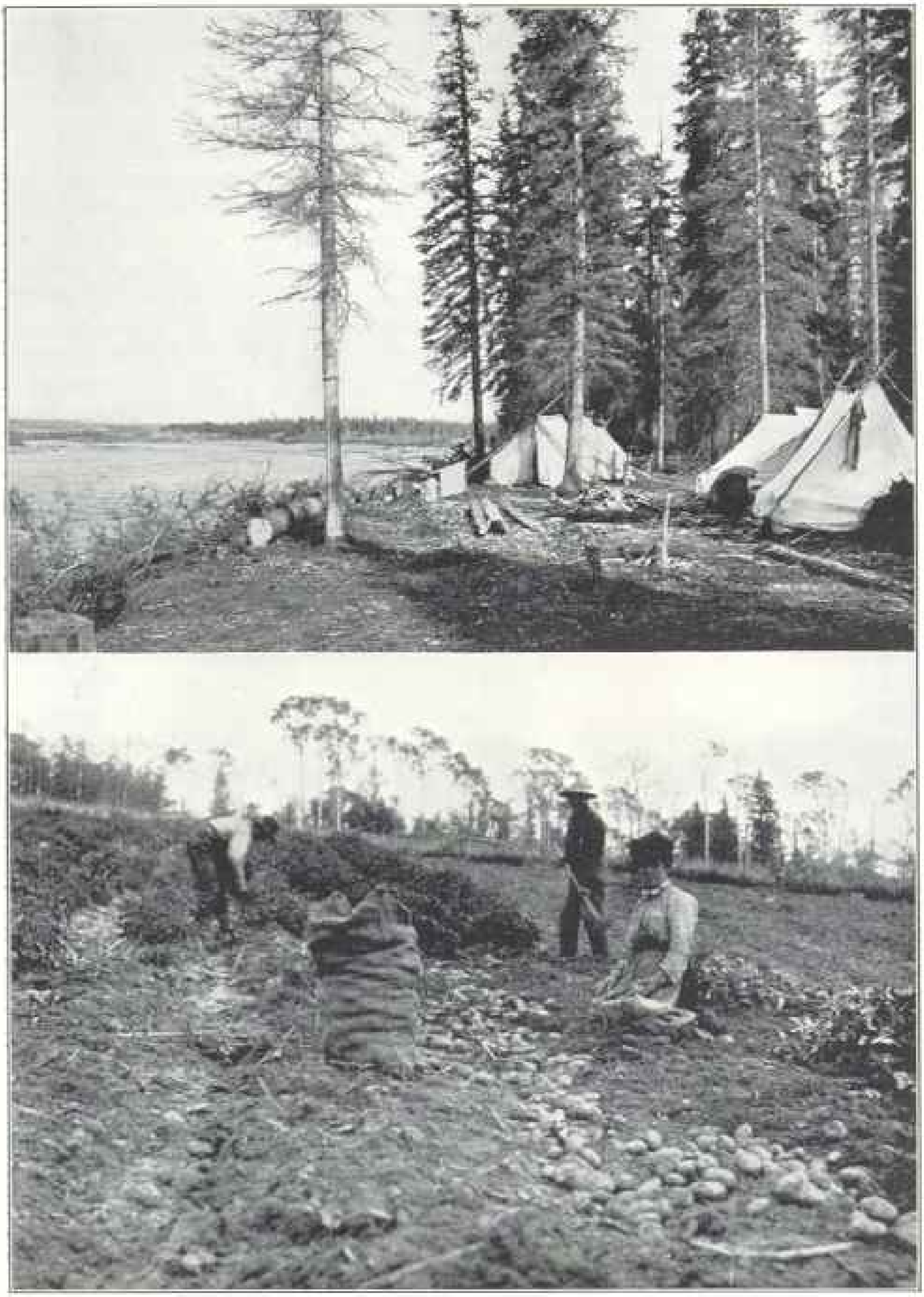
A corollary to this plan is to construct a branch line about 35 miles in length from the Copper River to the Controller Bay coal field (see map, page 178).

A rival company has made a survey for a railway from near the mouth of Katalla River, 30 miles east of the Copper, which is to run northwestward to the head of the Copper River delta. A single bridge will be needed to avoid the glaciers, beyond which point the route will coincide with the one above described. This route has the advantage of the one above described, inasmuch as it is somewhat shorter and has to bridge the Copper but once. Katalla is only 1,200 miles distant from Puget Sound, as compared with 1,350 for Cordova Bay. On the other hand, at Cordova there is an excellent natural harbor, while at Katalla a breakwater will have to be constructed. On the other hand, again, a harbor at Katalla would serve the Controller Bay coal field. Whichever line is built, certain it is that there is not room for two railways along this Copper River route.

VALDEZ-COPPER RIVER ROUTE

An alternate plan for reaching the copper belt of the Chitina region is to build a railway from Valdez. Valdez Inlet, a northeastern arm of Prince William Sound, is 1,400 miles distant from Puget Sound. Surveys have been made and some construction work has already been done on two railway projects which are planned to cross Marshall Pass, about 1,900 feet high and 30 miles from Valdez, and thence down the Tasnuna River to the Copper (see profile, page 179). From the mouth of the Tasnuna the route would correspond with the route up the Copper River. The distance from Valdez to the mouth of the Chitina is about 20 miles less than from Cordova, but a pass 1,900 feet in height has to be crossed; on the other hand, two expensive bridges over the Copper would not be needed. This line would not reach the Controller Bay coal field.

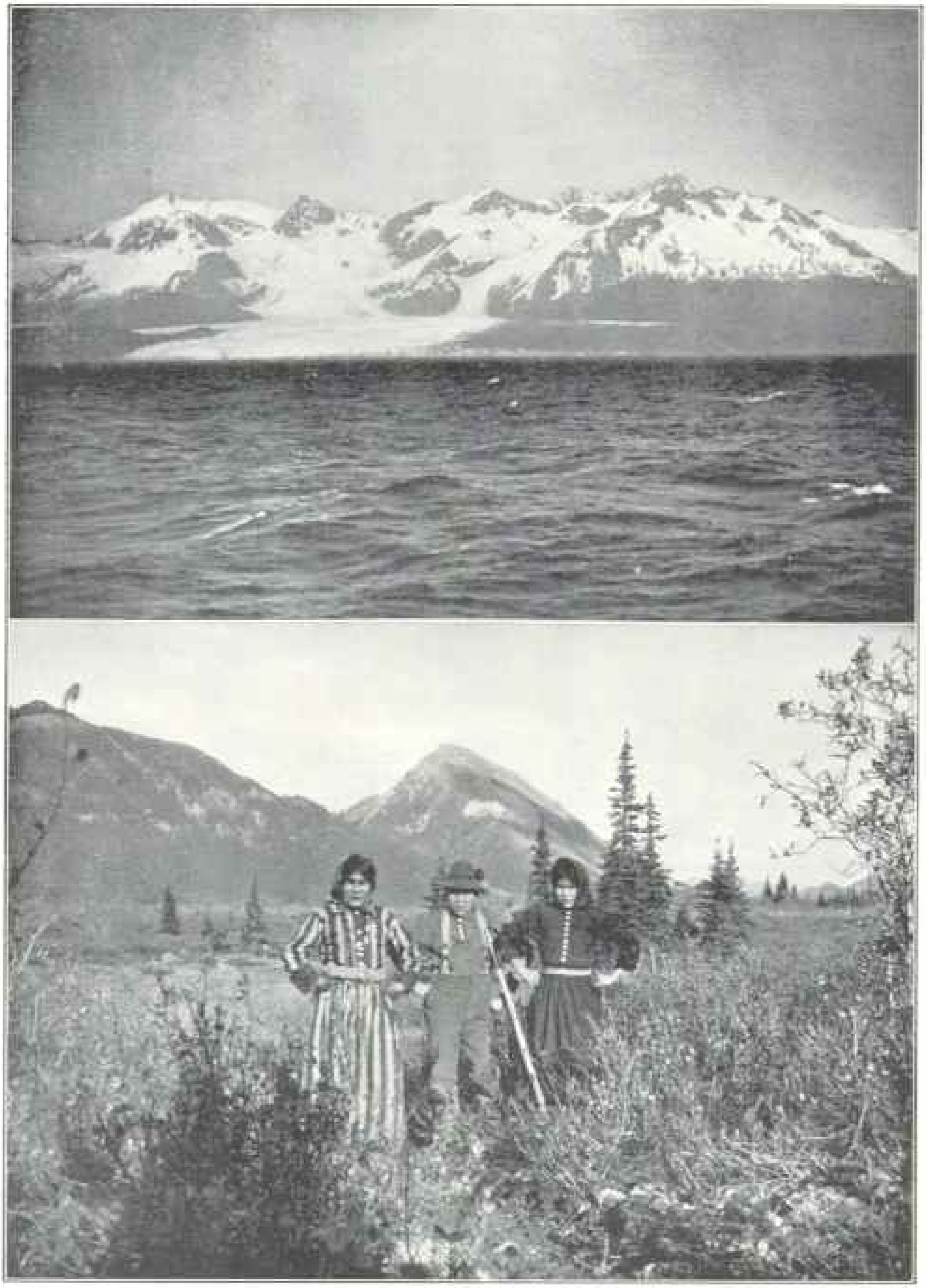
Most of the railway projects into the Copper River have been planned with the ultimate object of extension into the Yukon basin. Some of these have chosen Eagle, other Fairbanks, as their ultimate objective point. Of the two, Eagle ap-



Photos by W. C. Mendenhall and L. M. Prindle

Camp on Bank of Copper River, Showing Character of Timber

Potato Patch at Baker Hot Springs, Tanana Valley



Photos by G. K. Gilbert and F. C. Schrader

Mt Perouse and Glacier

A typical view of the coastal barrier of Alaska

Mentasta Pass, on the Railway Route from Copper River to the Yukon

pears to be the less logical, as a line built to it would pass through the eastern part of the auriferous district, while Fairbanks is much more central.

From the mouth of the Chitina a line to Eagle would follow the Copper River valley and cross to the Tanana through Mentasta Pass, 2,900 feet high (see illustration, page 184). Crossing the Tanana Valley, the line would enter an upland region not well known and would probably have to cross two passes, 3,000 feet high, before it descended to the Yukon.

A line to Fairbanks would be built up the Copper and Gakona River valleys across a pass 3,000 feet high, and down the Delta to the Tanana. Crossing that stream, it would continue down it to Fairbanks.

RESURRECTION BAY-SUSITNA VALLEY ROUTE

The upper waters of the Susitna River, which empty into Cook Inlet, are separated by a broad, low pass, about 2,400 feet high, from the Nenana, or Cantwell, River, which flows into the Tanana. This is one of the lowest depressions in the watershed between the Pacific and the Yukon.

Unfortunately the upper part of Cook Inlet is closed by the winter ice, so that a coastal terminal would have to be sought on the east side of the Kenai Peninsula, which separates Cook Inlet from the Pacific. Such a one has been found in Resurrection Bay, an excellent harbor, 1,400 miles distant from Puget Sound. Here the town of Seward was located two years ago and construction begun on the so-called Alaska Central Railway, of which about 50 miles has been completed and considerable work done on 20 miles more. This route stretches northward from Resurrection Bay and, crossing a pass, about 1,000 feet high, about 40 miles from the coast, descends again to tide-water at the head of Turnagain Arm. After swinging around Turnagain Arm, it bends northward, crossing the Matanuska near its mouth. Here a branch is to be built to Matanuska coal field, the immediate objective point of the railway (see map, page 170). It is proposed to extend the Yukon trunk line up the Susitna, across the depression above mentioned, down the Cantwell to a terminal which will be on the south side of the Tanana River, near Fairbanks. The total mileage from Resurrection Bay to Fairbanks is about 500. While this route is one of the shortest from the coast to Fairbanks and also has the best grades, it does not tap the copper deposits of the Copper River, and, with the exception of the Matanuska coal field and some placer districts, does not traverse an area now known to carry mineral in commercial quantities.

CONCLUSIONS

The matter presented shows that there is justification for a trunk line railway from the Pacific seaboard to inland points, for it is only by rendering accessible the vast mineral wealth of the interior that its full measure of development can be attained. It is evident that the value of such a trunk line would depend on the construction of many branches and feeders, which have not here been considered. Furthermore, these railways must be supplemented by many wagon roads.

The history of railway expansion in the United States has shown that the natural development is, first, railroads built supplementary to established lines of water transportation; second, the binding together of such auxiliary lines by a trunk system. In Alaska the same evolution is witnessed. The White Pass and Yukon Railway, traversing the coastal barrier, links tide-water with navigable waters of the Yukon system. The heavy traffic being all down stream, what should be a comparatively cheap form of transportation is established to Dawson, a distance of 700 miles. A placer field such as the Klondike yields practically no outgoing tonnage. When, however, lode or coal mines are developed, there is a return traffic which the upstream river steamers cannot handle economically. Moreover, freight shipped to Alaskan points on the Yukon must run the gamut

of two custom-houses, with all the attending annoyances of delays and formalities. It should be remembered, too, that the route to Fairbanks *via* the White Pass Railway involves the transhipment of freight at White Horse to Canadian steamers, a journey of 500 miles to Dawson, then a transhipment to American boats and another journey of 800 miles, of which 200 miles is upstream. If good connections are made, some eight days are consumed in going from tide-water on Lynn Canal to Fairbanks, which by a direct line could be reached in 450 miles. As a rule, freight is at least a month in transit. The journey up the river, while it avoids one transhipment, involves changing from ocean vessels to river steamers at the mouth of the Yukon, and then a 1,200-mile upstream journey. Moreover, these routes are only open from the first of June to the middle of September. It would seem, therefore, that if the resources of the Yukon are sufficient to warrant the construction of a railway, such a railway should hold its own against the competition of water transportation. In any event, a railway into the Susitna-Copper River province would encounter no competition with steamboat transportation.

Considered geographically, the routes described fall into two classes, namely, the one comprising those parallel to the lines of height, and the other those transverse to the lines of height. In the first group belong the trans-Alaskan-Siberian line, the Lynn-Canal-Fairbanks line, together with its alternate, the Alsek-Fairbanks line.

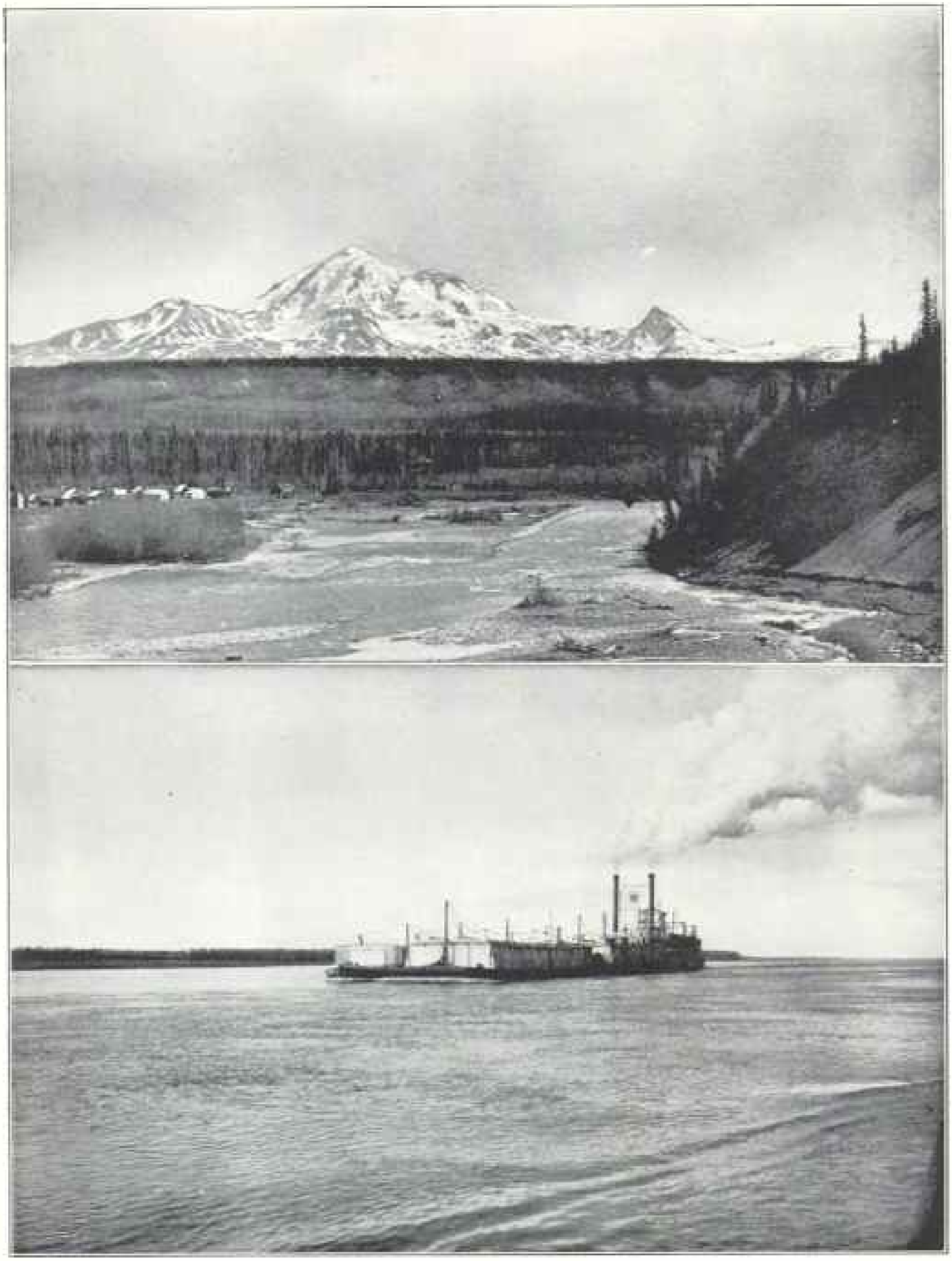
These routes, as has been shown, are parallel to the dominant axes of uplift, and therefore harmonious with the topography. As a matter of fact, however, pioneer railways are usually transverse to the watersheds, for the reason that they are located to supplement and not to supplant water transportation. The history of railway development in the United States shows that piedmont lines are the last to be built. A railway parallel to the inland front of the Saint Elias range would traverse a series of abandoned valleys such as are everywhere recognized as ideal topographic conditions.

Geographically, therefore, these routes would appear to have the advantage, and would, moreover, render accessible a large area in the interior of Alaska and northwest Canada not reached by any railways of the other group. When, however, the *developed* resources are considered, they are at a disadvantage, for while they would tap the upper copper-bearing region, they would reach neither the valuable southern copper belt nor the coal fields.

The transverse lines, including the Copper and Susitna routes, appear, as has been shown, to follow the laws which govern the location of pioneer railways; that is, they cross the watersheds and connect existing lines of water transportation.

In any event, it is clear that a properly located transverse line must follow one of the rivers which traverses the coast ranges. Two such railways, one up the Copper and one up the Susitna, are already under construction. The rival interests financing the two projects have been loud in claiming that each route was the best. In point of fact, the two supplement each other. It is certain that a railway by way of the Copper River follows the only feasible route to copper deposits of the Wrangell region. It is equally certain that as a route to the Yukon a railway up the Susitna River has the best of it. Again, neither of these lines bisect Alaska as would a railway extending from Lynn Canal to Fairbanks and to the Seward Peninsula.

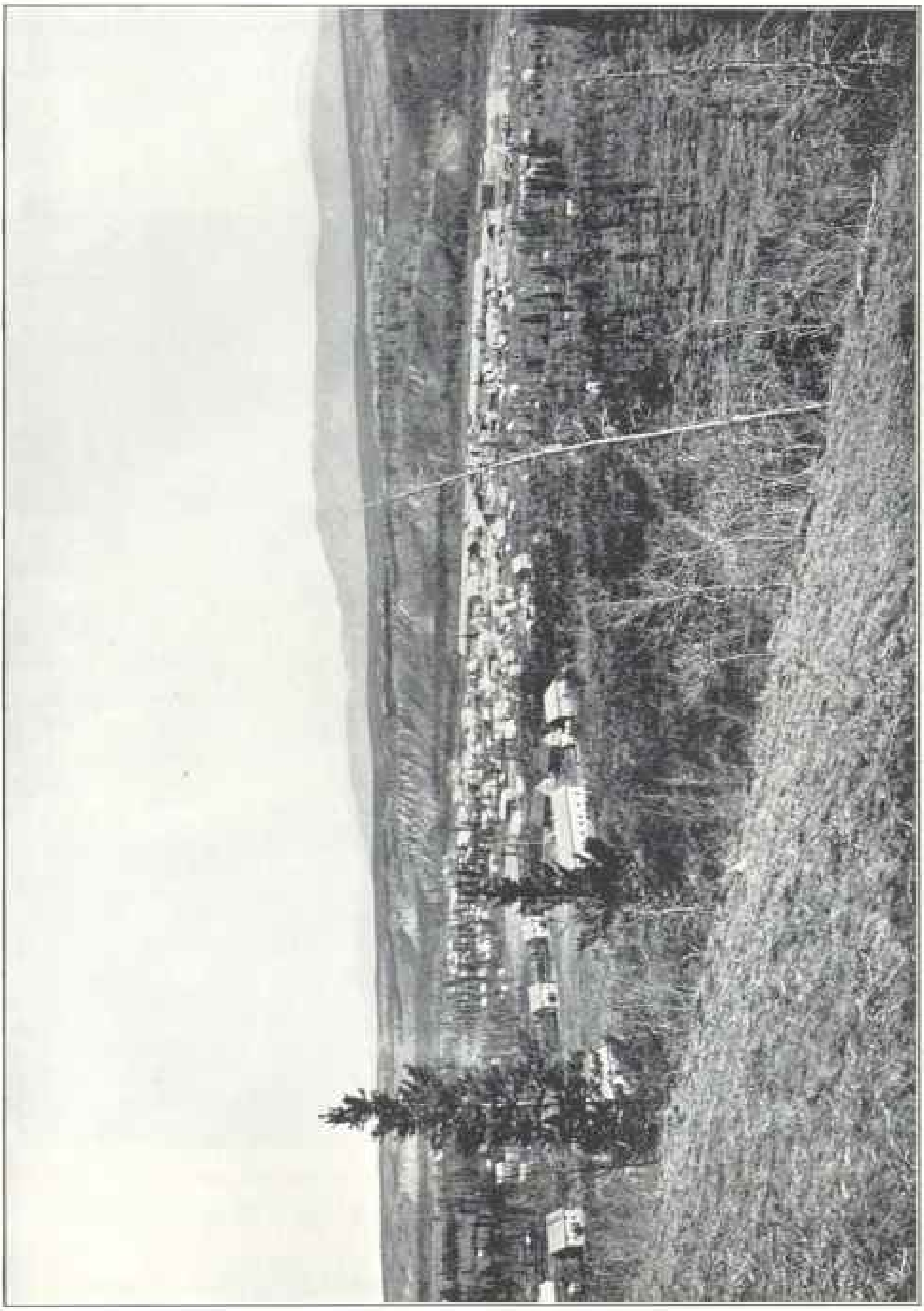
The matter presented in the foregoing pages indicates that more facts are needed before scientific deductions can be drawn of the best route *for immediate construction*. Meanwhile, however, in view of the large amount of capital ready for investment in any promising enterprise, it is only too likely that the problem will be solved by experimentation alone, as has been done at great cost elsewhere; in other words, by the survival of the fittest.



Photos by W. C. Mendenhall and L. M. Prindle

Copper River Valley at Copper Center, on the Railway Route from Copper River to the Yukon

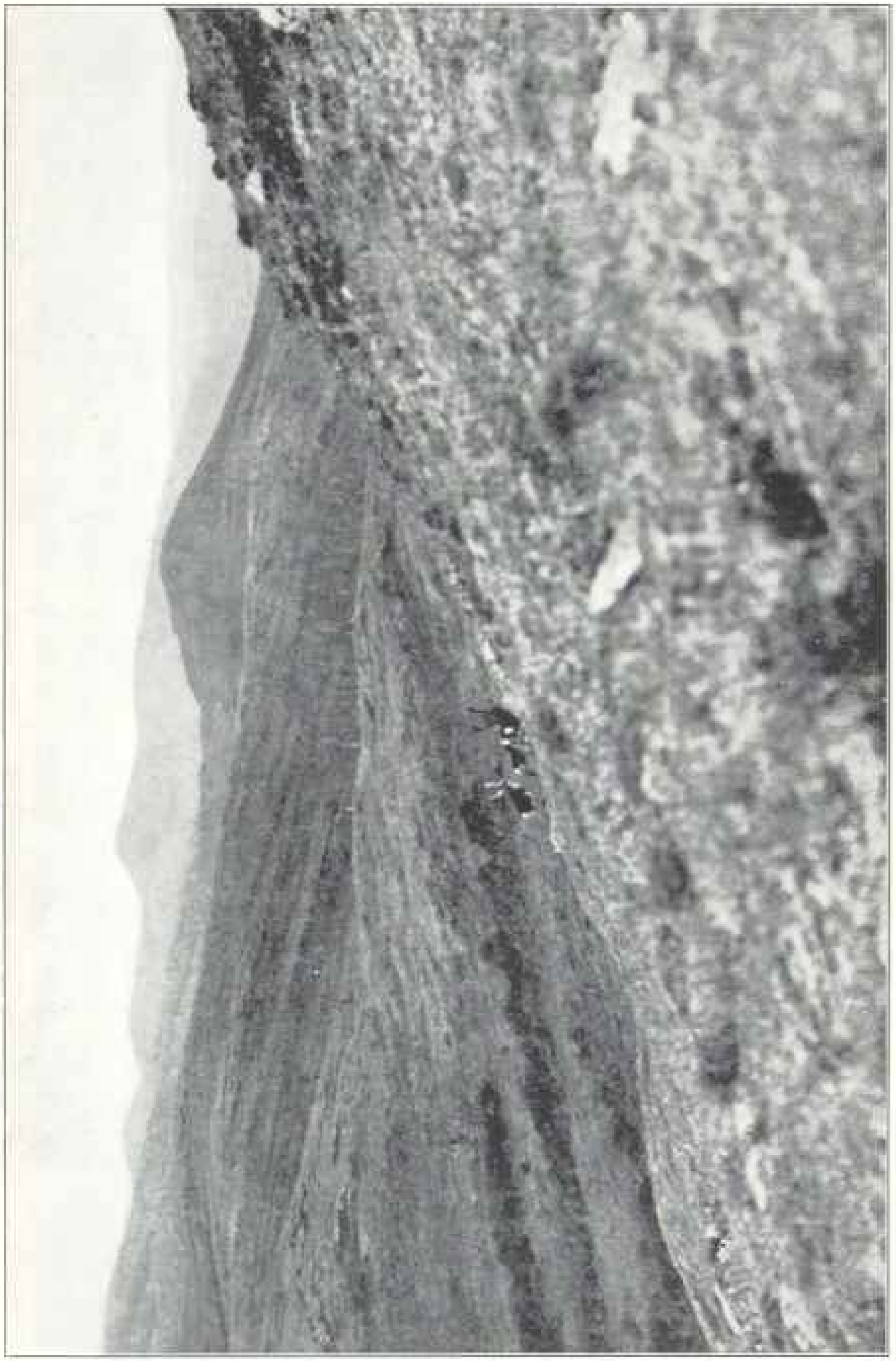
Freight Steamer and Barges on the Yukon River



White Horse, Inland Terminal of the White Pass and Yukon Railway

This town is 6 years old. It is of about the same latitude as St Petersburg

Photo by W. C. Mendenhall



The Interior Plateau Region of Alaska, Charlie River Basin

Photo by L. M. Pilsbury

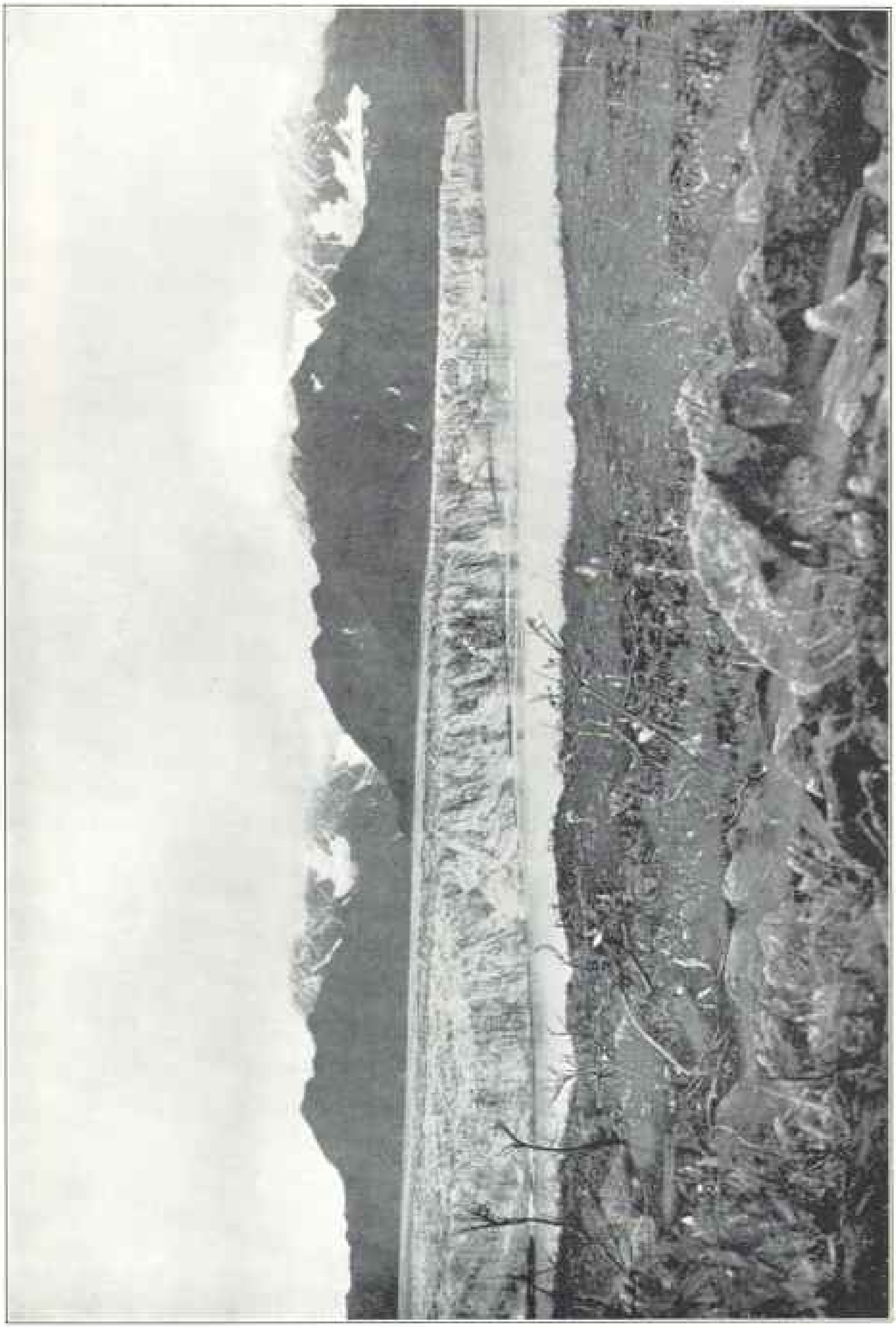


Photo by P. C. Schruder

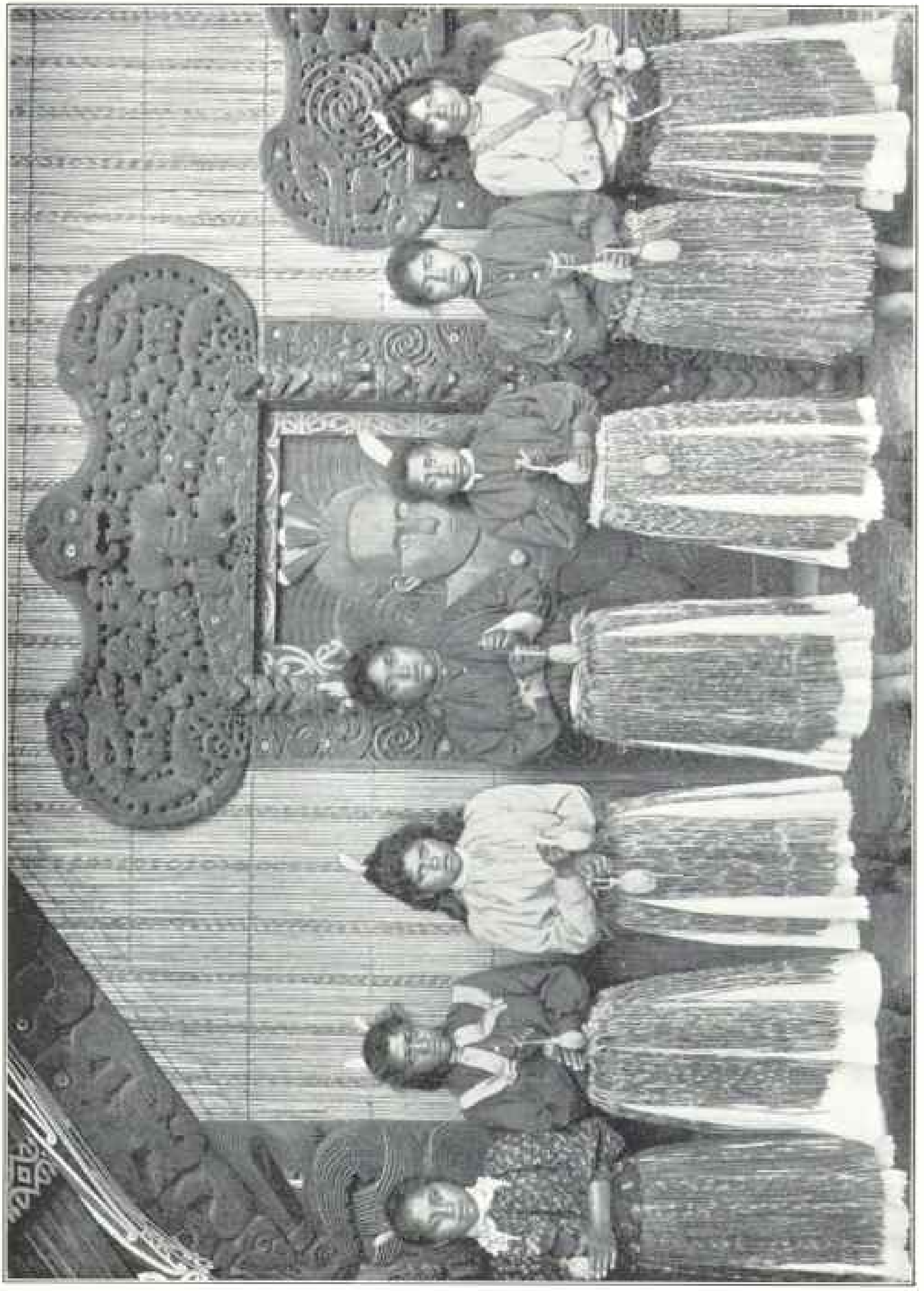
Mlles Glacier, Copper River

A Maori Girl (see page 198)

The Chief of One of the Most Celebrated Maori Tribes, Showing Their Remarkable Tatooing

A Maori Mother and Child

A Maori Hut



A Group of Maori Girls, Maori Carving in the Background

Two Maoris Saluting

The Daughter of a Maori Girl and White Man

THE MAORIS OF NEW ZEALAND

THE Maoris are in many respects the most remarkable savages with whom the white man has come in contact. Fifty years ago cannibalistic feasts, at which the flesh of their fallen enemies was served, were not uncommon. Today several members of their race are members of the New Zealand Parliament, and Maori women, as well as the white women of New Zealand, exercise the right to vote.

When the English first occupied the islands, in the early part of the nineteenth century, it is estimated that there were about 100,000 Maoris in New Zealand. They were divided into tribes, each tribe having its own unwritten laws regarding land, cultivation, and other social matters. The tribes were constantly fighting. The English found that they had a genius for war, showing unusual ability in building, fortifying, and defending stockades, and they experienced considerable difficulty in subduing them. The Maoris were also skilled in several arts: They tilled the soil with great care; as carvers and decorators they were unrivaled in the Oceanic world, and they displayed great originality in the design and perfection in the execution of rock paintings, and in carving the ornamental figures of their dwellings, their boats and sacred inclosures. Many of these objects are carefully preserved in museums.

But the Maoris were also noted for their remarkable tattooing, which was designed to clothe as well as decorate the body. The Maori artist knew how to give endless variety to the curves of his drawings; the natural furrows, the movements of the countenance, the play of muscles—everything was made to enhance the charm of the design; and a hale young man certainly presented a fine sight, draped only in this delicate network of blue lines on the ruddy brown of his skin. Whoever refused to undergo the protracted tortures of tattooing required at every important event of his life was regarded as a person by his own consent foredoomed to slavery. The men were actually depilated in order to increase the surface to be covered with ornamental tattooing, while for young women the operation was limited to the lips, whence the term *Blue lips* applied to them by the English.

There are about 35,000 Maoris left.

Maoris Practicing the Old War Dance

These have retired to the northern provinces of New Zealand, where certain "reservations" have been set apart as their exclusive property. Schools have been established which the Maori children attend regularly. It is said that such of them as continue into the higher branches of learning are worthy rivals of white students. Some of the Maoris have become large landed proprietors; they are proud of their right to vote, and especially of the fact that their women were given this privilege at the same time that it was given to the white women of New Zealand, in 1893.

The preceding illustrations of the Maori of New Zealand were taken by Mr J. Martin, of Auckland, and were sent to this magazine by M. Maurice Loir, editor-in-chief of *Le Tour du Mond*, of Paris.

THE GREAT NATURAL BRIDGES OF UTAH

IN the summer of 1904 the first public announcement was made in the *Century Magazine* and the NATIONAL GEOGRAPHIC MAGAZINE by Mr W. W. Dyar of the discovery in Utah of three great natural bridges, far surpassing in size the great Natural Bridge of Virginia and all other similar bridges known in the world. The article was illustrated from small photographs, and was based on a hurried view of the bridges. Last year a member of the National Geographic Society, Mr Edwin F. Holmes, equipped an expedition with surveyors and artists and sent it out to make a careful study of the bridges. Mr Holmes' report of the work done is printed below.

The three great natural bridges are located in an almost inaccessible portion of southeastern Utah, in San Juan County, lying south of the Colorado and Grande rivers.

The country is uninhabited and uninhabitable for the greater part, the only settlement of any account being the small town called Bluff, on the San Juan River, and the nearest railroad being Dolores, in Colorado, some 105 miles eastward, on a narrow-gauge branch of the Denver and Rio Grande and Rio Grande Southern, extending from Grand Junction to Durango, in the silver San Juan country. There is another small settlement, called Monticello, to the north of Bluff, with which it is connected by a wagon road, and on to Moab on the Grand and to Thompson's Spring on the main line of the Denver and Rio Grande Railway.

The country of the natural bridges can be reached *via* Bluff by either of these routes, going by wagons to the latter place, then by horses with pack train, taking a northwesterly direction from Bluff for a distance of about 65 miles, going south of the Blue Mountains and Elk Ridge, crossing Cottonwood Creek, and going up Comb Wash.

There might be a way of reaching this section by crossing the Colorado at Dandy Crossing, near Hite, in Garfield County, striking the White River Canyon some 60 miles below the Caroline Bridge, which, with the Augusta, is situated on the main canyon of the White River, while the Edwin Bridge is situated on Armstrong Creek at its confluence with a small stream coming in from the north. Armstrong Creek itself discharges in White River a few miles lower down. All three bridges are within a radius of about 20 miles.

A few miles above the Edwin Bridge, on Armstrong Creek, are the remains of ancient ruins, and about here are hieroglyphics cut into the rocks. No person should think of going into this region without having thoroughly studied all the conditions. The few guides that have been there have a very limited knowledge of the country, and the main and side canyons so cut up the country

The greatest natural bridge in the world; height, 265 feet; span, 320 feet; width in narrowest part, 35 feet; thickness, 83 feet. This and succeeding illustrations are from paintings of the bridge based on careful measurements

Caroline Bridge

The longest natural span in the world—327 feet

The Edwin Bridge

Height, 111 feet; span, 205 feet; width, 30 feet; thickness, 10 feet

that a party may easily become lost. The absence of forage and at times of water make it necessary to undertake the trip as early in the spring as possible, ten or fifteen days being about the limit of time one can spend here because of the impracticability of packing a sufficient supply of forage and provisions. Of course, a more extended trip could be provided for by keeping pack animals on the road to and from the base of supplies at Bluff, the only or nearest place where a suitable outfit can be obtained.

The Augusta Bridge was so named in honor of the wife of Horace J. Long, who in 1903 visited the bridges in company with James Scorup. They made approximate measurements, but, not having accurate instruments, their work was necessarily faulty, and their pictures were taken with a small Kodak, much too small for the purpose. Mr Scorup, it appears, had visited these bridges previous to this time, and in showing Long the way to them stipulated that the second one should be named the Caroline, after his (Scorup's) mother.

So far as Scorup knew, the bridges were first discovered by Emery Knowles in 1895, and he himself visited them in company with two cowboys, Tom Hall and Jim Jones, in the fall of that year.

The next party to visit this section, so far as known, was that promoted by the Salt Lake City Commercial Club during the winter and spring of 1905. The members of the party were H. L. A. Culmer, artist; S. T. Whitaker, photographer; Carleton Woods Holmes, son of Col. Edwin F. Holmes, ex-president of the Salt Lake Commercial Club, who first suggested the trip, and Scorup, guide, together with two packers and a cook. The party was well equipped with scaling ladders and all the necessary paraphernalia.

The measurements taken of the Augusta Bridge were as follows: Height, 265 feet; span, 320 feet; width in narrowest part, 35 feet, and thickness, 83 feet.

The measurement of the Caroline Bridge the party found to be: Height, 182 feet; span, 350 feet; width, 60 feet, and thickness, 60 feet, while of the smaller bridge, named by the Culmer party as the Edwin Bridge, for Col. Edwin F. Holmes, of Salt Lake City, they found the measurements to be: Height, 111 feet; span, 205 feet; width, 30 feet, and thickness, 10 feet, this bridge being the much more graceful and slender of the three.

Oil paintings of the three bridges have now been completed by artist H. L. A. Culmer, from photographs, sketches, water colors, and measurements taken at the time of the visit, the measurements having been corroborated from the records kept by two different persons of the expedition. The painting of the Augusta is a canvas 60 x 90 inches and has the noonday or mid-afternoon tints, with storm-cloud approaching from the southeast—an incident that actually occurred at the time of their visit. Great buttes and the high canyon walls are seen underneath the arch and great cottonwood trees in the distance.

The two other bridges are on canvases 42 x 60 inches in size, the Caroline being in a rich sunset glow of color, with parts in shadow, very dark, somber, and heavy in tone; the sky without clouds, but luminous with light from the setting sun. Little but rock and sky appear in the picture, the little green foliage in the dim distance being so far away as to show but faintly.

Of the Edwin Bridge the dominant tone of rock color is a creamy gray, with a purplish tint in shadow and interesting perspective beneath the arch, showing trees of mountain pine and cedar in the distance and near foreground. The sky of blue is marked by cloudlets of indistinct outline, all in the sunshine of midday.

These bridges, composed as they are of light sandstone, might seem to be wearing away very rapidly. Such, however, is not the case, as is evidenced in the

caves beneath the Caroline abutments, especially that to the south or west, where was found what may have been a workshop of the ancients, for evidences of their pottery work were scattered around, and at one place a number of fiber sandals were found in a fair state of preservation.

A few miles above the Edwin Bridge a considerable settlement of Cliff-Dwellers once existed, and rude symbols are found on the rocks in the vicinity of the bridges.

A NATIONAL PARK SUGGESTED

From all that is learned of this wonderful country, it is believed that its preservation and care should be undertaken by the United States Government, as in the case of the Yellowstone National Park, so that roads may be opened and these greatest of the world's natural bridges can be made accessible for the tourists from our own country and from all over the world, who would flock thither were the road made easier. The difficulties of railroad building do not seem to be unsurmountable, and an extension from Dolores, on the main line, is possible, even to a continuation through to the Santa Fe System, embracing all of the upper part of the Grand Canyon of Arizona—a scenic route comparable to nothing else in the world.

More than a passing word should be said about the little town of Bluff, on the San Juan River, from which point an expedition can best be fitted out for the Bridge Country. This is a place of about fifty houses, and is a thrifty little town with some excellent stone dwellings, some of them costing $5,000 to $10,000. The inhabitants of the town are generally well to do and kind in their treatment of strangers, and their prosperity is largely due to the cattle industry. They are on the northern border of the Navajo Indian reservation, having considerable barter trade with the Indians, who work for them cheaply and keep their dwellings for them. The people are mostly Mormons. Their young people are educated abroad and compare favorably with the young people anywhere.

Quite the opposite is the little town of Monticello, some 50 miles to the north and the county-seat of San Juan County, which is a town of about a dozen houses, some occupied and some not, built upon the apex or divide of a mountain range and formerly the headquarters for the cattle interest of this section. Its nearest point also is Dolores, which is south and east some hundred miles or so and connected by a wagon road little used.

There are mountains about here—Abajo, 11,445 feet, and Mount Linnæus, 11,000 feet—while farther north, toward Moab, are Mount Tukuhnikivatz, 12,034 feet; Mount Tomaskia, 12,218 feet; Mount Wass, 12,586 feet, and Mount Peak, 13,089 feet. Much of this portion has been surveyed, though the townships have not been sub-divided, but nearly all of the western part of the country is still unsurveyed and no very accurate maps exist, excepting of the courses of the Green, the Grand, and the Colorado rivers.

A RECENT REPORT FROM THE "DOUBTFUL ISLAND REGION"

By James D. Hague

THE San Francisco *Chronicle* of February 5, 1907, contained the following item:

"Captain Maurice Rose, of the French bark *Michelet*, reports to the branch hydrographic office that at 9 a. m., January 18, when in latitude north 22 degrees 19 minutes, longitude west 131 degrees 6 minutes, off the Mexican coast, he passed within 200 yards of a reef over which the sea was breaking for an extent of about fifteen yards. The weather was clear, wind northeast, light, with a light swell. He took no soundings. The chronometer was correct upon arrival in port. The observations by which the position was fixed were good."

The locality thus indicated by the above-stated latitude and longitude would be little less than 3½ degrees of latitude north and about 5 degrees of longitude east of the reported shoal which Captain Lawless thought he saw on the morning of March 17, 1902, in latitude 18 degrees 50 minutes north and longitude 136 degrees 10 minutes west, but which the U. S. S. *Tacoma*, when searching for it two years later, failed to find in that position or near neighborhood, May 28, 1904, as set forth in the National Geographic Magazine for December, 1904.

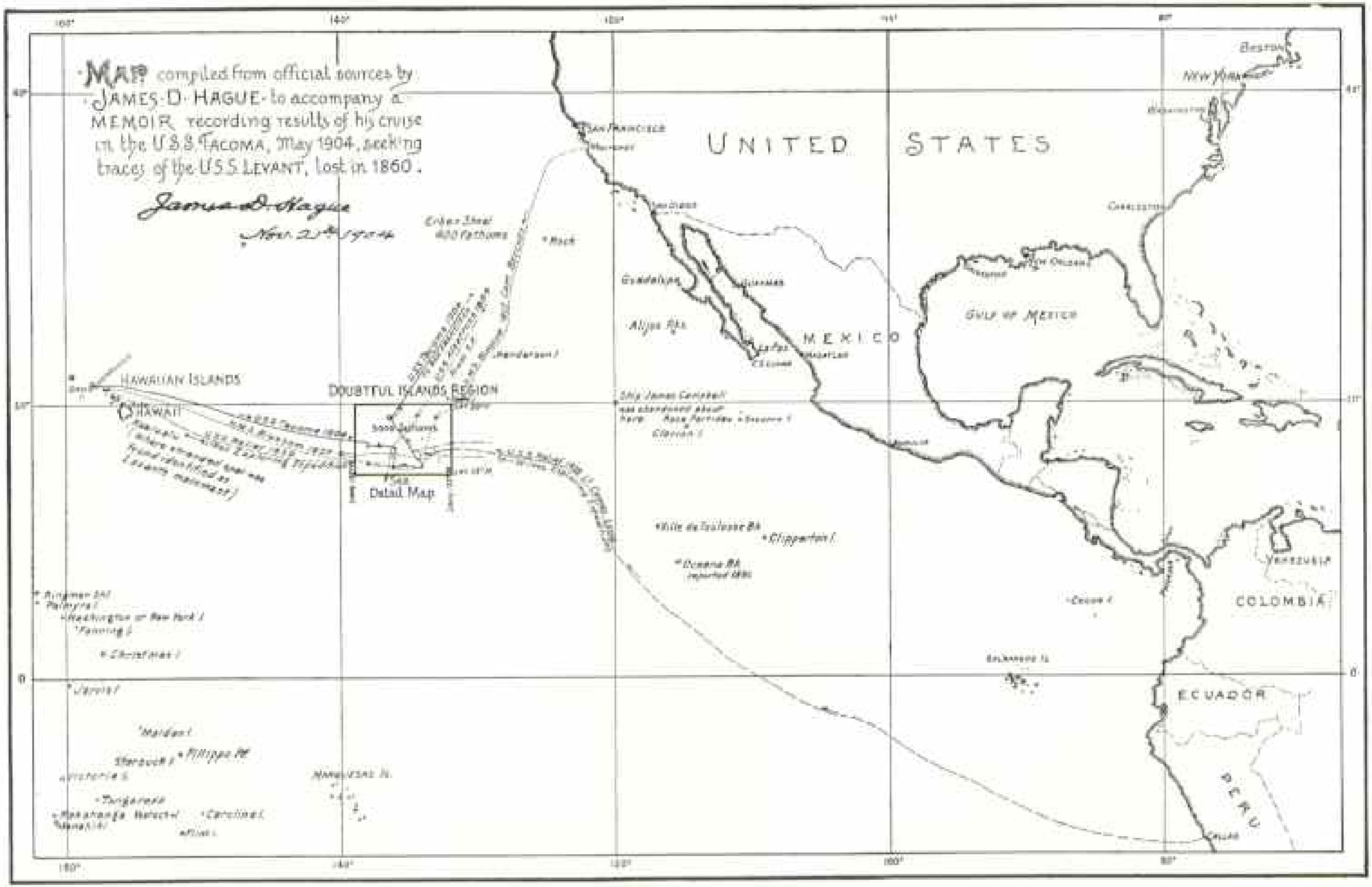
The recently reported reef, over which the sea was breaking, as above stated, would not be far distant (2 or 3 degrees northeasterly) from "Cooper's," one of a number of small islands, of doubtful position and questionable existence, indicated on the older charts, published 50 years ago or more, and it furnishes one more new item of evidence, certainly indicating the possible existence of a shoal region in this neighborhood, within which there may yet be found and definitely located one or more of the score of reefs and islands, which have been reported, mainly by whalemen, from time to time during the past hundred years, but so far never found by any of the exploring vessels sent to look for them.

On such a reef as this the long-lost *Lexunt* may have met her mysterious fate in 1860, and in this still unexplored sea there well may be not only similar reefs, but, as reported, larger and higher islands—possibly some habitable island—on which surviving castaways of the shipwrecked *Lexunt* may still be watching for a sail.

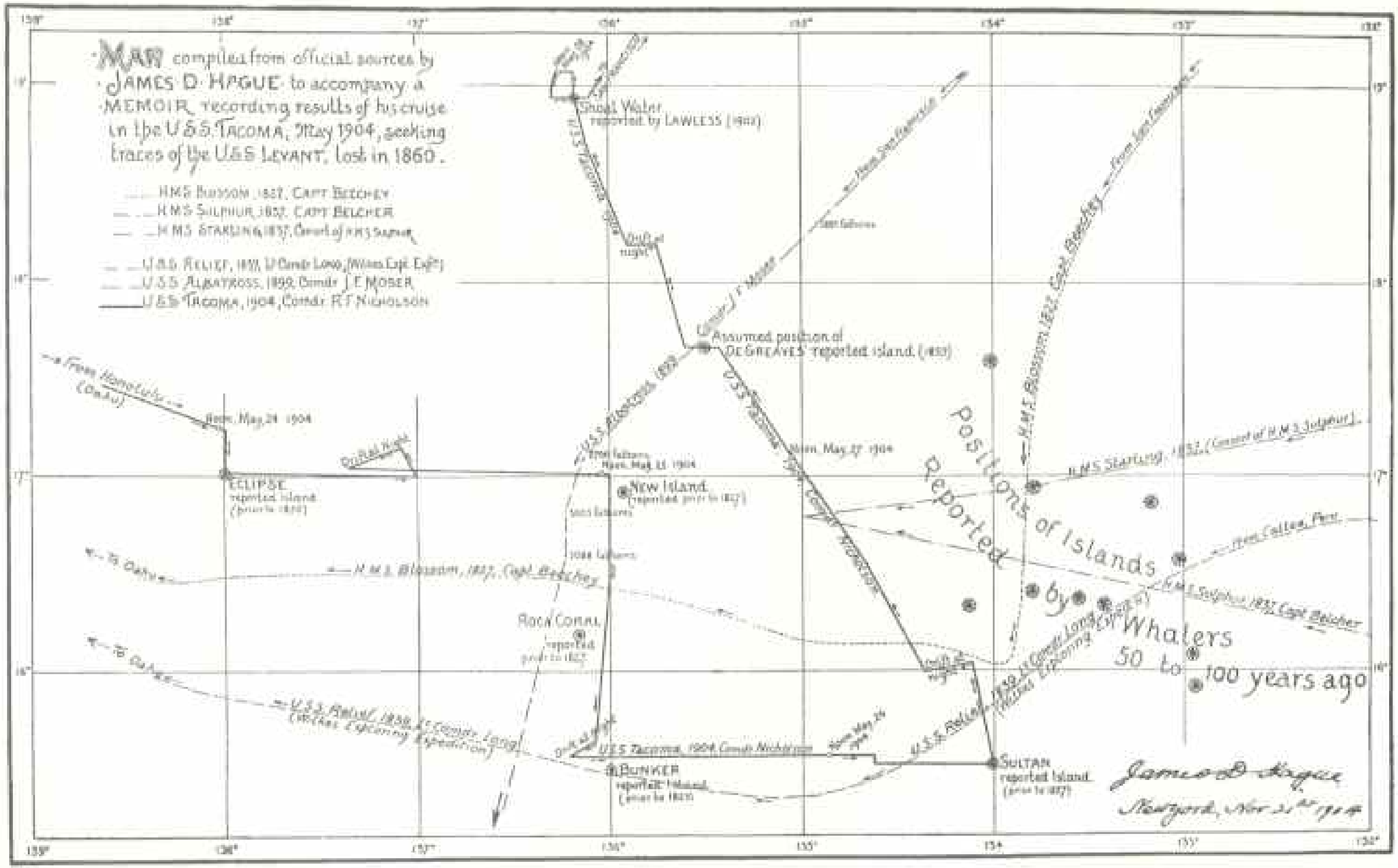
This new report is one more call from far midocean for renewed search and thorough survey of this unexplored region, with the purpose either to prove the non-existence of these most dangerous menaces to navigation or, if found existing, to locate them correctly on the charts, in the interest of commerce and for the benefit and safety of mariners.

The brief and only partial search of this region, made by the *Tacoma* in 1904, occupied only four days in cruising and covered but a comparatively small part, about 8,000 square miles, of this doubtful island region, leaving 20,000 to 30,000 square miles still unexplored and almost wholly unseen by any of the several vessels sent there for exploration. Every square mile of this region must yet be seen in daylight before it can be certainly known that there are no reefs or islands to be found or feared there by passing navigators. The search of the *Tacoma* was conclusive only for a part of the field, as above stated, and there are better reasons now for completing the exploration than there were originally for beginning it.

Although no sign of shoal water was found by the *Tacoma* at the place indicated by Captain Lawless, he still be-



Map Showing Relative Position of Doubtful Islands Region, the Hawaiian Islands, and the American Coast



Map Showing Assigned Positions of Reported Islands in the Doubtful Region, and the Sailing Tracks of Vessels Sent to Seek Them

lieves that what he saw and reported was in fact a shoal, but probably located a few miles out of his reckoning. He did not stop his ship to sound, but estimated the depth of water on the shoal to be thirty to forty feet, or, say, five to seven fathoms; and it is curiously interesting to note the singular coincidence between this estimate and the depth of "six or seven fathoms" actually found by sounding on another remotely related shoal observed and reported many years since, a recent reference to which is contained in a letter from Professor George Davidson, at San Francisco, an eminent authority on oceanography, who writes:

"Yesterday (January 9, 1906) I was browsing among old navigators, and in Burney, vol. I, pages 228 and 229, I came on the following, in the voyage of Villalobos: 'Dec 3 (1542) they discovered banks on which they had only six or seven fathoms.' The pilot's statement: 'and we sailed beyond Roca Partida about two hundred leagues, when we had soundings in seven fathoms, being then in 13 degrees or fourteen degrees north latitude, and no land in sight; but we believed ourselves to be near the Island San Bartholomeo.'"

This observation antedates Captain Lawless's by three hundred and sixty years; but it is somewhat more reliable than his, because of the actual soundings that were taken at the time, which have the same important significance as if made yesterday. Such a shoal is evidence of an elevated sea bottom and is an indication of a shoal region, in which there may be coral reefs near enough to the surface to menace navigation, and where there might be islands, possibly habitable, and, in that case, now inhabited by the survivors of shipwreck. In fact, during the three hundred and sixty years of elapsed time a coral island may have been formed on this same shoal. Such an island, developing conditions favorable to the support of life, like scores of tropical islands elsewhere, might have become habitable long ago.

The region from which this report apparently comes (two hundred leagues westerly from Roca Partida, shown on the charts) is perhaps ten degrees east and eight or more degrees south of the assigned position of the reef over which the sea was breaking, as recently reported by Captain Rose of the bark *Michelet;* but it is within the great, generally landless, ocean area of which we have but comparatively little information and hardly any knowledge concerning the elevations and depressions of the sea bottom.

The traffic of this hitherto-unfrequented region is steadily increasing. Steamships between San Francisco and Tahiti traverse it occasionally in northerly and southerly directions, and the American-Hawaiian Steamship Company has just now inaugurated a fortnightly service between Hawaii and the Mexican coast, which will pass through this region in easterly and westerly courses; and when the Panama Canal is open for business the movement of ships in these waters will be constant. With these conditions in view, it seems obvious that a complete survey of the region should presently be made in the interests of commerce and navigation.

THE POSSIBILITIES OF THE HUDSON BAY COUNTRY

THE Canadian Geological Survey has issued a popular narrative and report of its recent expedition to Hudson Bay and the Canadian Arctic Islands by Hon. A. P. Low, the leader of the expedition and now Director of the Geological Survey of Canada.*

One reason for the expedition was the formal assertion and installation of Canadian authority over that drear coast and its adjoining waters, a domination which previously had been largely taken for granted, so far as the islands north of Hudson Bay were concerned. Another important reason for the expedition was the securing of further information about the navigability of Hudson Bay. Other reasons were to obtain scientific information about the geology, botany, and natural history, minerals, and timber of the vast territory, about its inhabitants, the Eskimos, and about the possibilities of fishing and whaling, the latter of which has been the sole industry of the northern seas or their neighborhood.

The report makes an exceedingly valuable volume of 350 pages and is illustrated with about 75 pictures of Arctic scenery, of the Eskimos, and whaling views. There are excellent chapters on the Eskimos, the whaling industry, and a very good historical summary of previous explorations of the Hudson Bay region. Mr Low also publishes a large map of the region.

All that is needed to open Hudson Bay for ordinary commercial navigation, says Mr Low, is a line of rails to carry freight to one of its ports. At present the Hudson's Bay Company and the Revillon Fur Company have ships going annually to the bay, and a greater amount of freight would attract more steamers.

The period of safe navigation for ordinary iron steamships through Hudson Strait and across Hudson Bay to the port of Churchill may be taken to extend from the 20th of July to the 1st of November. This period might be increased without much risk by a week in the beginning of the season and by perhaps two weeks at the close.

The fur trade with the Indians and Eskimos living about Hudson Bay or along interior routes tributary to it has for a period extending over two centuries and a half furnished cargoes for two or more ships belonging to the Hudson's Bay Company. At the present time two ships are engaged in this trade for the company, while Revillon Brothers employ two more. The whale fishery now supports two ships. These four ships represent the developed trade of the bay and strait at the present time.

The undeveloped resources of the region surrounding these waters appertain to mining and fisheries and to the forests, which include large areas of pulp wood and merchantable spruce. Iron ores and copper-bearing rocks have been found in several places and a valuable mica mine is being worked. Not much is known about the fisheries, but sea run trout, whitefish, Arctic salmon, etc., are believed to be abundant.

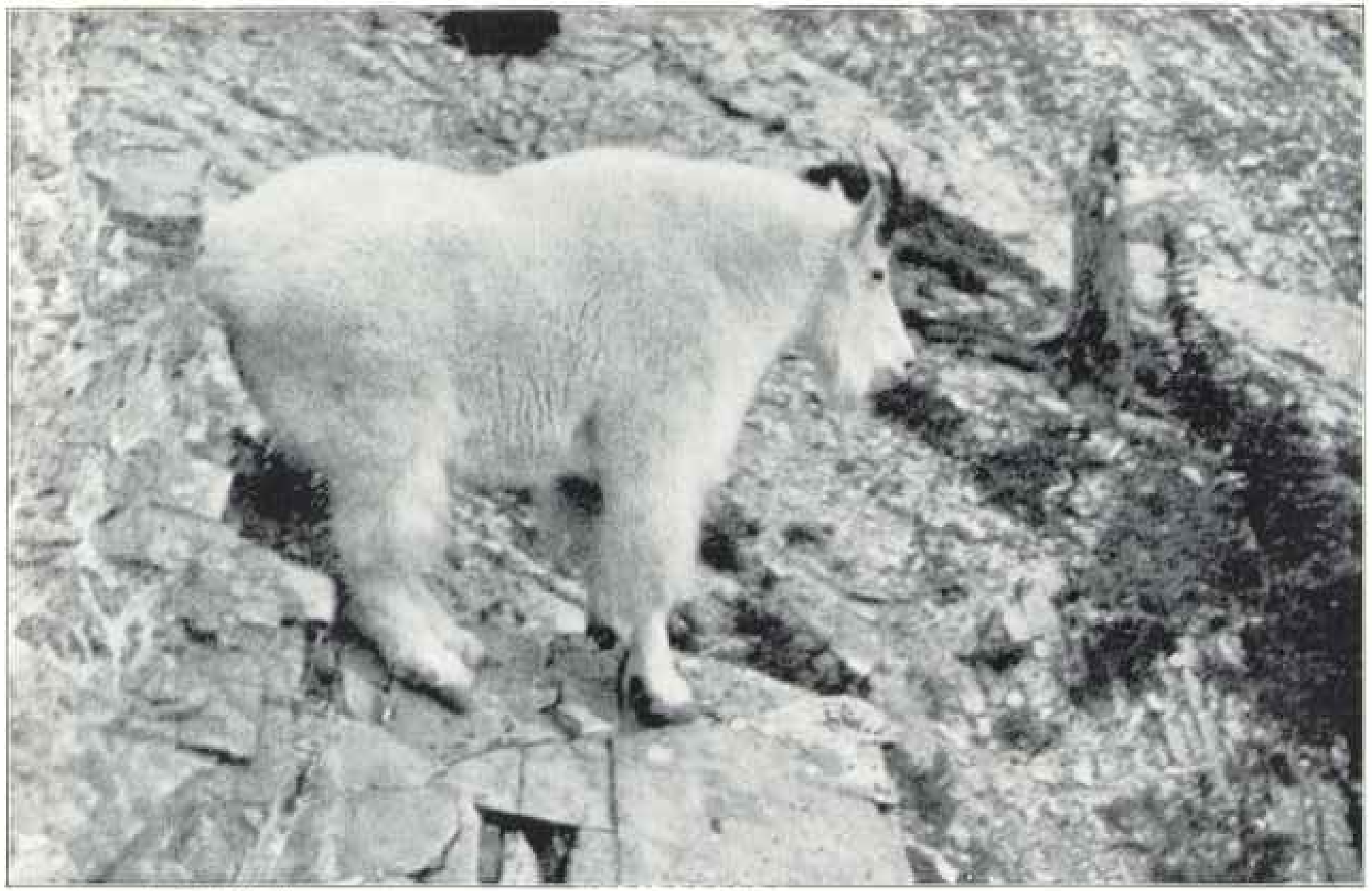
These undeveloped resources of the north will no doubt, when developed, add greatly to the annual shipping of Hudson Bay, but the main increase to the fleet will be due to the products of the great plains of the Northwest, now rapidly filling with robust settlers. These products of the western farms—grain, butter, and cattle—will naturally seek the shortest road to the European markets; a road not only shorter, but, owing to its cool climate, capable of landing perishable products and grain in better condition than the more southern routes.

Taking Regina as a convenient center for these northwestern farming lands, the

*The Cruise of the *Neptune*. By A. P. Low, Officer in Charge. Pp. 350. 6 x 9 inches. 75 illustrations and one map. Ottawa, Government Printing Bureau, 1906.

The Interior of an Eskimo Snow House, Showing the Snow Blocks of which it is Constructed. Cape Fullerton

Photo from "The Circle of the Arctic," by A. P. Low



The Goat at Ease

Distance eight feet. All these photographs of a living mountain goat were taken September 15, 1905, with Stereo Hawk-Eye Camera, No. 1. No telephoto lenses used.

From Alpina Americana

Tehipite Canyon

From a point 4,000 feet above the river. Photographed by G. K. Gilbert. The clean white granite walls rise from 3,000 to 4,000 feet above the level floor

distance from there by way of Prince Albert to Churchill is about 800 miles, or the same distance as from Regina to Fort William, on Lake Superior, and a thousand miles shorter than the distance from Regina to Montreal, at the head of sea navigation on the Saint Lawrence. The distance from Churchill to Liverpool is almost the same as that from Montreal to Liverpool; consequently there is a saving in distance of a thousand miles of rail or river carriage in favor of the northern route.

The question of the storage of the grain until the season following the harvest is at first sight a serious one, but when it is known that not twenty per cent of the grain at present reaches the seaboard before the opening of navigation of the year following that in which it is harvested, this objection practically disappears, for the grain may be as well stored on the shores of Hudson Bay as in the elevators on the plains or at Fort William.

THE HIGH SIERRA

ALL lovers of mountain scenery and mountain climbing will be interested in a new publication, *Alpina Americana*, established as a quarterly by the American Alpine Club, whose object is to encourage interest in our beautiful western mountains, and at the same time to teach how they may be best appreciated and enjoyed. The first number is entirely devoted to a monograph on "The High Sierra" by Professor Joseph N. Le Conte, of the University of California. It is illustrated with some excellent views, and also contains a map of the mountains prepared by Mr Le Conte. Prof. Charles E. Fay, of Tufts College, the editor, and the editorial committee deserve much gratitude from the public for their generous support of this worthy undertaking.

Professor Le Conte gives a highly instructive account of the Sierra, describing their geological history, their scenery, and the best means of exploring them. The following paragraphs are abstracted from his article:

The Sierra Nevada forms a part of the western bulkwark of that great continental plateau upon which is built the North American Cordillera. Though it is but one of the many ranges within the boundaries of the United States, not one surpasses, if any equals, the Sierra when extent, altitude, and grandeur of scenery are taken into account. It is one of the great features of the earth's surface, standing in remarkable isolation, wonderfully simple in general outlines, and fascinating alike to the scientist, mountaineer, nature lover, and, in fact, to any one who has once penetrated its deepest recesses.

The Sierra Nevada, as generally defined, is limited strictly to California, and may be considered to extend from the Tehachapi Pass (latitude 35° 10′) to Mt. Shasta (latitude 41° 25′), a distance of over 500 miles along the eastern border of the state. The exact termination to the north and south cannot be clearly defined, as its spurs mingle with those of the Coast Range in those portions; but throughout its central part it forms a single, isolated mountain mass, extending from Tejon Pass (latitude 35° 45′) to Lassen Peak (latitude 40° 30′), a distance of about 385 miles. Between these points the crest line, which is the hydrographic divide between the Pacific Ocean and the Great Basin, is nearly straight, as are also the lines, about eighty miles apart, which terminate its slopes on the east and west.

The range is one of the grandest known examples of the "basin" type of formation. It can be briefly characterized as a single block of the earth's crust upheaved along its eastern edge, and thus presenting to the west a long gradual rise covering nine-tenths of its entire area, and to the east a precipitous front of imposing dimensions. The total dissimilarity of the two slopes is perhaps its most striking feature. It is the result of its geologic history and is the primary cause of the peculiarly Sierran

type of canyon sculpture, of the regular distribution of the belts of vegetation, and of many characteristic features of the High Sierra scenery.

The western slope may therefore be considered the main portion of the Sierra Nevada, containing not only 90 per. cent. of its area, but also most of its great forest and mineral wealth, receiving nearly all the annual precipitation and giving rise to all its rivers.

During the Glacial times the High Sierra was completely covered with ice, and enormous glaciers filled its canyons, reaching in some instances for forty miles down its western flank. This ice mantle has vanished within very recent geological times, and the High Sierra exhibits to a most perfect degree the effects of this recent glaciation. Great areas are everywhere found polished smooth as glass and covered with glacial erratics. The canyons are all of the characteristic U-shape, with walls showing polished and scored surfaces. Large streams flow over smooth rock slopes without channels, and indeed the general appearance is as if the glaciers had vanished but yesterday.

At the present time three large national parks have been created on the western slope of the Sierra, the Yosemite National Park, which now includes the Yosemite Valley; the General Grant and Sequoia National Parks, which include some of the finest of the sequoia groves. The whole of the western slope, from the southern portions of the Kern Basin to Lake Tahoe, has been set aside as a national forest reserve. The creation of these parks and reserves has restored the magnificent flora of the Sierra, which previous to 1899 was in danger of total destruction through sheep grazing and forest fires.

The eastern crestline contains the two highest points in the state and the highest one in the United States, Mount Whitney, 14,409 feet, and Mount Williamson, 14,384 feet. As to the height of Mount Whitney, there is no longer a doubt, as it has been leveled up by the United States Geological Survey from two independent bases. It is of but little interest to the mountain-climber, however. Its ascent has always been easy, and within the past year a horse trail has been constructed to the summit. Mount Williamson is by far the more imposing of the two and affords a really interesting climb. Mount Tyndall (14,025 feet) and Mount Langley (14,042 feet) are both exceedingly easy of ascent.

MOTOR SLEDGES IN THE ANTARCTIC

A NEW South Polar Expedition is being organized by Lieutenant E. H. Shackleton, who was a member of the recent British expedition and also one of the sledging party who reached farthest south, 82° 17'. Mr Shackleton plans to leave England October of this year on a steam whaler, and to establish his winter quarters at the station used by the *Discovery* near Mount Erebus. His party will be limited to from nine to twelve men. Mr Shackleton introduces two innovations: The use of Siberian ponies, which Fiala found so useful in the north, and a specially designed motor car for traveling over the ice barrier. Mr Shackleton in his announcement says:

"A North China or Siberian pony is capable of dragging 1,800 pounds on a food basis of 10 pounds per day. A dog drags 100 pounds at the outside, and requires over 2 pounds of food per day. Therefore one pony drags as much as eighteen dogs, at less than one-third in weight of provision, and can travel comfortably 20 to 25 miles per day.

"The motor will be of a special type, taking into consideration the temperatures to be encountered and the surface to be traveled over. I would propose to take three or four ponies on the southern journey and the motor car. As long as the car continued to remain satisfactory, it alone would be used to drag our equip-

ment and provisions. If it broke down and could not be fixed up, then the ponies would take over the load.

"I would propose traveling at the rate of 20 to 25 miles a day, and feel assured that, providing the motor does its work, 82° 16′ S. I intend, every 100 miles, to drop a sledge load of provisions and equipment; so that, in the event of every means of traction breaking down except the men, we would only have 100 miles to go between each depot on return. The geographical South Pole is 731 miles from winter quarters, and allowing that we only go with the motor to 82° 16′ S., we would then practically be starting for the remaining 464 miles as fresh as if we were starting from the ship. What lies beyond 83° S. we cannot tell, but I am of the opinion that we can follow the trend of the southern mountains for a very long way south before they turn either east or west."

ORIGIN OF THE WORD CANADA

IN the "Memoirs of the Historical Society of Pennsylvania," vol. 12, 1816, John Heckewelder gives an account of the origin of the word Canada. He quotes from "Mr Zeisberger's papers" to the effect that he (Zeisberger) translates "the German word *stadt* (town) into the Onondago by *ganatage*." He surmises that by the substitution of K, and finally C for *g*, and *d* for *t*, the word may have been derived in some form of the Mohawk dialect. "So that it is highly probable that the Frenchman who first asked the Indians in Canada the name of their country, pointing to the spot and to the objects that surrounded him, received for answer *Kanada* (town or village)." The mistake made by the Frenchman, consisting in applying a term meaning specifically town or village, to the generic significance of country in general, and he "consequently gave to their newly-acquired domain the name of *Canada*."

In connection with an old French map, the date of which is not affixed, is a "Dissertation sur le Canada ou la Nouvelle France," from which the following is translated:

"Since the year 1504, when the French discovered this great country, they have given it the name New France. The Spaniards first made the discovery, but as they found nothing of any account in it after their visit, they readily abandoned it, and gave it the name Capo di nada—that is to say, the *Cap de rien*—whence has arisen, by corruption, the name Canada, which is now generally given to it on the maps."

Francis Parkman is inclined to the view of Heckewelder, although he does not mention that missionary's name (*Pioneers of France in the new world*, footnote on p. 184 of the 19th edition). He states definitely that the name Canada is "without doubt not Spanish, but Indian," and refers it to the Mohawk dialect, in which it means a *town*. "Lescarbot affirms that Canada is simply an Indian proper name, of which it is vain to seek a meaning. Belleforest also calls it an Indian word, but translates it *terre*, as does also Thivet."

N. H. WINCHELL.

BOOK REVIEW

Camp Fires in the Canadian Rockies. By William T. Hornaday, with 70 illustrations by John M. Phillips and 2 maps. Pages 350. 6×9 inches. New York: Charles Scribner's Sons, 1906.

Dr Hornaday has given an exceedingly entertaining description of one of the most beautiful sections of North America. It is only in the last few years that the mountaineer and sportsman has learned by personal investigation of the wonders of the Canadian Rockies, where the wild goat and mountain sheep are found. The volume is illustrated with some very remarkable photographs of mountain goats and mountain sheep, which were taken by Mr John M. Phillips, of Pittsburg, with an ordinary stereo-camera. Dr Hornaday describes very pleasantly his experiences in hunting this game and particularly the risks incurred by Mr Phillips to obtain his photographs. There are also interesting notes and photographs of the grizzly, porcupine, squirrel, wolverine, marten, grouse, mule-deer, etc. One picture from the volume is given on page 211.

DECISIONS OF THE UNITED STATES GEOGRAPHIC BOARD

The following important decisions relating to geographic names and their application were made by the United States Geographic Board on February 6, 1907. In reaching these decisions the Board has obtained the advice of many of the foremost American geographers and geologists, and the decisions here given are, in nearly all cases, the result of a consensus of opinion among the gentlemen consulted.

CORDILLERAS—the entire western mountain system of North America.

ROCKY MOUNTAINS—the ranges of Montana, Idaho, Wyoming, Colorado, New Mexico, and western Texas.

PLATEAU REGION—the plateaus of Colorado River and its branches, limited on the east by the Rocky Mountains, on the west by the Wasatch Range, and extending from the southern end of the Wasatch southward, southeastward, and eastward to the eastern boundary of Arizona, following the escarpment of the Colorado Plateau, and including on the north the Green River basin.

BASIN RANGES—all those lying between the Plateau Region on the east, the Sierra Nevada and Cascade Range on the west, and the Blue Mountains of Oregon on the north, including the Wasatch and associated ranges.

PACIFIC RANGES—the Cascade Range, the Sierra Nevada, and the coast ranges collectively.

SIERRA NEVADA—limited on the north by the gap south of Lassen Peak and on the south by Tehachipi Pass.

CASCADE RANGE—limited on the south by the gap south of Lassen Peak and extending northward into British Columbia.

COAST RANGE—extend northward into Canada and southward into Lower California, and include all mountains west of Puget Sound and the Willamette, Sacramento, and San Joaquin valleys, and southwest of Mohave Desert.

BITTERROOT RANGE—extends from Clarks Fork on the northwest to Monida, the crossing of the Oregon Short Line on the southeast, including all mountain spurs.

MISSION RANGE—range east and southeast of Flathead Lake, Montana.

WASATCH RANGE—includes on the north the Bear River Range, extending to the bend of Bear River at Soda Springs, Idaho, and on the south extends to the mouth of San Pete River near Gunnison.

SAN JUAN MOUNTAINS—include all the mountains of southwest Colorado south of Gunnison River, west of San Luis Valley, and east of the Rio Grande Southern Railroad.

SACRAMENTO MOUNTAINS—include those groups known as Jicarilla, Sierra Blanca, Sacramento, and Guadalupe.

SALMON RIVER MOUNTAINS—include the group in central Idaho lying south of main Salmon River, west of Lemhi River, north of Snake River, and east of the valley of Weiser River.

BLUE MOUNTAINS—include all the mountains of northeastern Oregon with the exception of the Wallowa Mountains, and extend into Washington.

SANGRE DE CRISTO RANGE—extends from Poncha Pass, Colorado, to the neighborhood of Santa Fé, New Mexico, thus including the southern portion locally known as the Culebra Range.

FRONT RANGE—includes on the north the Laramie Range as far as the crossing of the North Platte and on the south includes the Pikes Peak group.

APPALACHIAN SYSTEM—includes all the eastern mountains of the United States from Alabama to northern Maine.

BLUE RIDGE—includes the ridge extending from a few miles north of Harpers Ferry to northern Georgia.

APPALACHIAN PLATEAU—includes the entire plateau forming the western member of the Appalachian system, known in the north as the Allegany Plateau and in the south as the Cumberland Plateau.

OZARK PLATEAU—the plateau in northwestern Arkansas and southern Missouri.

QUACHITA MOUNTAINS—the ridges of western Arkansas south of the Arkansas River, Indian Territory, and Oklahoma.

COMMITTEES OF 1907

The following committees of the National Geographic Society have been appointed by President Willis L. Moore for 1907:

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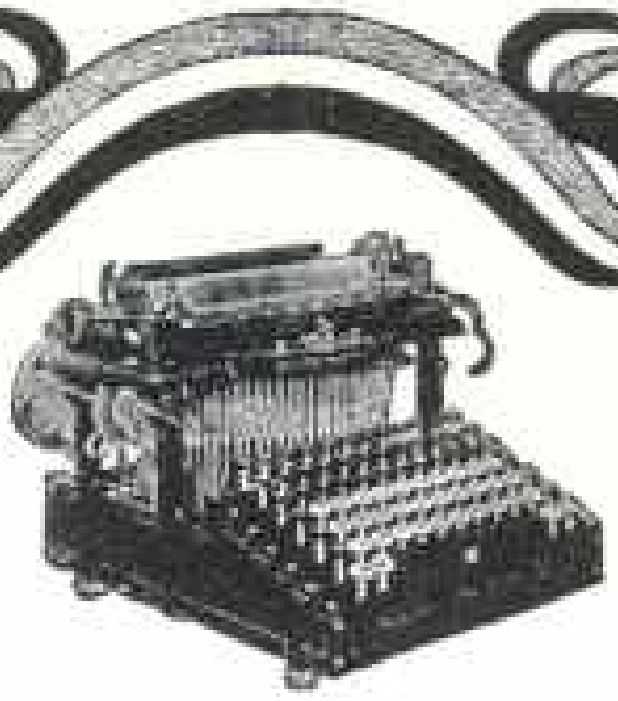

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