

NON-FICTION

Francis Rolt-Wheeler

The Boy With the US Survey

A PUBLIC DOMAIN BOOK

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THE CHIEF GEOGRAPHER OF THE UNITED STATES, SURVEYING THE SIERRAS, WITH ASSISTANT TOPOGRAPHER.

U. S. SERVICE SERIES.

THE BOY WITH THE U. S. SURVEY

BY
FRANCIS ROLT-WHEELER

With Thirty-seven Illustrations from Photographs taken by the U. S. Geological
Survey



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THE BOY WITH THE U. S. SURVEY

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To
My Son
ROGER ROLT-WHEELER

PREFACE

Just as manly, courageous, and daring work as has ever been done in the past still is being done, and adventures as great as the world has contained before are happening to-day in these United States. The difference is that while the explorer and adventurer of the past too often sought but personal glory in his exploits, these now are done in the name of and for the benefit of the American people.

The adventures in this volume, startling as they may seem, were recounted to the author by the very men who underwent them; slight details only being changed to fit them into the rapid sequence with which they have to be compressed in the pages of a book. This little company of "men who dare" are real beings, living a real life, and ennobling as well as enriching their country by their efforts. In the administration of this department, manliness, alertness, untiring industry, and unfailing courage are the prime essentials, favoritism is unknown, and every American boy and man has an equal chance.

The world is not yet all sordid and commonplace and the glamour of an undiscovered peril is not yet all worn away. To show the inner and the outer worth of the United States Geological Survey, as well as to depict the adventurous possibilities open to a lad of perseverance and spirit, is the intent and purpose of

THE AUTHOR.

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THE BOY WITH THE U. S. SURVEY

CHAPTER I A START AT THE CAPITAL

"Mr. Rivers?"

The Alaskan explorer and geologist looked up from his desk and took in with a quick glance the boy, standing hat in hand beside the door, noting with quiet approval the steady gray eye and firm chin of his visitor.

"Yes?" he replied.

"I'm Roger Doughty," explained the lad sturdily, "and Mr. Herold told me that I should find you here."

"And what can I do for you?"

The boy seemed somewhat taken aback by the direct question, as though he had expected the purpose of his visit to be known, but he answered without hesitation.

"I understood from Mr. Herold that he had spoken to you about me. I want to go to Alaska."

"You mean on the Survey?"

"Yes, sir."

"Your father wrote to me some time ago that you would be coming. He said, if I remember, that you had been nominated one of the new field men under that college scholarship plan."

"I think I am the first, Mr. Rivers," answered Roger with a smile.

"Sit down," said the elder man; then, as the boy hesitated, "just put those books on the table."

The table in question was covered with an immense map showing the vast unexplored and unsurveyed regions of Alaska, that far northern portion of the United States which is equal in size to all the States west of the Mississippi and north of Mason and Dixon's line.

"Mr. Herold spoke of the plan to me," continued the explorer, "but he gave me few of the details. Tell me, if you can, just how the project is to be worked."

"I don't know for certain, Mr. Rivers," replied the boy, "but so far as I can make out, it is this way. You see, Mr. Cameller gave a large fund to get some special boys into the government bureaus to give a chance for the upbuilding of the personnel while still young, and this plan was indorsed in Washington. The scholarship paid everything for two years and gave the usual two months' vacation beside, giving also a liberal allowance for personal expenses."

"And you say this plan is now proceeding?"

"I heard that it was to be tried this first year only in two or three schools. I guess I was lucky, because they started out with us."

"But how does your father like the idea of your roughing it? In the days when I knew him, he believed in keeping his boys near home."

"He wants me to stay, but, you see, Mr. Rivers, I always wanted to get out and do something, and city life isn't what it's cracked up to be. I want to be doing things worth while, things that will tell in the long run, and this poking over columns of figures in a stuffy office doesn't suit me worth a cent when I'm just aching to get out of doors."

The explorer's grave expression relaxed into a half-smile at the boyish but earnest way of describing the feeling he himself knew so well; but he felt it his duty to put bounds to that enthusiasm. Before he could speak in protest, however, Roger continued:

"I know what you're going to say, all right, Mr. Rivers. I know there's just as good work done nearer home as there is far away in Alaska or the Bad Lands or any of those places, but why can't that work be done by the fellows who like to hang around towns? I don't, that's all, and the whole reason I went in for that scholarship and won it"--these last words with an air of conscious pride--"was just so that I could get into real and exciting work."

"If it's work you're after, you've come to the right place, Doughty," was the prompt reply, "but it's more laborious than exciting."

"Why, I thought it was full of excitement!" exclaimed Roger.

"Not especially. The work follows a regular routine on the trail, just as it does anywhere else. It isn't so much the ability to face danger that counts in the Survey, as it is the willingness to do conscientiously the drudgery and hard work which bring in the real results."

"No getting lost and wandering over frozen tundra until nearly at the point of death, and then being rescued just in time?" asked the boy breathlessly, his mind running on an exciting book which had occupied his thoughts a few hours before.

"No!" The negative was emphatic. "The Alaskan parties are composed of picked men, all of whom have had considerable experience and who don't get lost. And if, by any chance, they are late in getting into camp, they know how to shift for themselves. Besides, the chief of the party is ever on the alert for the welfare of his men."

"But aren't there really any snowslides, or rapids, or forest fires, or bears, or anything of that sort?" cried the boy in a disappointed tone. "Surely it isn't as tame as all that?"

"I wouldn't go so far as to call it tame," responded the head of the Alaskan work; "no, it's not tame, but you can't expect a different adventure three times a day, like meals. We don't go out to find adventures, but to do surveying, and are only too thankful when the work goes ahead without any interruption. But of course little incidents do occur. I was considerably delayed in scaling a glacier once, and you're bound to strike a forest fire occasionally, but things like that don't worry us. Rapids are a daily story, too, and of course there are lots of bears."

"Lots of bears!" exclaimed Roger, his eyes lighting up in the discovery that the days of adventure had not yet all passed by, "have you ever been chased by a grizzly bear?"

"Worse than that!" The old-timer was smiling broadly at his would-be follower's interest, being roused from his customary semi-taciturnity by the boy's impetuous enthusiasm. "I thought a Kodiak bear had me one time."

"Worse?" The boy leaned forward almost out of his chair in excitement. "Is a Kodiak bear fiercer than a grizzly? Do tell me about it, Mr. Rivers!"

"Oh, there wasn't much to it, I got away all right." Then, with intent to change the subject, he continued, "but about this desire of yours to go to the field----"

"Please, Mr. Rivers," interrupted Roger, his curiosity overcoming his sense of politeness, "won't you tell me about the bear?"

The bushy brown eyebrows of the explorer lowered at the interruption, but the boy went on hastily:

"I've never met any one before who had even seen a real bear loose, much less had a fight with one. I don't want to seem rude, but I do want to hear it so much."

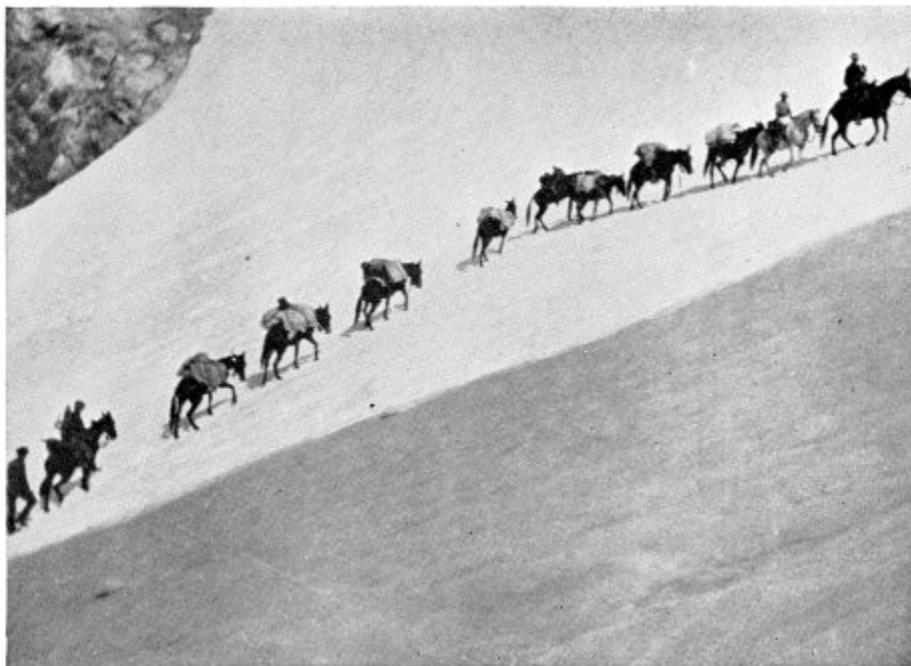
"You are persistent, at least, Doughty," answered the other, with a suspicion of annoyance in his manner, "but sometimes that's not such a bad thing. Well, if you want to hear the story so much I'll tell it to you, and perhaps it may show the sort of thing that sometimes does come about on the trail. It was this way:

"Some four years ago, the Survey sent me on a trip which included the mapping of a portion of the foothills of the Mt. St. Elias Range. It is a rugged and barren part of the country, but although rough in the extreme, no obstacles had been encountered that hard labor and long hours could not overcome. It was a packing trip and everything had progressed favorably, there was plenty of forage, the streams had been fairly passable, and we feasted twice a day on moose or mountain sheep. For days and weeks together we had hardly been out of sight of caribou. They had a curious way of approaching, either one at a time or else in quite large bands, coming close to the pack-train, then breaking away suddenly at full gallop and returning in large circles. Even the crack of a rifle could not scare them out of their curiosity, and we never shot any except when we needed meat.

"One day I got back to camp with the boys a good deal earlier than usual, somewhere about four o'clock. We had started very early that morning, I remember, trying to gain a peak somewhat hard of access. It was difficult enough, so difficult in fact, that the trail had to be abandoned that day, as we found it could only be approached from the other side. Of course our arrival sent George, the camp cook, into the most violent kind of a hurry. He mentioned to me, as I remembered later, that he had shot at a Kodiak bear somewhere about noon, and though he had found tracks with blood in them, he did not believe that he had wounded the bear sufficiently to make it worth while to track him. But George was hustling at top speed to get dinner, and no one paid much attention to him, I least of all, for I was trying to figure out the best way to climb that peak next day.

"After dinner, it was still early, and as I was anxious to get a line on the geology of the section, in order to determine how far the volcanic formation of the Wrangell mountains intrudes upon the St. Elias Range, I thought an hour would

be well spent in investigating. I was not going far from camp, so, as it chanced, I took nothing with me but my geological hammer. About a mile from camp I found a sharp ravine, and I wanted to see whether the granodiorite, which I could see in the walls of the ravine, extended its whole depth. I scrambled down into the ravine, making observations as I went, until the cleft ended in a sort of dry lake bed, shaped like a deep oval saucer. Steep declivities ran upward from the rim of this depression in every way but two, the ravine down which I had come and a creek bed running to the south. Being desirous of tracing the origin of this unusual configuration, I scrambled to the edge, breaking through a clump of bushes on my way.



Photographs by U.S.G.S.

IN THE HOME OF THE KODIAK BEAR.

The pack-train on its way to the camp, where chief of party narrowly escaped death.

"As I did so, I was startled by a deep and vicious growl which seemed to come from my feet, and before I realized what the cracking of the brushwood meant, the cook's story came back to me, and I broke for the ravine. I was too late! There, in the path down which I had come, his muzzle and paws red with the blood from the deep flesh wounds he had received, and which he had been licking in order to try to assuage the pain, stood an immense Kodiak bear. The Kodiak is not as ferocious as the grizzly, but this beast was maddened by the pain of his wound, and by the suspicion that I had followed to work him further ill. My slight geologic pick was of no avail against the huge brute, my road of escape was cut off, and the bear was advancing, growling angrily. I broke and ran for the rim of the lake, hoping to be able to encircle it and return to the opening of the ravine by which I had entered, and as I ran I heard the bear charge after me.

"At the edge I paused, but there was no path along the former beach, and having no alternative I slid down the debris into the lake bed. Blind with rage the bear followed, and for a moment he seemed to have me at his mercy. A hundred yards further on, however, some slender bushes grew out of the shelving bank and with the bear but a few yards behind I leaped for these. Had I missed my grasp, or had they been torn from their slender rooting the story would have ended right there. But they held, and I reached the level of the old beach, leaving my pursuer momentarily baffled below. I lost no time in reaching the ravine, and I think I pretty nearly hold the speed record in Alaska for that half-mile back to camp."

"And the bear?" queried the boy.

"I'm on the Geological Survey, not in the wild animal business," was the ready answer, "and I left that bear alone. I never hunt for trouble."

"And shall I see those bears if I go up with you this summer?" asked Roger.

"Likely enough you will see them if you go up to Alaska, but that will not be this summer."

"Why not, Mr. Rivers?"

"That work needs trained men, as I told you, and you know nothing of the Survey yet. Besides, you will be sent where Mr. Herold thinks best, not where you prefer to go."

"And I had hoped to see Alaska this summer!" cried the boy dejectedly.

"That could not be in any case; all the parties have started already," replied the older man. "You see, in order to make use of every day of the short Alaskan summer, the men start early in the spring when a long trip is planned, so that they will be at the point of start when the break-up comes."

"Then I am too late after all!" said Roger, with the most acute disappointment.

The experienced Alaskan explorer smiled.

"Doughty," he said, "you should realize that you could not possibly have gone up with us this year. Minutes are too precious on the northern trails to spend any of them teaching the routine of camp life or the duties of the Survey. We take absolutely no men who are not experienced. But, besides that, this year would not be the one in which you would wish to go, since the parties now up there are surveying small sections of territory to fill up gaps in the more populated areas."

"Then there is no chance for me?"

"Not this summer. But Mr. Herold did tell me that he had seen you, and perhaps there may be an opportunity later for you to get into the Alaskan work."

Roger bent forward eagerly to find out what was coming.

"If, therefore, you make good in the Survey during the coming year, I might take you with me next summer, in what is going to be one of the most interesting Alaskan trips ever undertaken, wherein I am going to make a reconnoissance of Alaska from south to north, beginning at Cook Inlet and working through to the Arctic Ocean. It will be my personal party, and because the distance is so great it will have to be a forced march every day without a break. That needs toughness, and of course I know nothing of your powers of endurance. One weak man in the party, you see, might delay us so that we would not reach the Arctic until after the freeze-up and then there would be no getting out."

"I may not be very big, Mr. Rivers," said the boy with a conscious gesture, "but I strip well."

The echo from the athletic field sounded strange in that office so full of the actualities of life, and even Roger himself laughed at the way his words sounded.

"I mean," he added, "that I was always able to do good track work and had lots of wind."

"You need more than that. You need muscle and grit. I think you'll do, Doughty," the explorer continued, "but if you want the chance of going with me next spring, you've got to make a reputation for yourself in the Survey. Learn your business as a rodman and so forth, become able to pack a vicious mule, know how to swim an ice-cold river with a six-mile current, get so that you can swing an ax and build a bridge, be an expert canoeist in a boiling rapid, sit anything with four legs that ever was foaled, accustom yourself to sixteen hours on the trail and to picking out the soft side of a rock to sleep on, grow to like mosquitoes, and by that time you'll be about ready for the Alaskan trail. But it's no job for a weakling."

"Those are just the very things I want to be able to do," answered Roger.

"I suppose you think because those seem to imply adventure that it will be all very pleasant in the learning, but there is another factor involved. We can find a hundred boys and men who are ready to face danger and hardship to one who will face the drudgery of every-day existence at the desk or in the field. It is not the shooting the rapids which is difficult, but it is the days of heart-breaking toil in packing around the rapids that test the man. Physical courage has ever been one of the cheapest of commodities, and if we needed only this in our work, it would not be so difficult to fill the ranks with the kind of men the work demands. My own experience would lead me to believe that what we need in the Geological Survey is the 'staying' rather than the 'dashing' qualities. And you must remember that even if you do come with me next year, there's no pull in it to bring you a sinecure, the chief of a party has entirely a free hand in the selection of his assistants, and their value for the work is almost the only consideration. If you come, it will be practically as a camp hand, just to do what you're told, whether it is what you want to do or not. Work on the Survey needs backbone."

Roger's jaw set hard.

"You can enroll me on that party of yours, Mr. Rivers," he said with determination, "and I'll be with you to the last ditch. I'm not altogether a city boy, I've roughed it a good deal, and by the time you're ready to start I'll be as hard as nails. I don't care what trouble it takes, I'm bound to go!"

The older man rose from his seat and put his hand on the boy's shoulder.

"You've the right spirit, Doughty," he said, "and I expect I'll be able to take you. You'd better go down and see the Director and he will get you started, so that you can begin to get ready to come with me next spring. No, on second thoughts," he added, "I'll go down with you myself."

Chatting pleasantly, the two took the elevator to the second floor of the Survey building, where was located the Director's office, and as John, the old colored hallman, told them that the chief was engaged, Rivers led the way into the big room, where Mitchon, the Director's secretary, had his desk.

"Well, Roger," said the latter, for he had met the boy before he had gone up to the Alaskan geologist's office, "did you find out a lot of things about Alaska?"

"Quite a number, Mr. Mitchon," answered the boy.

"And are you still as anxious to go as ever?"

"More!"

The chief of the northern work put his hand on the boy's shoulder. Then, greatly to the secretary's surprise, for he knew how rarely Rivers could be got to talk, the geologist recounted with gusto his endeavors to dissuade the boy by representing the hardships of the trail and how each successive obstacle had but deepened the lad's purpose; and when he told of Roger's determination to acquire in a few months all the accomplishments and virtues of an old-time woodsman, Rivers's short and infrequent laugh found vent.

"And I tell you what, Mr. Mitchon," he concluded, just as two visitors entered the room, "that's the kind of boy these United States want!"

On seeing the Director and his guest, the secretary, who had been leaning back in his swinging chair listening with great amusement and zest, sprang to his feet, but before he could say anything the visitor broke in with warm, enthusiastic tones.

"And that's the kind of lad I like to know. Shake hands, my boy, and tell me your name."

"Roger Doughty, sir," answered the boy, wincing a little under the grip.

"The first of the Carneller nominees," put in the Director.

But the guest had turned, and after greeting the secretary, spoke to Rivers, who still had one hand on the boy's shoulder.

"I think I met you with reference to Alaska," he said readily, "but I do not recall your name."

"Rivers, Mr. President," answered the geologist.

"Mr. President!" Roger felt almost suffocated with joy at hearing that this praise of him had come direct to the ears of the President of the United States.

"I am delighted, Mr. Rivers, delighted," said the President, "to have this opportunity of seeing you again, and to hear you approve this new plan so heartily."

"I didn't approve of it at all, Mr. President," answered Rivers with characteristic abruptness, "but this boy has converted me."

"Tell the President the story, Mr. Rivers," suggested Mitchon.

"I had been pointing out to the lad," accordingly said the geologist, "how exceedingly strenuous is the work on the Alaskan trail, how that none but picked, experienced men of iron constitution and frontier powers of endurance could carry out the work, and how one weak man in the party might cripple the entire season's trip."

The President nodded.

"That is absolutely true," he said; "that is why so many hunting trips are failures when there is a large party along. But I interrupt."

"So I urged that he must get a reputation before coming with me. As far as I can remember, I said to him, 'You must first learn your business as a rodman and so forth, be able to throw a diamond hitch over a vicious mule, climb a peak with no firmer hand-hold than your finger-nails will give you, learn to swim a glacier-fed river with a six-mile current, ride any brute that ever was foaled, run every kind of rapid in any sort of a canoe, find out how to swing an ax and build a bridge, be able to find your way over the most rugged country in the vilest weather or on a pitch-black night, get used to sixteen hours on the trail, and to picking out a soft rock to sleep on, chum up with grizzlies and grow to like mosquitoes, and by that time you will be ready for the Alaskan trail.'"

The President burst into a hearty laugh, and said,

"That ought to have settled him!"

"Hm! Settled him! He just said, 'You can enroll me on that party of yours,' and by all the powers, I will."

"You're right," said the President emphatically, "and I say to the workers of the Survey, as I said to another band of workers once, that it is a good thing that there should be a large body of our fellow citizens--that there should be a profession--whose members must, year in and year out, display those old, old qualities of courage, daring, resolution, and unflinching willingness to meet danger at need. I hope to see all our people develop the softer, gentler virtues to an ever-increasing degree, but I hope never to see them lose the sterner virtues that make men, men."

Roger listened with all his ears, hoping that the President would turn directly to him. Nor was he disappointed. After some congratulatory words to Rivers on the value of the Alaskan work and the ability displayed in its direction, he turned to Roger.

"My boy," he said, "you are starting out the right way. You are the first of a little army of workers who shall help to win the victories of peace. You have a nobler mission than that of preserving a fine tradition unspotted, you have the rare honor of making the tradition. Be manly and straight, give a square deal and never be afraid of hard work, and make for yourself and for those who shall come after you a record worthy of inclusion in the annals of the Geological Survey of which we are so justly proud."

He shook hands with Roger again, and bowing to Rivers and Mitchon, went on his way with the Director. For a moment no one spoke, both men watching the boy keenly. Suddenly the look of solemnity and attention slipped from his face, and stepping forward unconsciously as though to follow, he burst out:

"He's fine! Oh, isn't he just bully!" Then he caught the secretary's smile, and he checked himself. "And wasn't he just kind to me! Oh, Mr. Mitchon, how can I thank you, and you, Mr. Rivers. I have wanted to see the President for years and years, but I never dreamed of seeing him close, like that, and talking to him, except at some public reception, which

would seem altogether different."

Tears of pride and joy stood in the lad's eyes, and he choked, unable to go on. The men were touched by the boy's intense patriotism and emotion, and then the secretary said softly:

"That, Roger, will be something to inspire you and make you stronger in all the hard moments of your life. The greatness of the President," he continued, "lies in his power to make greater all those with whom he comes in contact."

"I could never forget it," replied Roger in a low voice.

"And now," resumed Mitchon, "I may tell you that we were sure Mr. Rivers would not advise you to go to Alaska this year, and Mr. Herold told me to take you to Mr. Field, who has charge of the swamp work in Minnesota. You will go out with him as soon as he opens field work, which, I presume, will be next week."

Rivers then turned to the boy.

"Doughty," he said, "probably I shall not see you again until next autumn, when I come back from an inspection of the Alaskan camps, but I don't want to lose track of you. Write to me here, at the Survey, at least once a month, and they will forward my letters. I will not add anything to what the President has said, because I think no more is needed, but I will say that if you make good as well as you promise, I shall be glad to have you in my party. Not," he added, as an afterthought, "because of your scholarship or any friendships you may possess, but because I think you will be willing to work hard and do your best."

"My word," said the secretary with a whistle, "that's a lot--from you."

"It is," answered the geologist, shaking Roger's hand heartily, and leaving the boy alone with Mitchon.

"And now, Roger," said the latter, "I will take you where you can begin to acquire that large stock of experience."



CHAPTER II A TENDERFOOT SNIPE-SHOOT

"What do you think of a man," said Mitchon to Roger, as they started for Field's office, "who can transform a festering tamarack swamp into a busy and prosperous farming country?"

"He must be a daisy," answered the boy emphatically.

"That's what Mr. Field has done in the last couple of years, and that's what you're to spend the next few weeks in doing. The Survey works for results, and if turning square mile after square mile of rankly timbered bog into a fertile region dotted with busy homesteads isn't getting results, I don't know what is."

"But how is it done?"

"By drainage, my boy, as you will learn. Hundreds of thousands of acres are being reclaimed. That's what makes a country rich; it isn't the gold stored in vaults, but the gold waving on the fields at harvest time."

"But it must take an awful lot of work."

"Of course it takes work. Don't you remember Mr. Rivers told you that there would be no chance to loaf? You'll start on that toughening process soon enough, all right, all right."

Turning a corner of a hallway, Mitchon and the boy passed into a small office, which was undergoing the throes of the annual tidying-up before being left alone all through the summer.

"Mr. Field," said the secretary, as he entered, "this is Roger Doughty, of whom I was speaking to you, who is to go out with you for a couple of weeks until Roberts comes back from the tule swamps and rejoins your party. You will have just about the same men as last year, will you not?"

The swamp surveyor extended a large loose-jointed hand to Roger.

"Glad to see you, Mr. Doughty," he said, and then, in answer to the secretary's question, continued, "I hope we do have the same men, Mr. Mitchon, it makes the work a lot lighter."

"That's what you all say; but it doesn't make so much difference to you as it does to the parties away off from civilization, does it?"

"Well," drawled the other, "Minnesota's civilization in that swamp country doesn't hurt her much yet, I reckon. When you're eleven miles away from the nearest road, and that only a 'corduroy,' in a swamp over which you can't take a horse, and through which you can't take a boat, you begin to think that other human beings live a thundering way off. Why," he said, "I've seen parts of that swamp so soft that we'd have to make a sort of platform of brush and three or four of us pull out one chap who had sunk below his waist, and that with only half a pack instead of the full load. No," he added, turning to Roger, "Minnesota's not so powerful civilized if it comes to that!"

"Why, I hadn't any idea that it was so wild! Is there much of that swamp?" asked the boy.

"Well, the little piece of land we're working on now contains about 2,500,000 acres."

"That's the Chippewa land, isn't it?" asked the secretary.

"Yes, all of it."

"What's Chippewa land?" queried Roger.

"It's land the Chippewa Indians ceded to the government to be held in trust and disposed of for their own benefit. It's worth just about nothing now, but when the land is all drained it'll be a mighty valuable section of the State."

"I saw a report on the crops from some of that reclaimed land," said Mitchon, "and it certainly was calculated to make the worked-out Eastern farms sit up. Well, I suppose I must get back, so I'll wish you good luck, Roger, if I don't see you again. You start soon, do you not, Mr. Field?"

"To-morrow morning."

"So soon? That means hustling."

"No, Mr. Mitchon, everything's ready, I reckon."

"Well," replied the other, "I hope you'll have a pleasant summer, and, Roger, you write and let me know how you like it. Good-by." But he had hardly gone three or four steps from the door when he turned back suddenly and said, "By the way, Roger, there's something I wish you would do for me."

"I'll be only too glad, Mr. Mitchon, if I can," answered the boy readily, eager to show his appreciation of his friend's kindness.

"That's a great snipe country you're going to, and I'm very fond of snipe. I wish you would send me a couple of brace. You organize a snipe-shoot while Roger's with you, won't you, Mr. Field?"

"Well, I'll try, anyway," answered the surveyor, "and we'll do the best we can to give you a feast."

Mitchon nodded and disappeared down the hall, and Field turned to the boy.

"Roger, your name is, isn't it?" he said.

"Yes, sir."

"Mr. Mitchon seems to think you're quite a shot."

"I've done a little shooting, Mr. Field, but I wouldn't like to call myself a crack shot."

"That's all right. Much better not to brag. If Mr. Mitchon wants snipe we'll go out some night and get him so many that he won't know what to do with them."

Roger's eyes glistened at the thought of a night shoot in a country where birds were so plentiful, and he began to congratulate himself that the Survey was just as good as he had expected, and even better.

"Now, son," said his new chief, "what kind of an outfit for the field have you got?"

The boy ran rapidly over the somewhat elaborate stock he had laid in for rough work, and when he came to describe the various shotguns and rifles with which he was provided he dwelt on them in detail, as it had been that part of his outfit in which he had taken the most interest, and in the completeness and excellence of which he felt great pride. But to his annoyance, instead of seeming impressed, the older man chuckled.

"You've got shooting irons enough for a regular stage brigand," he said; "you won't need all that truck, at least as long as you're with me. Take a shotgun, yes, and you can take a revolver along if you want to very much. You've been thinking more about your guns than you have about your boots, though, and you'd better go down and get a pair of river-drivers' boots this afternoon. Ones something like these." He pulled out of a drawer a special catalogue, and opening it, passed it to Roger.

"I've got a regular pair of fisherman's boots," volunteered the boy, "the kind that come 'way up to the hips. I should think they'd be just the thing for swamp work."

The surveyor shook his head,

"No," he said, "that sort of thing won't do. Water and mud will get in those. These others lace up tightly. Of course you'll be wet higher up most of the time, but as long as your feet are tolerably dry, that doesn't matter. Now you get those and do anything else you want,"--then handing him a map--"you'd better look over this too; and meet me at the Union Station to-morrow morning at 8 o'clock, and we'll take the 8.20 for Red Lake."

The trip out to Minnesota was the most enjoyable railroad journey Roger had ever spent. His leader proved as entertaining a companion as a boy need ever meet, and his stories of the wonders of the water power of the United States were more fascinating than any story of adventure.

"I was out in the dry part of South Dakota, one time," he said, "when some people, knowing that I was on the Survey, asked me to locate an artesian well site for them. That was a dry country, I reckon. Why, the little water that was there was so ashamed of itself that it tasted bad. Well, after I had studied the lay of the land for some time, I told them where to sink the well. It was an unlikely looking spot, I'll admit, but I knew there was water there if they would go down deep enough."

"But how did you know," asked Roger. "Did you use a divining rod?"

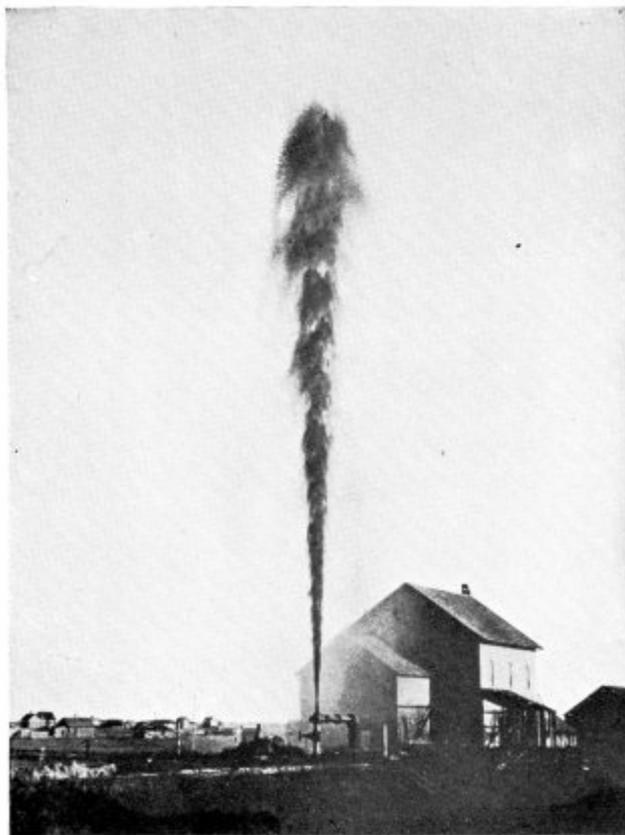
"I'm not a seventh son of a seventh son," said the older man with a laugh. "No, indeed, that sort of thing is done to-day by science, not by magic. You see, Roger, water will always be found in large quantities in porous rocks like sandstones, and none at all will be discovered in what are called impermeable rocks like shale and limestone."

"Why not?" asked the boy, interrupting.

"Because a porous rock is like a sponge, and will hold the water, and an impermeable rock isn't. So, you see, if a thick bed of shale is underlaid by a thick bed of sandstone, you are pretty sure of getting water if you drive a well through the shale."

"But I don't see how that helps," interjected Roger; "it seems to me it would be as hard to tell that there was sandstone so far below ground as to tell that there was water there. You can't see through rock!"

"No, my boy, but if you know the general make-up of the country, and how the rocks lie in the nearest mountains and in the ravines and so forth, you can tell. For example, if a river bed has been cut through the upper shale to the sandstone and through the sandstone to some other rock beneath, you are sure to find that sandstone under that shale everywhere, until you strike a place where geology will show that there has been some other change. In this particular case, the sandstone and the limestone appear in successive layers in the foothills of the Rockies, so that the water and snow from the mountains drains into the sandstone layer, which, being between two strata of harder rocks, can't sink any further down, but must force its way through the pores of that sandstone as far as the stratum runs. Of course things come up to complicate that, but such is the general plan.



Photograph by U.S.G.S.

A LOFTY SPOUTER.

Artesian Well at Woonsocket, South Dakota. Well throws a 3-in. stream to a height of 97 ft.



Photograph by U.S.G.S.

WATER ENOUGH FOR ALL.

Artesian Well at Lynch, Nebraska. Flows more than 3,000 gallons a minute.

"Well, as I was saying, the spot that I picked out looked so little like water, that the Burlington railroad people--it was the Burlington that had asked me about it--called in Spearon, who really was the expert on the work. He's an expert all right. He promptly approved the site I had chosen, and told them to go down and they would strike good water at 3,000 feet. At first they laughed at the idea of any man being able to guess at the existence of water, 3,000 feet distant through solid rock, but they knew that Survey statements usually are to be depended on and they began. Some water was struck in an upper layer, but Spearon told them to go on. A dozen times the railroad was about to give up the project as useless, but, being urged, at last they agreed to go down the 3,000 feet, but not an inch further. At 2,920 feet they struck the sandstone, and boring on to 2,980 feet they struck water, and so, within twenty feet of the exact depth advised, they got a well flowing half a million gallons daily under a pressure of 75 pounds."

"A couple of hundred years ago, they would have burned you at the stake for a wizard," commented the boy.

"They would, son, sure enough. But people never stop to think how important this very water is. Why, it is by far the most valuable mineral in the United States!"

"More so than gold?"

"A thousand times! More than coal, too, which is vastly more valuable than gold. The coal's going to give out some day--by the way, remind me to tell you what the Survey's done on the coal question some time. I'd tell you now, but there's a man who got on at the last stop that I want to see," and with a nod, Field rambled to the other end of the car.

With stories and anecdotes of the Survey the time passed quickly, and Roger felt quite sorry the next day to find that they had arrived at their journey's end. At the depot, a small frame station, the rest of the members of the party awaited them, with a big lumbering farm wagon, but a pair of the finest horses Roger had ever seen. He won the heart of the teamster immediately by noticing them, and had the satisfaction of knowing that he had made a favorable impression on his future companions for the next few weeks by evincing a ready knowledge of the good points of a horse.

The drive that afternoon through the upper Minnesota country was Roger's first experience of a corduroy road, that abomination of highways, which consists merely of logs laid down horizontally across a trail and some dirt and sand

sifted on top of them. In course of time, the dirt all seeps through between the interstices of the logs, and the latter arrange themselves in positions more picturesque than comfortable; which, being ridden over in a springless wagon at a good fast clip, is a more energetic "bump the bumps" than any amusement park has thought of inflicting on a suffering public.

Roger was thoroughly tired that night, though not for the world would he have shown it before his new-made friends; still he found much ado at supper to keep his eyes open and his head from nodding, when suddenly all his senses were galvanized into activity by the word "snipe."

"Boys, I promised Mr. Mitchon," Field was saying, "that we would have a snipe-shoot just as soon as we were able. Now, if we wait until we get right into the thick of the work, no one will want to knock off. Suppose we try a shoot to-night."

"Right you are," "Sure," "Just the thing;" a chorus of approval came from the members of the party and Roger was compelled to chime in with his assent, and, what was harder, to force an enthusiasm which, owing to his fatigue, he did not feel. Only one dissenting voice was heard, that of the farmer at whose house they were to put up for the night.

"There ain't no snipe round here," he said, "leastwise not this time of year."

"Yes there are, lots," answered Field, "I saw a big flight of them as we drove by that large slough a few miles out."

Roger thought it strange that the farmer should be mistaken about the bird season on his own farm, but surely people who could discover a flowing well 3,000 feet below the ground with nothing to show where it was, wouldn't be stopped for a few snipe. In fact, if any one had told the boy that the Survey had discovered the Fountain of Perpetual Youth or was making a detailed topographical map of Mars he would have accepted the statement without question or surprise.

The farmer's muttered objections being silenced by the united voices of the party, the plan of operations was outlined by Field.

"You see, Roger," he said, "as the youngest of the party you are always the guest of honor at the first few things the camp gets up, and so, as I promised, we'll let you have the best of the fun to-night. Remember, though, we expect you to get a big bag. It's a good dark night and you ought to be able to pick out a whole lot."

"But I don't see how you can work it at night," objected Roger. "Do you go out with torches, or how?"

"We'll show you how, when we get to that slough that I told you of. Bring that best gun of yours along, and we'll post you right where the birds will come."

There was a sense of strangeness about the whole affair which was puzzling to Roger, but he attributed it as much to his fatigue as to any other cause, and obediently fetched his gun out, saw that it was clean and in good order, and prepared to accompany the party. They borrowed a light rig from the farmer and started out. It was a little after nine o'clock when they left the house and fairly cold, while, as one of the men remarked, "It was as dark as the inside of an empty tar-barrel with the bung driven in."

They drove and drove for what seemed to Roger an interminable time, though he could not help wondering at the sudden twists and turns in the road, and several times, by the scraping of the underbrush against the body of the rig, he knew they were on no road at all. The undergrowth grew thicker and thicker and the ground more and more boggy, when, after they had been driving for at least two hours and Roger had fallen into a light doze, the horses were pulled up with a jerk.

"Here we are," said Field loudly. "Tumble out, boys."

The horses had been stopped at the very edge of an immense marsh, that looked almost like a lake in the dim light, but that its margin was fringed with reeds and bulrushes, and although it was so early in the year a scum was beginning to form. The place was not at all inviting, and Roger felt well satisfied that he was not there alone.

"Now, son," said Field, lighting a large lantern which was part of the camp outfit, "you stay right here and we will drive the horses away a little distance so that the possible noise of their moving about restlessly won't disturb the birds, and then we will circle the slough in both ways and drive the birds to you. You see, they won't rise at night, but keep to the ground, and if we start in opposite directions from the other side of the slough all the birds will come together right where you are. Then, when they find their escape cut off, they'll have to hit the water or else take wing."

"But it will be pretty hard to shoot them," protested Roger; "it's almost pitch-dark."

"They won't rise until they come into the circle of light shed by the lantern," said Field, "and then, if you're quick, you

can get them as they rise. Now, remember, you've got to keep silent, or else, caught between two fires, they will scatter back from the water; we will be silent, too, so as not to scare them too much. Keep still, and don't shoot until the snipe begin to come into the light."

With this Field jumped into the rig, and a minute or two later Roger heard him stop the horses and speak loudly about tying them to a tree. A few moments later, he returned with one of the men.

"Harry and Jake have gone round to the south of the slough," he said, "and we will take the other side. Now remember, not a move until the birds begin to come. Good sport to you," and they were gone.

Roger sat patiently with his gun across his knees, waiting for the birds to come. He had been sitting perhaps for a quarter of an hour, when a very faint "Coo-ee" was heard and he stiffened to attention. The men, he thought, must be beginning to drive the birds from cover. The night wind was chill on the edge of the marsh, and Roger, expecting every minute that the birds would begin to come into the circle of light, dared not move. His left foot became numb, but he did not rise to his feet until the numbness became unendurable, and then, as softly and silently as he could, he stood up. The scene was even more lonely, viewed standing up. There was not a light to be seen, not a sound to be heard, save the hoarse croaking of the frogs and the booming of a bittern in the far distance.

The minutes passed into hours, until it became agony to refrain from sleep, but Roger felt that he would be forever disgraced in the eyes of his comrades if he were found asleep at his post on the very first occasion they had given him a trial of endurance, and he promised himself that he would stay awake, no matter what it cost him.

Then a faint mist began to wreath upwards from the lake and took all sorts of fantastic shapes before the boy's tired eyes, and while, for a little time, it afforded him occupation to watch their curling gyrations, at the last this but added to the dreariness of the place. Once his eyes had closed and he dozed for a few seconds, when he was aroused, and not only aroused but startled, by the far-off howl of a wolf. Roger was no coward, and had all the boy's contempt for the coyote of the prairies, but he was woodsman enough to know that the coyote troubles timbered lands but little, and that the call was from the throat of the dreaded timber wolf.

What would not the boy have given for one of his rifles? But there he was at the edge of a slough, not even knowing in what direction he could retreat should flight prove necessary, with no weapon but a shotgun loaded with small bird-shot, and a timber wolf prowling near. Once, indeed he thought of shooting in order to attract attention, but the morbid fear of being thought timid and old-womanish restrained his hand from the trigger.

Again came the call, clear and unmistakable this time, and drawing nearer. All the wolf stories that he had read beside the fire at home rushed across his memory now--the Siberian wolves who chased across the steppes that traveler who saved his unworthy life by sacrificing to the beasts successively the three children intrusted to his care; the wolves who picked clean the bones of all the inhabitants in the Siberian village who refused to help escaping prisoners; the were-wolf, who, half-maiden and half-brute, lives on the blood of men; until, in spite of his courage, Roger found himself feeling far from at ease and deeply wishing that some of the others in the party were there to keep him company.

Again the wolf howled, a long-drawn-out howl with a little "yap" before it. Had Roger but known, he need have had no fear, for such is not the call of an angry or a hungry wolf, but merely the cry of the solitary hunter not running with the pack. A wolf after his prey does not howl, but gives a succession of short, sharp barks. Presently the boy received a sensation as of movement among the bushes to his right. He looked intently, but could see nothing. At one time, indeed, he thought he could discern two specks of light that might have been the eyes of the intruder, but knowing how easily the eyesight is deceived when it is being strained, and also having the good sense of not making matters worse by wounding a beast he feared he could not kill, Roger contented himself by keeping a lookout with every nerve strung. There was no longer any thought of the snipe, they had paled into insignificance before what appeared to be--although it was not--a real danger.

So Roger stood, watching the brush, the long night through, the little lamp shedding its pale gleam upon the ground at his feet and glimmering upon the waters of the lake, until in the east the first gray light of the false dawn began to appear. Gradually the light increased, and Roger with a sigh of relief took his eyes from the bush he had watched anxiously so long. As the day began to break and to disperse the slight mist, objects in the distance seemed to take shape, and Roger could hardly believe his eyes when he saw, but a few hundred yards away, the very house where he had supped the night before, and from which he had been taken a long two-hours' ride.

In a moment it all flashed on him, the old farmer's incredulity at the presence of snipe at that time of year, the readiness to put the newcomer in the place of honor, the unanimity of all the members of the party in falling in with the chief's suggestion, the folly of shooting anything on a pitch-black night, and he saw that he had been hoaxed. He was wet, incredibly weary and stiff from the strain, and Roger's first impulse was that of intense anger. As he would have phrased it himself, he was "good and mad." The boy soon reflected, however, that if this was a regular performance on

the tenderfoot--which appeared probable from Mitchon in Washington having been in the game--a good deal depended on the way he took it. They would expect him to be angry or sulky. Well, he would disappoint them.

Just as he was about to walk into the barn, however, where he proposed to have a nap in the straw, who should meet him but Field and another of the men! They greeted him with a shout of laughter and satirical queries as to the number of snipe he had shot. Roger schooled himself to laugh in reply.

"That was one on me, all right," he said, "but this is only my second day. It's your turn now, but mine will come some other time."

The chief laughed appreciatively.

"That's the right way to take it, Roger," he said, "and now you'll know enough not to go shooting snipe any more at night, I reckon. But, lad, it's early yet, and we won't start for a couple of hours, so you just turn in and we'll call you when we are ready to go."

"I won't deny that I'll be glad of a nap," said Roger, yawning, "and I'm mighty glad that this part of my initiation is over with."



CHAPTER III FOOLING A RESCUE PARTY

Roger speedily found that Field's remark to the effect that the "snipe-shoot" had better take place before the actual work started was really a merciful suggestion, for three or four days later, when the swamp survey was in progress, the boy found himself at night so tired that he would not have budged from the camp for anything smaller than a tiger. He was no mean athlete and had been accustomed to consider himself in good training, but after a day in the marsh the muscles of his back felt as though he had been lying on a corduroy road and allowing a full-sized steam roller to run over him.

The work itself was not so hard to understand or to follow, but the difficulties of the nature of the ground made it appear to him almost insurmountable. Arising early in the morning, about half-past five o'clock, he found himself fully ready for breakfast, which was duly over by half-past six, when the work of making up the packs began. Each man in the party was supposed to carry a pack, all the properties of the camp being divided up into equal weights. The making up of these was a source of no small anxiety, as the division of weight made a lot of difference in the day's march. The load was so divided that it would rest upon the back, just below the neck, and to keep it in place a broad strap, called a "tump-strap" was passed across the forehead. If the strap was a little long, or the load adjusted so that it hung too far down, the effect was to jerk the neck back until it seemed that it would snap off, while if the load was too high up on the neck, in order to distribute the weight evenly the bearer would have to bend so far forward that he would be walking almost double.



Photograph by U.S.G.S.

IN THE TAMARACK SWAMP.

Morning start from small dry spot where camp was made. Chief of party in center, holding axe.

Sometimes, though not often, the party was able to proceed straightaway without any ax-work, but more often all hands had to set to work, clearing away underbrush and second growth so that a clear distance might be secured for making a sight. At first it would seem that a swamp perforce must be level, and in such a case drainage would be extremely complex and difficult, but in the Chippewa swamps there is a heavy fall toward the Red Lake River, this fall, however, being interrupted by numerous small hog-backs and elevated stretches of ground which might almost be called islands.

"But, Mr. Field," said Roger to his chief, when this was explained to him, "if a drainage ditch were cut direct from the highest point of the marsh to the Red Lake River, would not all the water naturally flow into it, and so drain the swamp without all this elaborate surveying?"

"And how would you find the highest point or points of the marsh," said the other, smiling, "without a survey? You see, son, this swamp is like a continent on a small scale. It has its mountains and its valleys, its plateaus and its ravines, though these be measured in inches instead of hundreds of feet. Now, if this ground were rocky, all this drainage would make for itself a network of small streams and flow down to the river, but as the ground is naturally spongy the water

has lain instead of running, and therefore has not cut any channels. Add to this the hundreds of thousands of years' deposit of rotting vegetation, and you see how impossible it is for the water to do what would naturally be expected, that is, find its own level."

"But it must flow down some time, surely," said the boy.

"The overplus does. In spring, that is to say in early spring, right after the snow melts, this whole swamp is a sheet of water, even worse than it is now, and the houses on the higher grounds are on islands, the farmers going to and from them with boats, but that soon runs off until it reaches the level of complete saturation, in other words, a bog as wet as it can hold. Now, what we have to do, is to trace this highest point or points, such as you spoke of, or, to speak more correctly, the succession of the lines of highest points, a very crooked series of lines, and find out their relation each to the other. This you see, will divide up the swamp into several drainage areas. Then each of these areas is to be surveyed to determine the line of drainage, the whole to be conformed to the main ditches that will flow to the river, and this intricate network of ditches must be kept at just the exact level of fall, so that it will flow unencumbered to the streams on either side of the swamp."

Roger whistled softly.

"That's why you've got to go over every foot of the country so carefully," he said.

"Of course. If it wasn't for the trees and brush, which prevent us seeing just where every little rise is, it would be comparatively easy, but unless we know the lie of the ground, we might plan a ditch just on the wrong side of a ridge of comparatively solid earth, which would divert the entire stream. Of course, there's a pretty good fall to the river, both the Mud River and the Red Lake River, but even so, an unobserved ridge of earth a few feet high, running along for a couple of miles would throw out the value of that particular ditch and create the cause for a new drainage area."

"I see," said the boy, "and I'm very glad you told me, Mr. Field, because it did look to me as though a lot of this exactness was unnecessary."

"We do nothing unnecessary on the Survey," came the prompt response. "No man knows better than we how much work there is yet to be done."

As the days went on Roger found himself becoming quite apt at the pack work, and, to his great delight, found his muscles hardening under the exercise so that the strain was not so great. Several times too, and this gave him great joy, the chief would send him out off the line of march, not more than fifty yards, with instructions to report on the nature of the ground. When about that distance, well within earshot, he was supposed to "Coo-ee" in order to find his way back to the party.

It chanced one afternoon, right after the short stop in the middle of the day, that Field sent Roger off, to the right of the party, in quite dense timber, and told him not to go further than twenty-five yards away. For twenty or thirty feet the boy hacked manfully through the underbrush, and then, to his delight, came across a smooth piece of marsh overlaid with water. Testing carefully every step he took, the lad found the bottom of it less like a morass than was the general character of the swamp, and he knew enough to realize that there must be firm ground on the other side. Knowing, moreover, that a piece of information such as this would be of great assistance he ventured to cross the stretch, and as he surmised, found a small hog-back on the further shore of the shallow lake. This ran parallel, so far as he could judge, with the route being taken by the members of the party, and Roger conceived the idea of following along this line, until it would be time for him to rejoin his friends. The wood was thick on the ridge, however, and Roger found that he was not making good time, so after going half a mile or so, he decided to strike across and meet the rest of the party.

When Roger turned, however, he found that he had ceased to be opposite the slough, and he plunged into a dense and palpitating quagmire, the kind against which he had been specifically warned, fairly firm on the surface, but which quivered like a jelly as far as he could see when he stepped upon it. None the less, it was the only way the boy knew to rejoin his comrades, so with considerable trepidation he stepped upon the edge. It held him, though with a sort of "give" that was most unpleasant. Another step he took, and this time the quag seemed to resent his intrusion; large black bubbles formed slowly and broke a few inches before his foot and the ground seemed to heave in front of him. The boy realized that he could go no further, but for daring and curiosity he took another step gingerly to see what would happen.

He learned! As the foot touched the ground it sank even with the little weight that he threw on it, almost to the depth of an inch, and with that slight pressure suddenly the suction of the marsh gripped him as though some foul fiend had him by the heel, and he threw all his weight back on his left foot in an endeavor to pull out the right. But this disturbed the balance of his poise, and the sudden weight on the one foot caused it to break through and the marsh had him by both feet. The pressure was so fearful that Roger knew shouting was useless, he would be deep under the quagmire

before his comrades could even begin to find him.

But Field had not instructed Roger for nothing, and the lad was quick of thought. Instantly he threw his surveyor's rod down so that one end was on the comparatively dry ground whence he had stepped, the other by his feet, and with one supreme effort he threw himself flat upon the rod, though wrenching his ankle cruelly as he did so. This distribution of his weight over so much larger a plane surface prevented his further sinking, but the suction was still so great that he could not draw out his feet. Finally, by exerting all his strength he freed the one that was furthest out, and which had sunk but little, but he was held a prisoner by the other foot. Then an idea occurred to him. Taking his ax, he chopped the ground around his leg, and had the satisfaction of seeing water bubble up in its place. Little by little he loosened the suction of the bog until at last he was able to pull out his foot and crawl along the rod to the bank, where, trembling and exhausted, and suffering considerable pain from his wrenched ankle, he sat upon a projecting root to recover his breath and his somewhat shaken nerve.

This was Roger's first experience of the folly of attempting more than he had been told to do, before he was an old enough hand at the game to know the greatness of the risk. As soon as he had in part recovered himself, he shouted, according to agreement, expecting to hear immediately the return hail, which would tell him exactly where the party might be. But there was no answering cry! A little startled at the thought that he might have wandered out of hearing of the party, Roger waited a moment, then, making a megaphone of his hands, let out a stentorian howl, for all that he was worth. But the cry fell stifled in the dense branches and a muffled echo was the only response. Thinking that perhaps a whistle would sound further, he put his fingers in his mouth and whistled long and shrill, a note loud enough, it seemed to him, to be heard for miles; but for all the token of human answer, it might have been the crying of the curlew above the marsh.

By this time Roger was fully alive to the difficulties that confronted him. If he were out of reach of the party, and could not make himself heard, it would be very difficult to trace them, even if he crossed their trail; unless it were where they had been making a sight or where undergrowth had been cut, there would be no mark of their passage, as the soft ground speedily sucked in all trace of footsteps. A shot, he thought, would travel farther than the voice, and so, taking out his revolver, the boy fired three times in the air. He strained his ears eagerly, though fearing that no shot would answer, but when the minutes passed by he knew that he was lost and that he would have to find his way back to the party unaided.

But one thing remained to be done. He must retrace his steps, trusting to his new-born knowledge of woodsmanship to lead him aright, back to the place where he had gained the ridge of ground from the shallow lake, then cross that, if he could remember the direction, and he would be but twenty yards or so from the path the party must have traveled. He would be a couple of hours behind them, of course, but if he could strike their trail he was bound to overtake them some time that night. There was no other alternative, he must endeavor to find them, even at the risk of becoming still more enmeshed in the mazes of the swamp.

Limping back over the ridge of ground, his ankle growing sorer each step, Roger painfully wended his way to the little lake. He found the ridge, but in returning it appeared to divide into twain paths, and for a moment his heart sank within him; as luck would have it, however, he remembered seeing a tree that had been struck by lightning somewhere about where he then was, and he determined to go along each of the paths until he struck the tree. Taking the left hand, at random, he hobbled along for half an hour, but seeing no blighted tree, retraced his way and took the other path. Just as he was about to give up that route also, in despair, the sentinel tree on which he had been building loomed up before him. It was the first sure sign that he was on the right trail, and Roger let out a boyish whoop of delight. Suddenly he thought he heard an answering yell, and he called again, but there being no answer he felt that his ears had deceived him. Soon he came to the banks of the little shallow lake, and struck in to wade across.



Photograph by U.S.G.S.

A TANGLE OF SWAMP.

Conditions which must be overcome by topographic parties, though "too wet for walking, too dense for boats."

It then became evident to the boy that he had entered the lake at a different point, for while it had been a little over his knees at the deepest part before, now it came to his thighs and was steadily deepening. In the middle the water was almost to his waist and the boy began to be alarmed concerning the contents of his pack, which he had stuck to throughout despite the pain in his foot. But while the water came to within six inches of the pack at one place, the bottom remained fairly hard, and presently it shallowed rapidly and Roger stood upon the farther shore.

This time, however, the luck which seemed to have deserted him so long, returned, for he found himself, in the course of a few steps, just at the place where the brushwood had been cut recently for the making of a sight, and the boy knew that he could not now be very far from the rest of the party. He followed the blazed trail as rapidly as his somewhat crippled condition would permit, shouting occasionally as he did so, when suddenly he heard voices. Stopping to make sure, and hearing speech quite distinctly, he hurried on, coming at last to a dense dark piece of the wood through which a path had been hewn with some difficulty. Another two minutes, he was assured, would bring him among his comrades, when he heard the voices again, and what they said made him pause.

"It's a good one on the boy," said one of the voices.

Roger knew that he was always spoken of in camp as "the boy," and he thought if they were planning some practical joke on him, like the "snipe shoot," over which they had never ceased to tease him, there could be nothing wrong in listening so that he could checkmate it.

"He must be quite near us, now," replied the other.

"Almost as near," said the first speaker, "as he was when he first thought that he was lost. That was an awful howl he gave, the second one we heard. It would make a fair sample for an Atlantic liner's foghorn."

Both men laughed, and the rich, easy voice of the chief of the party broke in.

"I'm not sorry the boy got a scare," he said; "he's all right, is the boy, but he thinks he knows it all. They all do, at first. I told him not to go thirty yards away, and one way and another he must have gone a mile. It's a good thing he paralleled us, or somebody would have had to go after him."

"I thought sure he'd find us right away when David called back," said the first speaker.

"Yes," replied Field, "I thought so, too. But he didn't, you see. Now let him learn how hard it is to find a party in these swamps and he'll know better next time. You've got the location of his last call, haven't you?"

"Sure!" said one of the men.

"Oh-ho!" thought Roger to himself. "So that's the reason I got no answer to my shouting and my shots. They're just

waiting until I get in to guy me some more." He sat down on a root and thought for a few minutes. Then he grinned, and decided to bear the pain in his ankle a few moments longer. Striking off sharply from the trail that had been cut, he wormed his way up and on until he was almost opposite the party, and directly to the left; then, holding a bunch of grass over his mouth to give the muffled sound as of great distance, he gave a howl, putting into it as much anguish as he could manage.

As he expected he heard the sounds of work cease.

"The young idiot's wandered off the trail again," he heard David say to the chief.

"Well, get the direction," was the answer, with a tinge of annoyance this time, "and you two had better go after him. I made sure from his last hail that he was right by the camp."

Roger waggishly nodded his head in the direction of the speaker.

"I don't envy those two men their job," he said in an undertone, and, doubling on his tracks, he came back to the trail that had been blazed. Then circling round to the right, so as to be in the opposite direction from that which his searchers had taken, he quietly made his way past the working force and came to the spot where the cook was just making preparations for dinner. Unobserved, he crept quite close to the camp, and finding a convenient spruce with widely spreading branches, he climbed up some fifteen feet, where was a natural hammock in the boughs, and lay down, taking off the boot from his swollen foot and awaited what should come.

He had not long to wait. In less than half an hour the two men returned stating that they had found some signs of ax-work in the vicinity of the last hail, but that they had called and called and received no reply. The men spoke gravely and one of them said:

"I hope the youngster has not struck a quag!"

The leader gave an impatient exclamation.

"Well," he said, "it's our own fault if we have any trouble finding him, but he has been within a hundred yards of the camp all this time that he has been making such a fuss, and how he could be such an ass as to cross our trail and get on the other side of it without noticing, gets me."

Roger chuckled.

"You'll find it harder hunting for me than I did for you," he said to himself, "and perhaps the laugh won't be all on the one side."

He settled himself more comfortably in the tree and listened to Field giving instructions to the members of the party how they should separate and circle at an appointed distance, calling every few minutes as they did so.

In less than a quarter of an hour the camp was vacant except for the cook, who was still busy preparing the evening meal. That was the only part that was hard to Roger, for he had been through a good deal of excitement since lunch and not only was tired, but also very hungry. His foot was not hurting so much now that he was not stepping on it and with his boot off, although it had puffed up rapidly after the removal of the boot. But to be up in the branches of a tree, as hungry as a wolf, and to see the grub below, was almost more than boy nature could stand.

Presently the cook, having laid out a loaf of bread and a knuckle of ham, picked up his ax and went into the brush to get a little more dry wood, which was somewhat scarce about the camp. Roger slipped down from the tree and seized the bread and ham. Then in order that it might not be suspected who had done it, he scabbled on the tin plate with some mud, and in the stiffer soil about--for that was the reason it had been chosen for a camp,--he made some tracks with the first, second, and third knuckles of his hand and the mark of his thumb knuckle behind. At a little distance the track looked almost like fox tracks. By stepping carefully on tufts of grass he kept the marks of his own feet from being seen, and then, with his booty, he returned to the tree.

He was hardly more than safely ensconced among the branches when the cook returned. He busied himself about the fire with the wood that he had brought, then chancing to look at the dish, he saw that the hambone and the bread had gone. The cook, whose language was that of a woodsman, consigned all four-footed thieves to perdition, and then bent down to examine the tracks. He looked at them carefully several times over, then:

"I sure would like to see that beast critter," he said, "fer that's the most plumb foolish tracks I ever set eyes on. It must be fox--but there ain't no foxes in this kind o' country, and, anyhow, the tracks don't mate."

This was true, for Roger had made the tracks, both on the nigh and the off sides with the fingers of his right hand. The

cook, after muttering and grumbling to himself, got out from his store of provisions enough for the meal, and proceeded to cook the same, not without many returns to the mysterious tracks and comments more or less audible on creatures with feet like that who were so apt at thieving.

Presently two of the party came in, shaking their heads negatively to the cook's questioning gesture.

"Nary a sign," said one of the men, "he's lost a good and plenty."

"I ain't got much time to help," said the cook, "though I'll go out with you after supper. But this spot has got me locoed."

"How's that?" asked one.

The cook pointed to the tracks.

"I used to think I knew quite some about the swamps," he said, "I was born with an ax in my hand, pretty near, but I never yet saw any critter with tracks like them. An' what's more, I ain't never been informed that ham sandwiches form a reg'lar part of a fox's menoo!"

One of the men bent to examine the tracks, but the other said airily:

"I'm no Seton-Thompson on the tracks question. Wait till David comes, he's a regular nature-faker for you. Leave him alone and he'll tell a tale of seeing a fox do the honors at a ten-course dinner with squirrels popping the champagne corks."

The cook laughed, but awaited the verdict of his comrade, who, after a prolonged examination, straightened himself, and remarked soberly:

"That's got me! You say the hambone and the bread were clean gone?"

"Clean as a whistle! There was a lot of mud on the dish, and that was all."

"Put it up to David, or Field. Field will tell us all he knows, and what's more, will explain why he doesn't know the rest; but David will put up the best yarn."

A few minutes later the rest of the party dropped in and in turn expressed surprise and conjecture about the confusing marks upon the ground until all were back except David and the chief, and shortly David appeared.

"Where's Field?" one of the men asked.

"He stayed behind a minute or two for something. He said he'd be right along. No," he continued, in answer to a question, "we didn't see anything of the boy."

"Well, it's a good thing you're here, anyway," said the cook, "for we've been waiting for you to explain a mystery that's puzzled the whole camp. You're a woodsman, you know, and it's up to you to tell us."

"All right," said David with a confident swagger. "Trot out your mystery."

The cook led him to where the tracks were visible in the soil and related to him the theft of the hambone and the bread, concluding with:

"And what we want to know is--what kind of a critter made them tracks?"

David stooped down for a few seconds and looked at the marks on the ground, then turned around to the fellows grouped about him, and said in a tone of scorn:

"You don't know what that is?"

"No, what is it?" responded one of the men.

"Well, you're a pretty lot of lumberjacks not to know a swamp angel's work when you see one."

"Swamp angel?" queried the cook in amazement.

"Swamp angel, of course. Yes, why not? I suppose"--this in a tone of much condescension--"you have heard of a swamp angel?"

The cook grinned at him.

"You're a good one, David, all right," he said. "Go on, tell us about a swamp angel."

"Why, a swamp angel," said David, thinking rapidly, "is a cross between a flying squirrel and a flying fox----"

"With a strain of flying-fish thrown in. Go on, David," interrupted one of the men with a laugh.

"It lives only in the densest kind of swamps," went on David, ignoring the interruption, "and it is called an angel because it can fly so readily. Its chief characteristic is that it crosses its legs while walking, so that the off fore and hind leg track on the nigh side and the near ones on the off. That's what gives the tracks that peculiar look you noticed. Its usual food----"

"Is ham sandwiches," broke in the cook. "No, David, I guess the swamp angel yarn's a little strong. Here comes the chief; we'll see what he says about it."

As soon as Field arrived near the group of men, the cook started in to tell him about the theft of the food, but the chief stopped him.

"To Texas with the hambone," he said; "we've got no time to waste talking about trifles. It's up to us to find that boy without delay. I hold myself to blame in not getting after him sooner, but his last hail, it seemed to me, just before the one I sent you to find him on, was only a few yards from the camp. How, in so short a time, he could have got out of earshot, is a thing I don't understand. I only hope he hasn't put a bullet into himself somewhere with that pesky little gun of his while he was firing all those shots. Get busy at the grub, boys, because if we don't get him by the time it's dark, he may be out all night, and I don't want that."

"He can't be very far away, Mr. Field," said David.

"As long as he's out of reach, it doesn't much matter whether he's near or far. But he must be found, if it takes all night."

All through the supper the men discussed plans for the finding of the boy, but when Roger heard Field tell two of the men to start out and not return until midnight if they hadn't found the lad before then, he thought it was time to bring the jest to an end. He parted the branches over the chief's head and looked down.

Then, suddenly, the men gathered around the fire heard Roger's voice, saying in a smooth and sarcastic manner:

"I was never called an angel before, not even a swamp angel, though I'm pretty well up toward heaven in this tree. But this hambone is very dry eating, and I guess I'll come down for the butter and the mustard."

"You blithering idiot!" said Field, looking up angrily, though there was evidently a great relief in his voice, "get down out of that."

"Oh, very well!" said Roger with a grin, as he descended the branches of the tree. Then, coming into the circle, he added, "I thought I'd come down and help you eat that snipe that Mr. Field has just brought in!"

CHAPTER IV IN THE GIANT TULE SWAMPS

From the time that Roger fooled the members of the party just as they were organizing a rescue search for him, his path became much easier. Though still he occasionally made mistakes, as was unavoidable, he found they were condoned rather than exaggerated. Indeed, the boy realized that he was no longer treated as a tenderfoot, as he had been but a few weeks before, but, none the less, he was not sorry when Field told him one evening that he thought Roberts would be along shortly.

Roger was growing weary of the Minnesota work because it was evident that it consisted of the same routine day after day, that it was unremittingly hard work, and that the sense of progress was slow in proportion to the labor involved. Then the mosquitoes were beginning to get troublesome, and worst of all, the "bulldog flies" began to make their presence felt. These large horse-flies, which madden cattle and drive horses to distraction, in certain parts of the marsh were ferocious and hungry enough to attack men. Roger found that he was popular with them and got many sharp nips, which, though in no sense dangerous, were irritating and painful.

"I don't want to seem ungrateful, Mr. Field," he said, when his chief broached the return of his former co-laborer to him, "and I'm not, but Mr. Mitchon seemed to think that I would only stay a few weeks here, for the sake of the experience and to get the hang of this kind of work. I think I have gained some knowledge of it, and," he laughed, "I can shoot snipe and teach swamp angels to steal ham sandwiches."

The chief smiled in response.

"You turned the tables on us very neatly that time, Roger," he said, "and you really had me badly worried, because, as you know yourself, these swamps are not a good place to get lost in. I reckon, from what you've told me, that if you had walked heedlessly on into that quag without trying to test it step by step, you would still be there, only at the bottom instead of the top."

"I really believe I would," answered the boy seriously.

"If you stick to the Survey," went on Field, "and come to be the head of a party, particularly in wild country, you will see how necessary it is to do just what you're told instead of trying to run the thing your own way. If you follow instructions and anything goes wrong, then the fault belongs to the head of the party, who is supposed to have enough judgment and experience to know what to do in an emergency. What could have been more simple than to go twenty or thirty yards farther away than you had been told, just as you did, for instance, and yet, if you had not been lucky, you would have disappeared forever in that quagmire and by your death spoiled our record."

"Have many lives been lost in Survey work?" asked Roger.

"In the nearly thirty years of the existence of the Geological Survey, as a separate branch of the Department of the Interior," replied Field, "during which time explorations of the most extreme peril have been undertaken, only one life has been lost. Really, when you come to consider how much of the work has been done in lands absolutely unknown, and that thousands of miles of territory have been covered wherein a white man had never before set his foot, this is nothing short of astounding."

"But if sickness should strike a camp?" queried the boy.

"Hard work, clean living, good judgment, and the open air, are worth all the drugs we know about and a whole lot more that we don't. Of course a small chest of certain radical remedies accompanies each party, with quinine and things like that, but it is seldom that it is opened."

"But how about accidents, Mr. Field?"

"Such as?"

"Breaking a leg by a fall, or something like that," the boy responded.

"I don't see what business any man on the Survey has to fall. That isn't what he's there for. He's there not to fall. Personally, I have never had any accidents which would need other than ordinary attention, nor have I had any with any members of my party. Then an injury would have to be pretty bad, any way, that couldn't wait until some kind of a doctor was reached, that is unless it was in the north of Alaska, or some place like that, and in such trips a little surgical case is sent along, and the chief would do as well as he could do with it."

"Then," said Roger with a short laugh, "I'm just as glad that I'm not at the bottom of the quag, for your sake as well as

my own, for I should hate to be the one to spoil the Survey's record."

But while Roberts was expected in camp shortly, a couple more weeks rolled away before the party, completing its line through a very difficult piece of marsh, headed for one of the famous corduroy roads and made its way back to headquarters. There, with one of the farmer's children on his knee and the others grouped around him sat Roberts, occupied apparently in telling some interesting story or fairy tale. He put down the youngster and shouted as the party hove in sight.

The chief was delighted without question to see the newcomer, for while he had been greatly pleased with Roger, the boy could not be expected to be as valuable as an experienced man, and was not to be depended on to proceed in his work without instruction and supervision.

"I was looking for you a couple of weeks ago, Mr. Roberts," he said.

"I expected to be here earlier, Mr. Field," answered the other, "but Mr. Herold asked me to put in a few days in that Susquehanna flow-measurement business, and that put me back."

Roger looked inquiringly at his chief, who catching his look of question, said,

"Well, son?"

"I would like to ask," said the boy hesitatingly, "what that stream flow-measurement is for?"

Roberts looked up a little surprisedly, but a few words from Fields explained the situation, and the newcomer turned to Roger quite affably.

"Certainly, my boy, it's very simple," he said. "You see, all work on rivers, whether for the purpose of irrigation, flood control, or navigation, is dependent on the amount of water that flows through that river channel every year. A week of wet weather makes a vast difference to the amount of water the river is carrying, and a dry spell cuts it off."

"But don't springs and things keep the water about even?" queried the boy.

"No, indeed," answered his informant emphatically. "Why, the Tennessee River, which I worked on once, for three months never flowed more than 20,000 cubic feet per second, yet that same year, for fifteen days in the spring, it tore down with over 360,000 feet a second. In other words, in the spring it was as big as eighteen rivers its usual size."



Photograph by U.S.G.S.

MEASURING STREAM FLOW.

Trolley line one mile long, over an Eastern river. Instruments pulled up, ready for return to the bank.

"Are all rivers like that?"

"Most of them. You see, suppose in the middle of summer a river is ten feet deep with a three-mile current, in the autumn is only four feet deep with a two-mile current, but in the spring floods goes rushing through its bed forty feet deep with a ten-mile current, it makes a mighty difference to the towns and villages all the way along. The destructiveness of a flood lies in the top few feet of water. In the second place, the navigation of a stream can only be estimated by its lowest depth recorded, and its horse power in the same way. But this same river, which in the autumn was only four feet deep and developed a corresponding horse power, would have an average depth of eight feet with four times the horse power. If then, the water that wastefully and ruinously flows down in the spring is conserved all through the summer, the river has been made more than four times as valuable."

"And how is this done?"

"That's too big a subject to take up now. Still, you can understand that if you dam the stream high up, and divert all the water over a certain height into immense reservoirs, the water could be let down gradually later. But that all depends on the measurement, which is taken daily for years, often--as in the case I was in--from a cable stretched from bank to bank, from which a little 'bos'un's chair' is hanging on a pulley, so that sitting in this little framework you can reach up to the cable and pull yourself to and fro. The one over the Susquehanna, where I was, is over a mile long, and of course it's pretty high up to allow for the sag, which is not small on a wire of that immense span."

Roger had a host of questions to ask but kept silent, not wanting to monopolize the talk when older men were there.

"By the way, Roberts," asked Field, seeking to change the subject from a topic which was stale to all the members of the party except Roger, "how did you like the work in the lower Sacramento Valley?"

"Parts of it weren't so bad, Mr. Field," was the reply. "Indeed, I think I've struck worse going right up here and in the

Mud Lake district, but the project down there is on so large a scale that one is bound to become enthusiastic in the work. The bush is very dense, of course, semi-tropical in character, but where the growth is heavy the swamp is not so bad, so that it becomes a mere question of bushwhacking. Then, too, that southern stuff is all soft to cut and much easier to get through. The tule grass, however, is different."

"I've never been down in that tule grass," said one of the party, "is it as bad as has been described?"

"It's never been adequately described on paper," was the ready answer. "Uncle Sam wouldn't let the report go through the mails."

Roger grinned.

"But what is it like, Mr. Roberts?" he said.

The newcomer thought for a moment.

"It's like what a field of wheat would seem to a very small dog," he answered. "It's too thick to walk through, too high to see over, and as stuffy as a tenement house with all the windows nailed down."

"How do you manage it then," asked the boy. "Do you go on stilts?"

"Stilts!" ejaculated the surveyor. "You'd have to be an opera dancer with legs about twelve feet long to manage stilts down there. And even after you cut it down, walking on the stubble is like tramping over bayonet blades stuck in the ground point up. No, what we do is to cut a sort of trail for a horse, who is hitched to a light buckboard. The horse goes through because he's got to, and the buckboard follows unless the harness breaks."

"But how do you get your tripods above the rushes," said the chief, "for you surely can't cut lines everywhere."

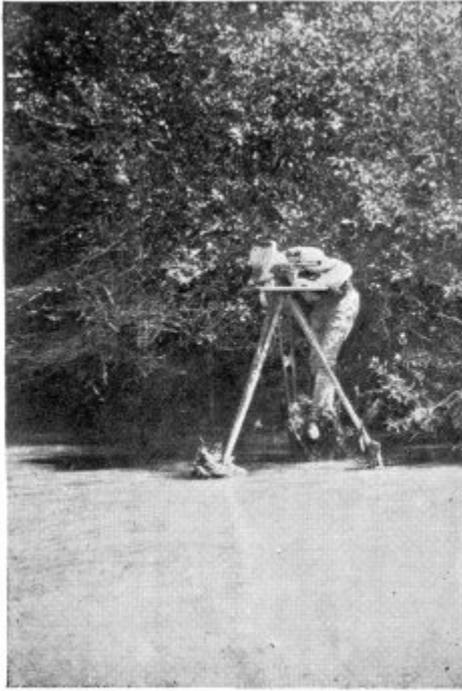
"We don't. The legs of the tripod are spliced to sticks long enough to raise them above the grass: and the topographer, standing sometimes on the body of the buckboard, sometimes on the seat, works with his nose just peering above the giant rushes, from a rod of extra length, deducting from his calculations the height of the tripod and the buckboard from the ground."

"And is it dry?"

"Mostly, except when the tide comes in at the lower part. At least, it's not soggy wet, like it is here. It's dead easy to get lost though, and you can't see any landmarks. You could chase your own back hair for a week and never know that you were going in a circle."

"Apropos of getting lost, Roberts," said the older man, "we had a little experience with the lad here that is worth repeating," and beginning from the snipe-hunt, he related the entire affair, showing first how well they had got the laugh on the tenderfoot, and how he had got back in return. Roberts laughed long and heartily at the picture conjured up of Roger sitting in the boughs above the party, hearing them discuss plans for his rescue and heroically resolving to leave nothing undone till they should find him.





Photographs by U.S.G.S.

DIFFICULTIES OF WORK.

In the Giant Tule Swamps in the Southern Sacramento Valley. The umbrella is not for comfort, but to keep the sun off the instrument.

"I didn't fare as well when I got trapped down there," he commented, "and while I suppose it was funny, I couldn't see the joke of it myself."

"Was that in the tule grass?" asked Field. "Tell us the yarn."

"I think I told you," began the new assistant, "how hard that stuff is to make a way through, and though it is really almost as tangled as this marsh work up here, the ground is so flat that far fewer bench marks are required. We had taken a long sight, because there was a sort of depression at that point which we wanted to delimit, and I was quite a distance from the plane table. Suddenly I felt a swish of water at my feet, my first realization that the tide was coming in. This had often happened before, and the water usually rose to a little above the knee, when, as soon as the tide ebbed,

it would flow out and leave all dry again.

"Of course I was aware that I was working in a slight depression, but as a matter of fact it never occurred to me that this would make any especial difference. I was surprised, certainly, at the strength of the tide as it flowed in, and I remember a little later wondering whether it was spring tide and not being able to find any reason for the heavy flow, but it was only casually that the matter occurred to me at all. Few minutes elapsed, however, before I realized that any greater increase of depth would be a really serious matter. The water was already above my knees and increasing at an alarming rate. I think I have shown you how hard it is to get through that stuff, and to cross a hundred yards of tule grass is a matter of half an hour's work. Still, at any moment, I thought the water would reach its maximum and I felt ashamed to start back after all the labor of reaching the point where I then was.

"Of course I am not usually the tallest man in the party [the speaker was not more than five feet six or seven] and the boys used to joke me about my height. I knew they would roast me to a turn if I had to let on that I was afraid of being drowned in a few feet of water. So I held on. But the water had crept up rapidly until it was well above my waist, and I determined, jesting or no jesting, that I was going to strike for higher ground, or, if possible, get as far as the buckboard. The other fellows couldn't see the trouble I was in because they were on a little crest of ground, and because the waving tule grass shut off all sight of the water.

"What's wrong?" I heard one of them shout, as I started back, but I didn't want them to get the laugh on me too soon, and I was coming back through that sodden grass just as rapidly as I could make arms and legs go. Well, sir, I suppose that tide came in slowly, but it seemed to me as though I could see it creep up my shirt inch by inch, and I had hardly got half the distance before it was up to my shoulders. I thought it was time then to let the boys know what was up, so I shouted:

"Bring the buckboard here, fellows, or I'll be drowned in this infernal grass!"

"Drowned?" I heard one of the men say questioningly, then immediately after, 'By Jove, he's caught with the tide down in that low spot.'

"But of course they couldn't bring the buckboard because the horse couldn't go through unless a path had been cut, and they couldn't very well cut a path, for the reason that in doing so they would have to stoop, bringing their heads under water, to say nothing of the difficulty of swinging an ax in the water. It looked pretty bad for me, but I thought it likely that Shriveter, one of the party, who was over six feet, would come to my aid, and six inches more of height made a considerable difference of time in the up-creeping of the water. Then I saw the chief pull out his watch and speak to the rest of the boys, and they began to laugh. I was about thirty yards away by this time and could hear them laugh quite distinctly. It made me as mad as a hatter, for the water was up to my chin.

"It may be deucedly funny to you,' I called out, 'but you might come and help a fellow!' But they only laughed the harder and it made me sore. Can you imagine what it's like plowing through that infernal grass with water up to your chin? You can't stoop your shoulder to push yourself through, because, if you do, a mouthful of salt water comes to your share; all your clothes are sopping wet and heavy; the ground under your feet has become slimy and hard to walk on and the blades of grass are sodden and almost beyond a man's power to move. I found it harder work to make a five-yard line through that mixture of tule grass and tidewater than Harvard ever did on the gridiron against Yale."

"Easy, old man," said Field, "I'm Yale!"

"I know you are," grinned the other, "that's just why I said it. But, as I was telling you, it sure was a man's job to fight through that stuff yard by yard, and the salt water was just about level with my lips, so that when I wanted a breath I had to give a little jump and breathe before I came down. And those beasts on the buckboard were simply howling with laughter.

"Look at the human jumping-jack!" I heard one of them say, imitating the voice and manner of a sideshow barker, 'The only original half-man, half-frog, in the world. See him hop! One hop is worth the money!' I tell you what," added Roberts, laughing in unison with the rest, at the picture he had conjured up, "I was just about hot enough under the collar to have ducked every one of those grinning oafs."

"But did you really think you were going to be drowned, Mr. Roberts?" asked Roger.

"I suppose if I had stopped to think, my boy," was the immediate response, "I would have known that the other chaps would have got hold of me long before that, but I felt more than half-way drowned as it was, hardly able to advance a step nearer safety, and only succeeding in getting breath by jumping up and down as if I was on a skipping rope. But when I thought I would have to give out, paying no attention to the jocose suggestions of the fellows, such as 'Get a balloon!' 'Talk about a grasshopper!' 'Look who's here, there's spring-heeled Jack on the trail!' and so forth, and when

my strength was nearly at an end, it seemed to me either that I had reached a little hillock or that the water was receding. I stood still, and found that by throwing my head back I could just breathe without making any wild gymnastics, and I thought it a good time to take a breathing space. In a few moments I saw that the water really was receding and half an hour later I made my way to the buckboard, where all the boys had gathered and were sitting smoking, watching my frantic efforts.

"'You're a precious lot,' I said to them, as I clambered up out of the wet, 'to let a fellow half drown without coming to help him. I might have gone under out there for all you cared.' Oh, I was mighty sore about it, and I didn't care if they knew it.



Photograph by U.S.G.S.

DENSE SOUTHERN PALM GROVE.

Through this lines must be cut to establish Survey points, showing wide range of territory with which a topographer must be familiar.

"But the chief, who had been laughing as heartily as any, said: 'Roberts, you know perfectly well that we would have come after you if there had been any danger. But I looked at my watch and saw that it was full time for the tide to turn, so that you really stood in no such awful peril as you seemed to think.'

"That's all very well,' I answered, 'but how was I to know it?'

"That was just the sport of it,' he said; 'you didn't know it, and we did. And you would have died laughing if you could have heard yourself, 'Schriveter (gurgle, gurgle), you lanky galoot (gurgle, gurgle), come and give me a hand (gurgle, gurgle), instead of sitting there (gurgle, gurgle), like an Indian cigar sign (gurgle).' I don't know just how Schriveter felt, but so far as I am concerned, I was so tired from laughing that I nearly fell out of the rig.' I suppose really the chief was right, knowing that the water would not come any higher, but then I didn't know, and it wasn't any too pleasant a feeling."

"By the way," continued Roberts, when he had finished his story, and other members of the party had added their mite of comment, approval, or equivalent yarn, "Mr. Field tells me that you are new on the Survey. I suppose your name is

Doughty, then?"

"Yes, Mr. Roberts," answered Roger, surprised that this man, who was almost a complete stranger to him, should know his name.

"Mr. Herold told me that I should find you here," he said, "and he asked me to give you this letter. He told me what was in it," added the new arrival with a smile, "and I think it should please you."

Roger took with eagerness the long official envelope handed him by Roberts, his first letter of instructions since he became a member of the Survey, and found therein a brief order, requiring him to report at the El Tovar Hotel, Grand Canyon, Ariz., on the first day of the month following. The same envelope contained, moreover, a personal letter from Mitchon, in which, though of course no official recognition could be made, was a phrase worded in such wise as to show that the boy had been well spoken of by Field, and that this new appointment was due to satisfaction with his first few weeks on the Survey. The lad colored with pleasure as he read it.

"I suppose, Roger," said Field, when the boy folded the two letters and put them back into the envelope, "that letter means that you are going to leave us?"

"Yes, Mr. Field," answered the boy, "I don't know just when I am supposed to leave, but I am ordered to report in Arizona on the first of June."

"Going on the desert work?" queried the chief. "My word, Mr. Herold wants to give you pretty sharp contrasts!"

"I think it must be somewhere about the Grand Canyon," answered the boy, his eyes sparkling with the thought of seeing that wonder of America, which he had so ardently desired to visit. "At least, I am told to report at a place called Grand Canyon."

Roberts nodded.

"That's right son," he said. "Grand Canyon is the tourist station for seeing the Colorado River gorge at its best."

"To whom do you report?" asked Field, "to Masseth?"

"Yes, Mr. Field, that was the name," answered the boy.

"Isn't that the man who did such clinking good work in the Little Colorado country?" asked Roberts.

"That's the man," replied Field. "You couldn't be under a better leader," he added, turning to the boy, "but you've got to keep both eyes and both ears wide open with him, for he has a knack of expecting every one with him to know everything. He'll teach you to think quickly, all right."

"Well, my present chief----" began the boy gratefully, but Field waved his hand petulantly.

"Cut that sort of thing out," he interrupted. "Any man will get along if he tries to do his work. But," he warned smilingly, "I don't know that it's such good discipline to play practical jokes on the head of the party. They might not all take it kindly."

"I had a letter from Mr. Mitchon," retorted the boy, "in which he bids me thank you for the snipe. He said they were much appreciated in the office. He writes awfully nicely."

"That snipe's an old joke on the Survey," answered Field, "indeed, it's pretty well known all over the West, but seeing that it was new to you, Mr. Mitchon wanted to enjoy the fun."

"I never met Mitchon until this last time I went to Washington," put in Roberts thoughtfully, "but I liked him very much."

"I had a little experience with Mitchon once," put in David, who had been listening, "and I found him white clear through."

"Mitchon's all right!" said Field.

"You bet!" affirmed the boy.

"Well," commented Roberts with a laugh, "that's a good enough epitaph for any man. Mitchon's a long way from being dead, and I guess no one's particularly anxious to start carving a tombstone, but at that, I guess he'd be satisfied with such a general opinion."

CHAPTER V. PERIL IN THE GRAND CANYON

Excited and expectant travelers were many on the Santa Fe railroad, but Roger felt that he had never met a more enthusiastic group than those who dined at the long low mission-like hotel Fray Marcos at Williams, Ariz., waiting for the train to Grand Canyon. And of all these none had been more a-tingle with anticipation than the boy, as the train, passing by the station of Hopi--the very name recording that strange tribe of Arizona Indians--ran through Apex and began to slow up for the last stop.

Throughout the past two or three hours of the trip, all the passengers had been speaking of the great sights that awaited them, and guidebooks and photograph collections without number had been scanned, bringing interest to fever heat. But in spite of all this preparatory ardor, those who had visited the Grand Canyon before and those whose friends had done so, bore testimony to the universal belief that nothing, no estimate of the wonders of that land, however extravagant, could discount the reality.

It was a little after four o'clock on the afternoon of the last day in May as the train drew into the station, and guides met the passengers ready to conduct them direct to the brink of the Canyon that they might gain their first sight of it. Roger's very toes were aching with the desire to follow them, particularly as he was not on duty until the following day, but still he felt that he was on government service and that he ought to report for duty at the appointed place immediately on his arrival. Then, the boy argued, should there be no one to meet him, his time would be his own until the following morning, and he could enjoy the pleasures of sight-seeing without feeling that he had in any way been neglectful of the strictest interpretation of his orders. His trunk had been checked through, so Roger, refusing the solicitations of the guides, picked up the small hand-grip he had carried for the necessities of the journey and set his face resolutely to the hotel.

Turning to view the country about him, Roger was as much disappointed as amazed to find how flat and uninteresting it seemed. Indeed, there was nothing in the region to suggest that a canyon was anywhere in the vicinity. So far as he could see, on either side of the railroad track up which he had come was a level treeless prairie, and in the direction whither the tourists had gone, there was naught to be seen but this same slowly rising plateau, which, a little further on, seemed to be bounded by a slight rise. The boy knew that the Canyon must be on the other side of this eminence, but there was nothing to bespeak its presence, not a sign to awake the consciousness that a few hundred yards away lay a view of the greatest scenic wonder that any man had beheld, primitive and untouched as since the days that antediluvian monsters roamed the plains whereon he now was walking.

When he arrived at the hotel, Roger walked straight to the desk.

"Is Mr. Masseth here?" he asked the clerk.

The latter, a being largely characterized by shirt front, gestured the boy to a slightly built man, sitting in the rotunda of the hotel reading a newspaper with an intensity of concentration which Roger immediately conceived to be typical of the man. He turned instantly at the boy's approach, however.

"Mr. Masseth?" queried the lad.

The reader rose with a quick though courteous motion of assent.

"I was told to give this letter to you," the boy continued. "I understand it contains my instructions to report to you. My name is Roger Doughty."

"I am extremely pleased," said the older man with a slight foreign timbre in his voice, "to be able to welcome you. I felt assured, from what Mr. Herold said when he wrote to me, that you would be here to-day, as he suggested that I should find you punctual. It is of the greatest service never to lose a minute, unless indeed, it be taken for a rest."

"I don't want to lose minutes, I want to make the most of them, and Mr. Field told me that I should never be losing any time as long as I was with you."

"In that case," replied the boy's new leader, with a quick smile, "what would you like to do now? You have never seen the Grand Canyon before?"

"Never!"

"And you are anxious to do so, of course?"

"You bet!" answered Roger. Then, with a laugh, "I pretty nearly mutinied on my first day; I came near going over with

the tourists instead of coming here to report."

"I am quite glad that you did not," said the topographer, "for I should like to be with you the first time you see the Canyon in order to be able to tell you what it all means and how it came about. You would probably try to guess at the reason of things and you would guess wrong, and a false first impression is a bad thing, because it is so hard to take out afterward."

"I'd very much rather find out right at first," answered the boy.

"Very well, then, suppose we walk to a near-by point, where an unusually good view of the Canyon can be observed."

Taking up his hat, as he spoke, he waited while the boy arranged for his grip to be taken to his room, and then without further parley started toward the brink of the chasm with quick, nervous strides which taxed Roger's walking powers to the utmost. They walked on to the rounded hill, Roger so full of excitement that he could hardly answer his companion's questions about his former work on the Survey, and just as they were about to cross the summit of the slope, Masseth touched him on the arm, holding him back.

"Wait just a moment," he said. "Look back over the country and tell me what you see."

Roger turned. "I don't see very much," he said. "I think it's pretty flat except for a range of hills to the east, away off, and that to the south the ground seems to be falling away."

"Is the fall long?"

"I hadn't thought of that," said the boy, "but I suppose we must be quite high up, for the road has been on a gradual incline for miles and miles."

Masseth took a few steps onward.

"You noticed," he said, "how gradual that slope was. Now," pausing as they crossed the ridge, "this is not so gradual." He smiled at the boy's speechless wonderment.

Roger found himself standing not three yards away from a drop of 6,800 feet, the first couple of thousand sheer almost immediately below him. So near that he could have leaped to it, rose a fantastic pinnacle, elaborately carved, springing from a base 1,200 feet below. Beyond this, seamed and jagged, thrown across this cloven chasm as though in defiance of any natural supposing, flung a blood-red escarpment, taking the breath away by the very audacity of its reckless scenic emphasis. Further, again, in unsoftened splashes and belts of naked color, mesa and plateau, peak and crag, shouldering butte and towering barrier, through a vista of miles seeming to stretch to the very world's end, impelled a breathless awe.

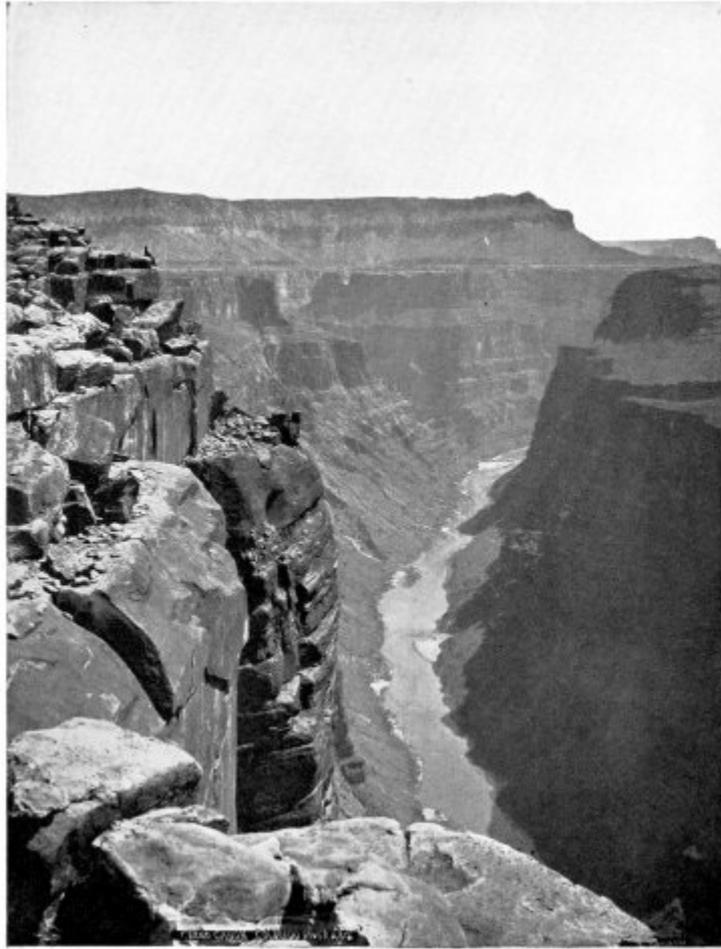
And, in Titanic mockery of pygmy human work, the glowing rocks appeared grotesquely, yet powerfully scornful of the greatest buildings of mankind. Minaret and spire, minster and dome, facade and campanile, stood guard over the riven precipices, and not to be outdone by man, nature had there erected temple and coliseum, pyramid and vast cathedral, castle and thrice-walled fastness, until it seemed to the boy that there was thrown before his eyes a hysterical riot of every dream and nightmare of architecture that the world had ever conceived.

"But--but, I never thought it was anything like this!" exclaimed Roger.

The older man repressed a smile at the triteness of the speech, which is that usually educes from every new beholder of the scene.

"What do you think of it?" he said.

"It doesn't seem real," answered the boy. "It's like the places you see in your dreams that you know can't be so, and what's more, it's like one of those places all set on fire with flames of different colors."



Photograph by U.S.G.S.

GRAND CANYON OF THE COLORADO.

Showing the nature of the apparently impossible obstacles found in traversing it.

The topographer nodded.

"But what you will find still more strange," he said, "is that it is never twice the same. If you move a few yards away"--he suited the action to the word--"it looks quite different, and even if you stay still, under the changing light new shapes appear."

"That's right," affirmed the boy. "From where we stood before, I could see a huge fortress, only it was a vivid purple, and now it's gone. And I suppose those really aren't richly carved churches over there," pointing with his finger, "but a fellow would bet that they were."

"Churches without any congregations, and whose only preacher is the thunder, but they do look like temples and are so named. But truly they have been carved, though not by human hands."

"By what, then?" asked the boy.

"By wind and water," was the reply, "which have made and unmade many a thousand square mile of the earth's surface. If you will notice," he went on, "jagged and pointed as those peaks are, from this side clear across to the other, not one of them rises above the level on which you are standing or rather, above the level of the opposite side of the Canyon, which is a little higher, the slope being continued across. So, you see, you must not think of these like mountains as being built up, but of gorges as being cut down."

"And has the river cut it all down?"

"The river started it, and then of course every little stream helps, and indeed, every rain adds another fissure to the carving."

"But what makes such curious shapes?" asked the boy, still considerably puzzled.

"The relative hardness of the different kinds of rock," was the reply. "Not to seem too technical, the top stratum, that is to say the rock immediately under the soil of this plateau, while quite hard, is very thin, and underneath it are various other layers of rock, some fairly hard and others very soft. The Colorado River has a very swift current, and once it had cut through the hard rock on the top it quickly ate its way downward through the soft limestones and sandstones below. But some strata were quite hard and these, resisting the water, formed the terraces which you see on every hand."

"But I still don't understand," said the boy, "what it is that gives them such curious shapes. I can see how a hard rock would make a terrace, but why aren't the lines all regular?"

"Just because it has been done by water. Sandstone, you know, is made of sand, pressed, and sand is all sorts of rocks ground down fine. So every handful of sand may contain particles of a dozen different kinds of rock, and if there was any difference in the hardness of the rock of which the sandstone was made, or any difference in the pressure while it was being made, each difference would show up by its greater or less resistance to the action of wind and water. So, you see this bit is hard and cuts slowly, that bit soft, and cuts rapidly, giving a carved effect."

"But if it all follows a regular rule, why does it look so unnatural?"

"That is easy," replied his informant. "The strata are regular--that is what makes the masses look like buildings done by hand, there is a sense of proportion, but they look unnatural because the ground plan is capricious, the water having found its way to the bottom of its thousand canyons by the irregular and complicated way of least resistance."

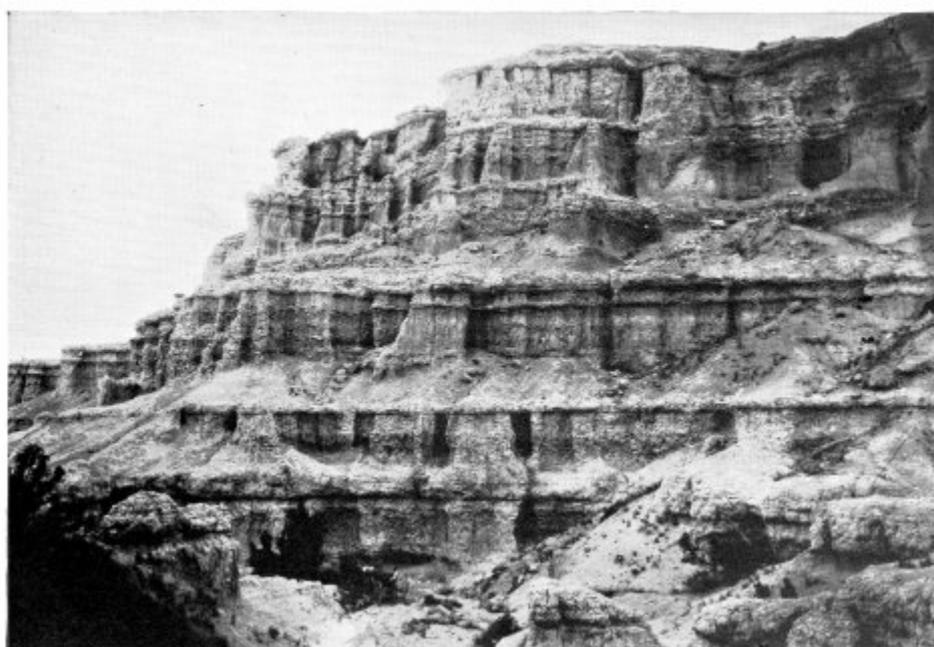
"And the colors seem so glaring and so strange!"

"I will explain those to you after dinner," said the topographer, "and, by the way, it is nearly time we returned to the hotel or we shall be late. I can show you how the various reds are due to iron in the rock--you remember how a rusty nail stains everything red?--and other iron compounds give the green, while the blues of the slates and the dark belts of hornblende all play their part."

Masseth was as good as his word and all through the time spent in the dining-room he interested the boy in the country by his vivid descriptions of how all these rocks had first been made, then reduced to sand and built up again, and how the Colorado River was fast tearing them down and carrying them away to be built up somewhere else in some other way.

"Then geology isn't all over!" exclaimed Roger in surprise. "I always thought of it just as a sort of history of things that happened a great while ago."

"Geology is happening right along," said Masseth, "and that's why it is so necessary to do this work and find out both what has been and what is going to be, even though it is both difficult and arduous."



Photograph by U.S.G.S.

The Terraces cut in the Western territory. Note buggy on trail at base of cliff

"But of all the work in the Survey," suggested Roger, thinking of the apparent inaccessibility of the Canyon as he had seen it, "I should think this Grand Canyon work the most difficult and dangerous of all."

The older man shook his head.

"It is not dangerous," he said, "unless carelessness is shown, because the most lofty buttes, simply being cut down from the level plateau, have their crests just that height, so that they can be fairly well mapped by a determination of their bases. But, though you can't see it from the top here, those bases are fearfully irregular and a cliff forty feet high may take miles to go round. You have noticed that there are plenty of terraces, so that in many places you can walk up or down the Canyon as on a made road, but that would help you not a whit in getting across."

"Well, it is difficult, anyway," said the boy.

"Extremely so. The intense color, the glowing rays of the sun seldom shielded by any clouds, the lack of vegetation and the absence of landmarks all help to confuse the idea of distance, so that you cannot trust to your eyes to map a point until you have been there."

"And how do you get there?" queried the boy in wonderment.

"Climbing. There is an Indian trail on this side that helps a little, and there are three roads down to the river on this side and one on the north. This one through trail, called the Cameron or Tourist trail, has been partly rendered passable, so that by herculean effort and with trusted and well-trained animals it is possible to cross. Usually, however, the trail is left in loneliness, for there is absolutely no traffic between Utah and Arizona. Except for a little corner in each, these States are more widely separated than if an ocean rolled between them."

"And how about these corners?"

"Well, Utah can get to hers by taking a little trouble, but the northwest corner of Arizona is No Man's Land, so far as any jurisdiction goes."

"But you say animals can be made to tackle those trails. I should have thought that kind of work would kill any animal that tried it."

"It's pretty hard to kill a burro," answered Masseth, "and I've never lost one. Indeed, in all the Survey work I've done in the Grand Canyon, I've only had one accident, and that was a case absolutely unavoidable. I lost one of my favorite horses that time."

"How did it happen, Mr. Masseth?" asked Roger.

"It was on the north side of the Canyon," began the topographer, "and I was working on an outlying butte with my assistant. We had made quite a number of bench marks and I was working out the contours--those are the lines on a map which show the height or elevation of any point--while my assistant was sitting beside me, making out some of the necessary calculations. We were working out from a little side camp, the two of us, the rest of the party being at headquarters, several miles away. I was drawing in at full speed, because I wanted to change from that side station that evening, and for a couple of hours I suppose we had not exchanged a word, except with relation to figures.

"Before coming out on that sun-baked exposed butte, I had tied the animals--a pack-mule, my riding mare, and the assistant's horse--to the branch of a tree. Suddenly, as it afterwards appeared, the other fellow heard a sound as of a fall and went to see what it was. He was gone so long that I noticed his absence. When he returned I waited for him to volunteer an explanation but apparently he did not want to disturb me, so I said, questioningly:

"Well?"

"Only two of them there now," he replied. 'Bella's gone over the edge. Neck's broken, so there's no use doing anything.'

"Now Uncle Sam, you know, is always willing to stand for accidents that can't be helped, but he's got to know all about it, and while I realized that it would really matter little in the long run, I was sure that the department would feel better satisfied if the manner of the accident were set forth. So I put away my pencil, folded up the plane table, and went to investigate. It was as puzzling a thing to decide as I ever saw. The tree was at least twenty yards from the brink of the precipice, although the ground sloped fairly steeply to the edge.

"When I arrived there I found the other two animals tied to the branch, as I had left them, and apparently undisturbed.

The ground, however, between the tree and the edge of the chasm, was torn up with hoof marks and the struggles of an animal that evidently had fallen to the ground, and the spoor from the tree to the Canyon's edge was easily traced. Of the animal, I could at first find no evidence, but my assistant touched me on the arm.

"Here, Mr. Masseth,' he said, 'you can see Bella from here.'

"Sure enough, on rounding the corner of a pinnacle which stood out a little distance from the edge, the body of the mare could be seen about one hundred and seventy-five feet down, lying on a sharply pitching bank of talus--that is, debris of rock and dust, fallen from the overhanging cliff above. It was still a wonder to me how the mare fell, and as she had been wearing a brand-new halter, this in a country where it is easier to get beast than harness, I told my assistant that I was going down to secure the halter and also to find out, if I could, what had been the cause of the accident.

"I think that was about as nasty a piece of climbing as I ever had. It would never come about in the regular course of business, you see, because we don't work that way, but I was going down to get that brute, no matter what labor it cost. At last I managed to make my way down to the point where she was lying. There, after studying the position in which she must have fallen, I gained some idea of the manner in which it had come about. Bella was from the ranches, where, you know, an animal is not muscle-bound like your eastern horses, and in trying to scratch her head--where possibly a fly had settled--with her off fore-leg, the calk of her shoe must have caught in the neck-strap of the halter, and of course, she could not get it out.

"The poor beast probably stood as long as she could on three legs, but the posture must have been cramped and painful after a few moments and she fell heavily, breaking the rope of the halter as she did so. Then, while lying on the ground, floundering about in an effort to free her foot from the thralldom of the halter-strap, she must have slipped nearer and nearer to the edge and then suddenly gone over, with her hind-foot still fast in the strap.

"Since I had got so far, though I did not much relish doing it, I determined to take off the halter, and at least save that out of the wreck. But you can readily see that the halter had been drawn fearfully tight, and I could not get slack enough to unfasten the buckle. At last I gave a hearty wrench, and was just about to be able to slip the prong of the buckle through the hole, when the insecure talus on which I was standing, and on which the animal had been resting, began to slide. Fortunately I am fairly quick on my feet, and in two or three springs I reached a little outjutting terrace. But I had scarcely reached that point of safety when poor Bella went over the edge another seventy-five feet into the chasm.

"That made me mad. I had come down a very nasty piece of climbing to get that halter, and I was bound to secure that bit of leather if I had to scramble down the gorge to the very bed of the river itself. So, as soon as I could find a way to start down, I went on and reached the mare, this time resting on a wide ledge where I could disentangle the halter with but very little trouble.

"I had gained the object of my quest, I had found out the cause of the accident to the horse, and I had recovered the halter, but in the achievement of these purposes I found myself two hundred feet down the gorge and I knew that it would be a great deal harder to get up that distance than it had been to get down, and even the latter had been no easy matter. Of course, my assistant was up above, and had been watching the proceedings, all the while, so that I knew he would get at me from the top in the course of time.

"I was anxious, however, to get back the way that I had come without taking a long trip to one of the side canyons, and after losing some time, and also some skin from knees and elbows and other parts of my body, I got back to the place where the horse had first lain. My assistant dropped me a rope--there is always a long rope carried by each party--and I climbed up that rope."

"Swarmed up a rope a hundred and seventy-five feet high!" ejaculated Roger, then, with a whistle, he added, "that's an awful climb."

"It was not a straight hand over hand climb, my boy," answered Masseth quietly. "You must remember that all those walls are in terraces and every other line of strata would give a ledge. Of course, in some parts they were overhanging and that made it all the harder, but there were plenty of places to rest on the way up and in due course I reached the top. That was the first misadventure, and I hope it will be the last in any of my camps in Grand Canyon work."

"And what part of the work are you doing now, Mr. Masseth?" queried the boy.

"I was just waiting for you to complete the party," was the reply. "We are going to tackle the Tourist's trail, that is the one I was telling you about, and will go up the other side. Then, from the north side, I will pick out a number of points which I want you--with other members of the party--to occupy. You will then do some work under my assistant, while I

cross back to this side, and on an appointed day we will strike a level across the nine-miles gap."

"Then we will be working together though miles apart?" asked the boy in surprise.

"Yes, and months apart, too."

"But how in the world can you do that?" was the amazed response. "Do you carry a wireless telegraph outfit in your vest pocket, Mr. Masseth? Is there anything the Survey can't do?"

"You seem to think," responded the chief with a smile, "that the race of wizards has been reborn and christened the Geological Survey, as a visiting diplomat once said of us."

"Well, pretty nearly," answered the boy.

"We're not quite that," admitted the other, "but," with a smile of mystification, "I do carry a little device by which I can make use of a system of wireless telegraphy which was in existence thousands of years ago."

"And can I see it?"

"Certainly," replied the topographer, and drawing his hand from his pocket, he showed it open to the boy.

"That's just a looking-glass," cried Roger in disappointment, having expected to see some delicate and ingenious piece of intricate machinery.

"Just a piece of looking-glass," assented his chief. "What then?"

"But how do you work it? What can you do with that?"

"That, my boy," answered the older man, "is one of the very many things you will learn while you are in and about the Grand Canyon."



Photograph by U.S.G.S.

"HOW IN THE WORLD AM I GOING TO GET UP THERE?"

A query for the topographer, which must be answered; a sample of rough country work.



CHAPTER VI A LONE HAND AGAINST HUNGER

Early the next morning quite a large group of tourists gathered to see the Survey party set out, it having become known that it was to make use of the old Cameron trail and endeavor to climb the other side of the Canyon. Some, who had been part of the way down the trail, were politely incredulous as to the possibility of the feat, others took an especial pleasure in prophesying disaster, and a few expressed a wish that they might accompany the party "to see how it was done."

To these various people Masseth paid no heed. Indeed he scarcely responded to questions, returning but the briefest replies, except once, when an old lady, quiet and gentle in manner, came up and laid her hand on his arm.

"You will pardon an old lady," she said, "but I should not like to think of your going down there, unless you can assure me that it is really safe."

The topographer turned to her immediately, raising his cap and smiling:

"I have been over the trail before," he said, "and indeed I have been in many worse places than this part of the Canyon, so you really need feel no alarm. It is very kind of you to be solicitous of our well-being, and I shall take your expressed interest as a happy omen for the journey."

This little speech, overheard by Roger as he came up with the head packer to say that everything was ready, gave him a quick insight into the intense graceful courtesy, which was so strong a characteristic of the man who was to be his chief for a couple of months to come. A few sentences between Masseth and the chief packer were followed by the words, spoken in a sharp tone of command, markedly different from the suavity of a moment before:

"You may start, then!"

Roger waited for instructions.

"Doughty," said the leader, "you will ride in the rear with Black, and you will do well to let him teach you how to handle the animals in rough spots. I shall go ahead, of course."

"Very well, sir," answered Roger, and cantered off to the pack train, where the assistant topographer was helping the second packer to get the mules started. The head packer had gone as far as the brink of the Canyon with the chief and there waited to deploy the animals on the trail in good order and to scrutinize every pack as it passed him, to make sure that none should become loose and slip.

The boy chatted freely with Black as they paced along behind the last of the mules, and he found his companion well-informed, as Masseth had said, but except on matters of the trail, somewhat non-communicative. In brief remarks, however, he explained to the boy many of the troubles he must expect to encounter and the best manner of meeting them, and his curt references to the lie of the land struck Roger as being of immense value. He pointed out certain striking landmarks as features of the landscape which were to be ignored, because, from any point of view, they would appear entirely different; and certain other eminences, perhaps not even as noticeable as the former, which he must remember, since, by reason of their conformation they would always appear the same and thus could be taken as absolute and certain guides.

But as soon as the trail fell over the edge there was no more speaking. Fell over the edge, Roger thought, was almost the only way to describe the road, which was precipitous and winding beyond belief. There was a supposition that the way had been made smooth for mules, but it did not seem to the lad that any four-footed animal short of a goat could keep his footing. The long line of mules treading easily in front, however, was evidence that he need not fear, so warily keeping an eye on his mule lest his mount should stumble, he preceded the assistant, following immediately after the last pack mule.

For several hundred feet the trail went down in this rough fashion, then suddenly turned sharply to the left along one of the broad terraces of rock, whereof Masseth had spoken to the boy before. After a quarter of a mile of easy going, the party came to a slope of loose shale, almost filling up the terrace. The pack mules picked their way over this without any apparent demur, but Black called out:

"Guess you'd better get off!"

Roger slipped from his saddle, and going to the mule's head started to walk beside it.

"Go in front, you chump," called the other. "If the trail's none too wide for one, how do you suppose two can go

abreast?"

"But I can't help him then!" protested Roger.

This speech was greeted with a hoarse chuckle.

"Any old time a mule needs a tenderfoot to teach him where to put his feet," he said, "I want to have a front seat to watch it. Don't you ever worry about that, I guess he can walk anywhere that you can, but on a shelving bank a rider makes a beast topeavy."

Down they went into the chasm, climbing over heaps of fallen rock, pitching down slopes which seemed almost perpendicular to the boy, and as they descended the sun rose higher and the air seemed to become less tenuous and almost visible. Roger had been expecting the wonderful radiance of the valley to become tenfold richer under the noonday sun, and was surprised to note all the color fade out of the rocks and the air become as it were so solid as to refract the light of the sun. The whole atmosphere seemed to be glowing with a metallic luster which was most confusing, because of the way in which it changed the whole environment. Lines of strata became distorted and even disappeared, the buttes appeared to flatten, the minor shadows to diminish and the darker shades to turn an inky black, till, when the halt was made at noon, the boy realized that he could not have made his way back one mile by reason of the chaotic look of the abyss under the direct light of the noonday sun.

After the march had been resumed and the afternoon was drawing to a close, however, the true witchery of the scene struck deep into Roger's mind. As the evening clouds began to gather and the twilight shadows deepened, the Titanic temples and cloisters seemed to awake and stretch themselves to meet the expected vesper. Little by little the atmosphere lost its density and the rocks behind began to glow, the colossal buttes assumed their due proportions; while a thousand bizarre forms, that had not been observable in the intense light of day, thrust themselves forward into an uncouth prominence. Then the sun disappeared from the view of the travelers, though still shining on the rocks above. Black cantered up beside the boy.

"Now watch," he said: "here's where you see the greatest display of color in the whole world."

"But how can it be brighter than it is now?" queried Roger, on whom the bold and striking scene was creating a profound impression.

"The best is yet to come," answered his companion, "and look, it begins now!"

For the first time since morning Roger was able to look upwards without being blinded by the sunlight. The sloping rays now fell full upon the upper part of the Canyon, at the crest of which a vivid yellow cut athwart the transparent blue of the sky and underneath its pallid brilliancy ran a soft belt of pale rose. The deep vibrating red of the body of the Canyon seemed to pulse with life as a faint blue haze began to gather in the dusk, changing second by second into the countless differing hues of crimson lakes and ruby violets, deepening as the hastening twilight passed. Strange and metallic gleams of burnished bronze and green gloomed from the intervening lines, all yielding place little by little to the veil of azure mist. And beneath all, the glowing red, now changed to imperial purple, as though the world were bathed in a regal radiance at the crowning of a universe's king.

It was not until the dark had really come and the stars were shining brightly that the boy awakened to the consciousness of a trail and felt that he could speak. He turned to the assistant.

"And that's been going on every day for years!" he said, struck by the wastefulness of such a sight to so few eyes.

"For thousands upon thousands of years that went on before any man saw it," replied Black, smiling slightly, "and it will go on when the present civilizations are deemed but musty antiquities."

The night was well advanced when the party reached the crest of the Canyon on the north side. The journey, as Masseth had said, was one devoid of special risk because of the numbers of the party and the known trail, though, in truth, it needed a keen eye at times to discern that such apparently impassable ground was intended for a trail. The top reached, however, a hasty camp pitched, the packs and saddles taken off, the mules and the animals hobbled to graze on the rich herbage of the Kaibab plateau, Roger sank to sleep without loss of time, and it seemed to him hardly ten minutes before the cook aroused him for the camp breakfast.

"You know something about the work of a rodman, and of the handling of the tape?" asked Masseth, after breakfast, referring to the 300-foot steel tape used in measuring distances in wooded areas.

"Yes, indeed, Mr. Masseth."

"Of course you realize that the tape is generally impracticable in such a country as this, and that all the work must be

done by the computing of angles with continual astronomical verification. As topographic aid you can learn as much as you are able of the use of instruments, at such times as you are not carrying out levels." And Masseth, questioning closely, elicited the mathematical ability of the lad. The boy had always hated arithmetic and its kindred studies, not realizing the value of the higher branches, but with the incentive before him, he found his chief's teaching markedly interesting.

The next day a semi-permanent camp was pitched, and there the supplies were kept. The head packer, who became a teamster as soon as things were settled, immediately left for the village of Kanab in Utah, over a hundred miles away, where a heavy wagon was in waiting, and whence the provisions were to be drawn for the party during the two months it should be on the north side of the Canyon. As it was a three days' journey there and the same returning, the teamster was a busy man, having but one day comparatively free and camping on the trail five nights out of seven.

Roger, of course, went out with the other men every day, scaling points picked out for him by the chief as places he desired occupied, measuring from the rod elevated by the boy, who then, at a signal, was ordered to go to the next point scheduled. To a boy as fond of climbing as was Roger, for a day or two this was good fun, but the novelty soon passed by and he did his day's work with a persistent regularity, which, though it brought forth the results required, was lacking in the adventurous. In short, the continuity of risky work became monotonous.

It was due to this cause, perhaps, that one afternoon, when this sort of thing had been proceeding for several weeks, Roger, passing from one outjutting piece of rock to another, but a few feet away, jumped carelessly, twisted his ankle beneath him and fell, spraining his wrist. Despite the sprain, however, he reached the point to which he had been sent, and then, instead of going on, returned to the topographer.

"What's the matter?" called Masseth, who had seen him fall, as soon as he came in hearing. "Did you hurt yourself?"

"Sprained my wrist, I think, Mr. Masseth," answered the boy. "Beastly sorry, but I'm afraid I'll have to lay off for the rest of the afternoon."



Photograph by U.S.G.S.

A HARD POINT TO MEASURE.

Note the comparative size of horse and men at the foot.

"Let's see, son." The topographer felt the wrist, then feeling that no bones were broken, and that a day or two would set it all right again, bade Roger go to the main camp and let the cook change places with him for a few days.

"I'll write to Mr. Mitchon, and tell him of your promotion to camp cook," called Masseth, laughing as Roger rode away.

On arriving at the camp and giving his message to the cook, the latter readily agreed to help for a few days.

"I'll go at once," he said, "the teamster should be back to-morrow, and while things are running pretty short, I guess you'll have enough to hold out."

The following morning early, after having told Roger everything he was to look after, the cook started for the side camp to take Roger's place, while the latter looked after the camp. Long and weary seemed the morning to the boy, so inactive it was after the strenuous life he had been leading for some weeks, and, though the teamster usually got in before noon, when evening came he had not arrived. Roger, who had counted on the cook's knowledge of the teamster's time, found himself almost without food for supper, and made a very light repast. He was just about to turn in for a sleep, when he heard the sound of horses' hoofs and went out to greet the teamster.

"Is that you, Jim?" he called out.

"Guess not, pardner," answered a strange voice, and a cowman loped into the circle of light. "This here a United States camp?" he queried.

"Yes," answered the boy.

"An' who's running the shebang?"

"I am just at present," Roger answered. "But I expected the teamster here to-day."

"You are? No offense, but you don't look more'n a yearling. Well, it's not so worse to brand 'em young."

The lad explained the circumstances of his being alone, pointing out that the rest of the party were only three or four hours' ride away, and the stranger nodded.

"Which I was a plumb forgettin' to explain is that the gent what you was a-greetin' with the airy name of Jim, won't come none this week to camp, but he allowed as you-all had a-plenty."

"What's the matter with him?"

"Which I ain't a sharp as a doc. Took a spell or somethin'. I opine he's a goin' to continue cavortin' around this Vale of Tears some more, though he has been figurin' on procurin' a brace of wings."

"He's getting better, though?" asked the boy.

"Which he holds a good hand for a long life."

"But I haven't got any extra supply of grub," continued Roger in some dismay.

"Shore!" The stranger, who was just gathering up his reins, half turned in the saddle. "I wouldn't bet a small white chip for any gent's success in a dooel with hunger. Which it is some uncomfortable to ignore the chuck-wagon. But this here Jim he relates that he toted a big jag last time, and it must be cached."

"It must be here somewhere, then," said Roger dubiously, "and I'll look. But it doesn't sound good to me."

"Which if you don't locate, saunter over to the Bar X Double N and we will supply the existin' demand a whole lot," and with a wave of his hand the rider cantered away into the darkness, without giving Roger a chance even to ask where the ranch might be.

But youth is little accustomed to troubled dreams, and Roger slept soundly enough, awakening the next morning, not to a hot and well-cooked breakfast, but to having to prepare his own. Laying hands on everything that he could find, the boy made out a breakfast and then started on a search for other provision. He doubted its existence for the cook had told him that it was nearly all gone. At last, in his rummaging he found a little notebook, marked on the outside, "Record of Supplies," and thinking that this might give a clew, he opened it.

There, under a date of a few days before, was an entry to the effect that the cook had sold to a passing party a large supply of surplus provision, thinking that the teamster would make his regular trip. It was small wonder, Roger thought, that the teamster was not at all anxious, because he made sure that the provision was still in the camp, and of course

the cook was not disturbed because he supposed that the teamster would come the next day.

The situation was gloomy enough so far as Roger was concerned, for he was practically without food, but what rendered the matter doubly serious was that the rest of the party would come in from the side camp two days hence with their supply of provision exhausted, only to find the camp barren, and leaving five men a long way from getting food instead of one. The more Roger thought over the matter, the more determined he was that he must procure supplies. The question was, where?

If the lad had known the country at all, there were undoubtedly ranches somewhat near at hand to which he could appeal at a pinch, but he had wisdom enough to know that it would be the height of folly to ride out upon the north Arizona plateau without the faintest idea of a destination. There was the ranch to which he had been told to come, and he had heard of it often enough to know that it was one of the largest ranches in the country, but who would direct him there? He feared that a blind try in the plain might put him out of touch of water as well as food, a condition insupportable.

There was only one bright spot in the position, and that was the presence of Jack. Jack was a burro, apparently of extreme age, who had been found one morning near the camp, and who had attached himself to the party. Of course all the rest of the animals were away, the cook having ridden back to the side camp the horse on which Roger had come from there. True, there was this burro, but what could he do with it, where could he go?

As he asked himself this question, an answer shot into the boy's mind which turned him hot and cold. He looked over the plateau to the plains and shook his head, then quietly went into the tent to think over the best course for him to pursue. Five, ten, fifteen minutes passed, then with jaw hard-set and lips compressed Roger walked to where the burro was grazing, and slipped a halter over his head. Obediently the patient animal followed him to the edge of the rift of the Canyon, and there Roger looked down and across. Nine miles away, across those fearful chasms and lurid cliffs lay food and necessaries not only for himself, but for the party.

Roger was conscious that prudent judgment would counsel his return to the side camp for the purpose of informing the party of the situation, so that they could cross by the old trail to renew supplies, but the boy knew that Masseth was working against time. Beside this, it would be a great achievement and the lad was burning with a desire to shine before the Survey. The old trail was the better way, but it had been night when they debouched on the plateau and Roger could not have told where the trail entered. He feared he might lose time by hunting for that faint trail, and decided to direct his whole strength into an attempt to force his way straight across the cleft in defiance of the decree that it had never been done and could never be done.

About a mile away along the bank there was a deep fault which could be entered a few hundred yards back on the plateau. The lad knew about this, for the spring whence the camp got its water was close by. Into this Roger turned with his burro, casting one long glance at the camp just visible in the distance, before he took his courage in both hands and plunged into the almost inaccessible ravine.

"They call this Bright Angel Canyon, Jack," he said aloud. "I'd like to have a pair of their wings right now."

The little gray burro looked at him for a moment, then went on picking his steps carefully. It was rough but not perilous for a few hundred yards and the boy's spirits rose until in an hour or so he came to an obstruction about ten feet high, but this puny ten feet, which had looked simply like a little ridge of dirt, baffled him for hours. He traveled up and down, but found the terrace continuous, and it seemed as though his quest would fail almost before it had well begun.

Suddenly there flashed into the boy's mind one of the old fables, and, as before, he took his rough-haired friend into his confidence.

"We can't jump it or knock it down, Jack, old boy," he said. "It's up to us to climb it some way."

With immense toil and labor he carried stone and rock and bits of boulders, and though hours were spent on the task he built up a kind of shaky and insecure pile up which the burro, following him patiently, reached the top. There luck was with him, for, by picking his steps carefully for twenty yards or so, he was enabled to reach a newly fallen piece of cliff, by which he got to firm ground on the other side. Stopping to rest, this obstacle over, the boy's ears were greeted by the musical and grateful sound of falling water, and hurrying to the place, he found a little stream fed by springs and gurgling merrily in tiny cascades to the river.

Although he knew but little of geology, Roger's sense speedily showed him that, by following this little tributary, he probably would have a fair path down to the river, or at least, while he would probably find many drops downward, there would be no walls across his path unless it were one through which the little creek had tunneled. So, ankle deep in the grooved bed, they started down the streamlet on its way to the bottom of the valley.

It was perhaps fortunate for the lad that he was not too well-informed in the customary ways of the burro, and was entirely unaware of the animal's intense objection to running water. Had he known this, in all probability he would have left the burro behind, which would have resulted grievously. But this old burro, as it fortunately chanced, must have belonged to some prospector working in a mountain country, for he evinced no fear of or dislike to the stream. One hundred and seven times did Roger and the burro cross Bright Angel Creek, each crossing growing swifter and deeper than the last. Dusk was falling as they reached the bank of the Colorado River at the base of the Canyon.

Before it became entirely dark, the boy climbed up a peak of rock to make sure of the direction of his objective point, a matter hard to be determined because of the windings of the river, and on descending laid several stones in a row pointing to the direction sought. Then, supperless and almost spent, he resolutely refrained from eating the few last morsels he had brought with him, and flinging himself down beneath an overhanging ledge he fell asleep.

In spite of the strangeness of his position it was bright daylight when he awoke and the burro was standing patiently near by. Taking from his wallet the solitary crust of bread and the few biscuits that remained, and noting that Jack had found some grass just at the water's edge, Roger put on his shoes and walked gravely to the edge of the river. There is only one Colorado River in the world, and it is perhaps the most violent stream in the two hemispheres. It was not at its height at this time, but it ran like a mill race with a vicious swirl and spume, and was ugly to look at. Roger was no mean swimmer, but his heart sank at the thought of plunging into it.

"Jack," he said, "I'd as soon try to swim the Niagara gorge," and the burro looked wonderingly at his master.

So up and down the bank for several hundred yards he went, striving to find some rapids that might be forded, but only at one place did it even appear possible and that, the boy thought, had large odds against it. Still, it was all he saw, and he put the burro at it. But Jack refused, point-blank, and as the obstinacy of a burro needs some considerable persuasion to overcome, things looked black for the boy.

There was just the river between him and safety, for Roger had heard the men speak of an Indian trail which paralleled the river on the southern side and whence he could reach one of the three trails that ascended the plateau, and not only safety, but the welfare of the party, which he felt was intrusted to his care. The burro would not try the ford. Very well, then, he would cross himself. On this side of that torrent, hunger, defeat, and death, on the other food, success, and reputation. Come what might, he would cross!

CHAPTER VII SAVED BY HIS NERVE

It was with a lurking fear that the burro had the better intuition of danger that Roger decided to attempt the ford that the animal had refused to try, but, so far as he could see, there was no other way out.

"He may follow me," said Roger aloud, looking at the little animal, "but I hate to leave him behind."

The longer he looked at it, however, the worse it got, and so, in order to test the feasibility of it, the boy sprang lightly upon the nearest boulder about four feet from the bank. Water to the depth of six inches was pouring over the stone, but he had paid no heed to this, feeling that it was easy to brace against a current of that shallowness. But if his feet ever touched that stone he did not know it, for the rush of water took his footing from him, throwing him headlong as though his feet had been jerked from under him by a rope.

As he fell, the boy threw out a hand to save himself and grasped a projecting corner of the boulder on which he had expected to land, and found himself hanging on for dear life with the current pouring over the rock into his face and almost strangling him. Very few seconds were enough to show that he had not strength enough to draw himself up on the rock against the force of the stream, but the bank was scarcely more than an arm's length away, and making a desperate lunge the boy reached it and clambered on shore, his breath gone and his nerve somewhat shaken by the suddenness of the peril.

The hope of a ford must be given up therefore; no boat or raft was procurable, and indeed could hardly live in such a torrent, bridging was out of the question, so nothing remained but to swim for it. Roger figured that, while of course he could not swim directly across, if he could manage to make any resistance to the current at all and would point up stream at a slight angle, the onrush of the stream would carry him across. A little distance below the ford he had attempted, the river flowed deeper with less apparent turmoil, and there, perhaps, was a chance to get through alive.

But the question of the wearing or the not wearing of boots was quite a quandary. If he kept them on, they would impede his swimming greatly, while if he took them off and did manage to get across, his feet would be cut to pieces in ascending the Canyon on the other side. But he decided to do one thing first, and if he crossed the river safely, then it would be time to consider ways of going up the chasm. Taking off his shoes he tied them to the burro's neck, feeling sure that even if the little animal failed to cross alive, he might be washed ashore on the further bank and the boots could be recovered.

Then, unexpectedly to the burro, while the latter was standing at the edge of the bank, he gave him a shove and toppled him in and sprang into the water after him.

But, despite his previous little experience of the force of the current, Roger had altogether underestimated its power. He could not even face it, the impetus stunned, blinded, and deafened him. The river took him like a chip, and though in an aimless sort of way, he tried to swim so as to keep his head above water, he knew that he was being swept down the reach with incredible speed. As for the burro, he had not time to think about the faithful little beast, who was being swept down the river even more rapidly than the boy.

But, about two hundred yards down the river, there stuck out above the water a large projecting snag, which had been carried down the stream from the forests hundreds of miles above, and which had been partly buried in silt and thereby held firm. The snag being on the further side of the river, just as it took a sharp curve, had made a tiny shoal and the burro was slung by the current against the snag and held there by the force of the water. The donkey had hardly struck the snag before Roger, gasping and exhausted, came whirling down upon him, but his smooth wet sides afforded no handhold and Roger was slipping away from him when his hands unconsciously touched and grasped the animal's tail.

A violent jerk followed, and for a moment it seemed doubtful whether the wrench would not tear the burro from the crotch of the limb in which he was imprisoned, but the anchored tree held fast, and Roger, though his arms were nearly pulled from their sockets, fought inch by inch his way to the lee of the burro, grasped the snag, and finally got footing on a part of it below the water, where the current was not so swift. But there was no time to lose, so Roger, rapidly unfastening his shoes from around the burro's neck, threw them to the shore, which was about sixteen feet distant; then to get a start for a jump he balanced himself on the topmost branch of the snag and gave a wild leap for safety.

He could jump six feet, and with arms outstretched reach five, leaving scarcely two yards to cover. This the impetus of his leap should give him, Roger figured, but even those few feet were almost too much, and had not the shore curved a trifle at that point he might have been carried out toward the center of the stream again. But the initial velocity of his spring was just enough, and a moment later, with his heart beating like a trip-hammer and trembling with the exertion, Roger flung himself upon the other shore. The Colorado was crossed!

Roger's first thought, after a sense of gratitude and relief, was for the burro, but for whose providential capture in the snag and whose most convenient tail, he would probably have been dashed upon the rapids below. He got nimbly to his feet, though considerably bruised and sore, and hurried up stream the thirty or forty feet to where he had left the animal. As he reached there, he saw that the burro had found shoal water under his feet and was pawing away for a foothold, thus loosening the hold of the snag upon the bottom, and the boy saw the tree begin to shift.

"Don't, Jack," he called, as though he believed the burro could understand, "keep still till I help you out!"

But the companion of the boy's perilous trip took the shouting for encouragement and kicked all the harder, till a few seconds later, amid a swirl of mud and sand, the huge wreck of a tree rolled over and whirled down in the river in a confusion of branches amid which the poor burro seemed to have no chance. The very size of the tree evinced to Roger how furious must be the torrent of the Colorado in the spring floods, for the snag showed that it must have come from a pine not less than thirty inches at the base. The forking, broken and splintered limbs, however, projecting on all sides, caught in the bed of the river now that the stream was low, and this prevented the burro from being swept into the middle of the current, and suddenly, to the surprise and delight of the boy, a swift back eddy caught the animal and threw him up upon the shore.

Roger ran to him, but there was no sign of motion, the poor burro lay quiet as though dead. Heaving a sigh, for their twin peril had made Roger quite fond of the little animal, he turned to go, half-thinking that, if there were any future state for the four-footed part of the world, he would have a candidate to present. Then, sitting on a fallen rock, he put on his boots, his feeling of pride at the great achievement of having crossed the Colorado River only dimmed by his sorrow for his faithful comrade. Before leaving, however, he went back to where the burro lay.

"It's a shame to leave you lying there, Jack," he said, "but there's nothing I can do for you. Of course, I know you're only just a burro, but I do hate to say 'Good-by.'"

There was a great big lump in the boy's throat.

"I'd like to dig a grave, or--or--something," he added, "but I can't. It seems playing it low down on you, Jack, when I couldn't have got across but for you, but there's no help for it. It's got to be good-by!"

He turned away sadly, when, just as he did so, he thought he saw the little burro's side heave. With a shout of delight, he stooped down, though he had not the faintest idea whereabouts to locate the animal's heart, and was feeling for a throb, when, with two or three deep breaths, the burro opened his eyes and staggered to his feet; looking with a mild surprise on Roger, who was dancing the wildest kind of a war-dance round him and whooping enough to make it sound as though the Apaches were on the scalping trail once again.

But while the difficulties of the trip were by no means over, the dangers were now few. Roger knew that he was bound to strike the Indian trail which paralleled the river on the southern side, and that, if he desired still easier going, though probably longer, he had only to follow any of the terraces and he would strike one of the trails. He decided on the latter course, and with Jack following him with absolute docility, he commenced his long trip up the other side of the Canyon. On and on he went, hour after hour passed, when, just as the boy had given up all hope of ever reaching the trail, the burro turned sharply and stood still. The afternoon was drawing on, and between hunger and exhaustion Roger was very nearly played out. Looking up, however, he found he could just discern the edge of the Canyon near the hotel, and he knew that the little black specks upon the brink were people, probably looking down at him, and all unaware of the desperateness of his condition.

His handkerchief had been lost somewhere, so Roger tore off the sleeve of his shirt to wave at the people, and a following glint of white told him that they were waving back. But it was help that he wanted, not greeting, and the boy puzzled his brains to think how he could signal at that distance. Then an idea struck him, and looking up to see that the people were there, he stumbled and fell as though to make them think that he had been hurt or wounded in some way. A rapid increase in the numbers on the edge of the chasm told him that his ruse had succeeded, and in a few minutes he saw several people debouch on the trail, which was only visible for a few yards from the summit.

He pulled himself together and started up the trail, but it was not until it was almost dark that the rescue party found him, the leader being a long, gaunt frontiersman.

"What's your name?" demanded the latter.

"Got anything to eat?" promptly countered Roger, to whom this was the chief need.

The frontiersman signed to one of the party who had brought some provisions along, and after the boy had been somewhat refreshed, the old man said:

"Now tell us whar you've been."

"I've come from the other side, down Bright Angel Canyon," replied Roger tersely, "and I came to get grub for the Survey camp."

Numerous inquiries brought from the boy enough of the story to give the members of the search party a fair idea of what had happened. He was too tired to talk, however, and contented himself with an appeal that Jack should be well looked after, and thereafter satisfied himself with sticking to the saddle of the mule which had been brought down for him to ride. When they reached the hotel the frontiersman walked into the rotunda with the boy, and as they stood before the desk, he turned to the crowd assembled and said:

"Ladies and gents, I'm no speechmaker, but I reckon we hadn't ought to let this young feller hit the bunk before we tell him what we think of a chap who is plucky enough to blaze a new trail across the Grand Canyon, and the first time in its history to cross it alone with one burro. This is Roger Doughty, ladies and gents, the first white man to cross the Grand Canyon alone."

Immediately all the curiosity-hunters that hang about those sight-seeing hotels crowded around the boy, but he would have nothing to say, and was far too wearied to undertake to tell his story. Bidding the clerk have all the supplies ordered for him early in the morning he turned to go, when his new friend, the frontiersman, said:

"Did you reckon to go back yourself with the grub?"

"Sure. To-morrow," said the boy. "That is, if I can get a little sleep to-night," he added pettishly.

"Then I'll go with you, boy. You've done a thing that will be talked about in Arizona, I guess, as long as the Colorado River flows. It isn't right for you to tackle the trip back alone, and anyway, I know the trail better than you do. An' what's more, you sleep till I call you myself to-morrow, and I'll see that all the supplies are ready and packed for the start. I'm an old hand at the game, bub, and you can leave it all to me."

Roger thanked him and once more turned to go to bed when he was intercepted by another group. The frontiersman stepped forward.

"The kid's going to hit the pillow," he announced, "an' I reckon that he's earned it. Any one that tries to stop him can talk a while to me. Go on up, bub," which Roger, portentously yawning, proceeded to do.

So, laughing at the mixture of friendliness and bravado exhibited by the boy's lanky champion, the people stood aside while Roger stumbled upstairs and fell on a bed asleep. A few minutes later the big frontiersman followed him, and seeing him dead to the world with all his clothes on, even his hat being still crushed over his eyebrows; picked him up on his knee, took off his clothes and tucked him in as tenderly as his mother might have done, the boy never even growing restless in his sleep the while. That done, the burly Westerner, whose touch had been throughout as light as that of a woman, looked down on the sleeping boy.

"If that's the kind the government breeds," he said, "no wonder we can whip the earth!" and he went down to arrange about the next day's trip.

In the meanwhile the Survey party had progressed rapidly with its work, and on the afternoon following Roger's arrival at the hotel, they returned to the main camp. They thought it strange, as they rode in, that Roger should not have heard the horses' hoofs and come out to greet them, and Masseth felt a slight alarm lest the hurt to Roger's wrist should have proved more serious than was at first thought. On reaching the main tent, however, he saw a large piece of paper, held down by a stone. He picked it up. It was written, boy-like, as an official report, and read as follows:

"MR. MASSETH: Sir, I regret to report that James, the teamster, has got sick, and will not bring any supplies this week. He sent word that there was a lot of supplies in camp, but I could not find them. A cowboy from Bar X Ranch brought word. I have taken burro and will try to cross Canyon to get supplies. I hope to be back Friday afternoon or evening.

"R. DOUGHTY."

"By the eternal jumping crickets!" was Masseth's first astonished exclamation. Then, calling to the cook, "George," he said, "come here a moment!"

The cook came over and the chief handed him the letter. George read it through carefully twice, then handed it back.

"I got a chance to get a long price for some pretty stale grub, and it looked to me like a good stunt. How was I goin' to know that bally chump of a teamster was plannin' to get sick?"

"But the boy!"

"It's sure tough on the boy. It's a beast of a trip, even if he's sure of the trail."

"But he's only been over it once, and he could never remember that confusion of canyons." He turned sharply on the cook. "It's your fault," he said; "you ought to know better than to let yourself run out. It's never safe to go without some on hand for contingencies."

The cook thought it wiser not to increase his superior's anger by replying, so went to the cooking tent to try to devise some sort of a meal from the remnants that had been brought from the side camp. As for Masseth, the more he thought of the situation the less likely did it seem that the boy could have found his way, but he could have struck water somewhere, so that perhaps search parties organized on the other side might have a chance of finding him, but every hour counted. He talked it over with the assistant.

"Well," answered Black, "of course the dark's confusing, but with both of us watching the trail and knowing the landmarks, we can't get far astray. And we might drop across the lad. I'm ready to start any minute you say."

Masseth thought for a moment, then pointed with his finger to the chasm.

"I don't believe any of us would be comfortable to-night," he said, "knowing that the lad was down there, when for all we know he may be dying of starvation and the loneliness of desolation, just within our reach. A bite to eat, whatever there is, and then an immediate start."

Gathered to the hasty and scanty supper, the cook found himself in a position of extreme discomfort, though no blame was attached to him. He had acted for the best and this result could not have been foreseen. Perhaps it was because his nerves were unusually upon the strain that he was the first to hear a sound along the chasm. He held up his hand to enjoin silence, and in a moment or two horses' hoofs and voices were heard. Then, looming unnaturally large in the last flush of twilight before the darkness fell, came two figures, one on a tall iron-gray horse, one on a mule, with a burro plodding along patiently behind.

A stentorian voice hailed them from the distance.

"Hey, there!" it said.

"Well?" called back Masseth.

The second of the oncomers answered, this time in a boy's voice.

"Oh, Mr. Masseth, have you been back long?"

"It's the boy," said the topographer solemnly, but with a note of joy in his voice, "and his life won't be laid at my door;" the soberness of words and tone revealing how keenly the fear of Roger's peril had been pressing on him.

When the two rode up the boy introduced his frontiersman friend to the chief of the party, the while he was being untied from the saddle, to which, in his still exhausted and stiffened state, he had been fastened. But introductions, however informal, did not stop the big Westerner from speaking his mind.

"I'm thinkin' there's some thunderin' big fools in this here party," he announced in his abrupt way, "that can get matters into such a hole that a youngster has to start off on a crazy trip like that, but I want to state that the boy is pay dirt all through. He's not only crossed the Canyon alone, but he's found a new trail!"

"Where?" asked Masseth eagerly, thinking it wiser to ignore the stranger's criticism rather than debate the point.

"Down Bright Angel Canyon, Mr. Masseth," answered the boy. "It wasn't so awfully bad, except in a few places."

"But how did you get through?"

"I went down by the spring," answered Roger, "keeping to the right, until I got wedged in between two cliffs, pink in color with a broad band of slate blue about two-thirds of the way up."

"That's usually a bad wall!" interjected Masseth. "How did you cross it?"

Roger described the device he had used, and received the encomiums of all his comrades for the work, and then, as briefly as he could, gave an outline of the various points of interest on the way.

He was especially gratified, when, after telling how he had got out of the pocket of rock, Masseth turned to his assistant.

"We'll chart that as Doughty Point," he said, "for the boy's sake."

The boy flushed with delight at having his name given to a part of the country, just like a real explorer, and cast a grateful look at his chief.

"It was just beyond that that I struck water. The ravine sloped abruptly for about one hundred feet, then struck an upcurving rock and gave a little jump like a fellow does on skis and fell like a long silver ribbon for about two hundred feet. I suppose that is Bright Angel Creek?"

"And rightly named," put in the assistant topographer, nodding his head affirmatively, "any stream that doesn't run dry in this sort of country is angelic, all right."

Roger continued his story of the trip, describing points which he had noted, Masseth naming them, "Deva Temple," "Brahma Temple," "Zoroaster Temple," etc., and at last he fixed the route by its relation to "Cheops Pyramid," one of the well-known configurations of the Canyon.

"But on which side of the creek were you, when you saw the pyramid?" asked the chief.

"On the other side from it," answered Roger.

"If you had only crossed once more, or once less, it would have brought you to the main trail where the boat is," said Masseth regretfully. "But how in the world did you cross?"

So Roger told the story of the burro, and the manner in which he had been caught in the crotch of a snag; and the party, though old hands at the business, hung on his tale as though they had been so many greenhorns. He told, moreover, as well as he could, his route up the other side, until the frontiersman took up the story from the point where the lad had been seen by the spectators on the edge of the Canyon, near the hotel.

The last few sentences of the boy's story had been somewhat incoherent, for the long trip of that day, following his arduous experiences alone had been too much for him, and he could not keep his eyes open. He was promptly taken to his tent and bidden to sleep, the while the frontiersman described enthusiastically the boy's pluck and nerve.

"And I thought, by thunder," he concluded, "that the overschooled kids of this generation were a pack of milksops, but I see there's grit in an American boy yet!"



CHAPTER VIII

THE LAND WHERE IT NEVER RAINS

It was well on in the afternoon of the next day when Roger woke, to find his friend the frontiersman bustling about the camp. He came sharply when the boy hailed him.

"See here, lad," he said, "I figured that a rest wouldn't hurt you any, so I told the thin fellow that if you stayed on here a while, I didn't have much on hand, and I'd keep you company. Jest to watch that you didn't get up in the middle of the night and try and find some other new trail. So it's you and me for a few days, and I guess that teamster of yours ought to show up soon, because, of course, he doesn't know anythin' about what's been goin' on."

A couple of lazy weeks passed by rapidly, lazy because the Westerner insisted on doing all the work that needed to be done, and before they were over Roger found that he had nearly regained his full strength, his wiry frame recuperating without loss of vitality. Masseth, on his return, was much gratified to find how well the boy had got along, and the following week he took him alone to one of the most prominent stations on the northern side.

"Now, Roger," Masseth said to him, "I've just about finished what I want to do on this side, so I'm going across to run a level on the other side. But I'm very anxious to get a clear sight of this peak, where we're standing, for an extensive triangulation, in order to correct or rather verify some results. The only way in which this can be done is to flash a heliograph message to me, at a certain time on a certain day, in the way I showed you last week."

"Across seven miles?" asked the boy in amazement.

"More than that," said his chief, smiling. "Now here is the way you had better get at it. In this box, which you see has been securely fastened to the rock, are two pieces of tin, one with a quarter of an inch hole in it, the other with a hole an inch square. They point, with mathematical correctness, to a peak on the other side, which is an old station, and easily seen. If you look through, you can see the place."

Roger bent down, and looking through the aperture was able to determine a slight projection on the far distant bank, which he described and which was in verity the point sought.

"Now," continued Masseth, "two months hence, or to be more exact, sixty days from now, at eight o'clock in the morning, I will be waiting at that point on the other side, and I shall expect you to be here. Over the further piece of tin, as you see, I have hung a cloth, which you can drop while you are testing the glass. In this movable frame, so devised that it can be screwed up or down, or shifted slightly sideways, arrange the glass so that the reflection of it, shining through the larger hole, appears at an equal distance on all sides of the smaller opening. You understand me?"

"Quite, Mr. Masseth," answered the boy, who had been listening with all his ears.

"Very well," the older man continued. "At eight o'clock sharp, then, you will raise quickly the curtain in front of the smaller hole, and drop it again, doing this three times, allowing the hole to remain open for ten seconds each time. Do that every five minutes for half an hour, or six times in all, to allow for any possible variation of time in your watch. By the way, you had better have two watches in the event of one of them stopping or the hands catching, or something of that sort, because a month's work will depend on getting that signal. But I think I can trust you."

"You can, indeed, Mr. Masseth," said Roger. "But what shall I be doing during those two months? Am I to remain alone in camp?"

"Hardly," said his chief, smiling. "The Survey does not waste men that way. Mr. Mitchon has written me that Mr. Herold desires you should have an insight into the varied work of the department, and I have arranged for another topographic aid to meet me on the other side, so that, except for this heliograph signal, which I must remind you is excessively important, you will have finished with the work here."

"Then what?"

"Death Valley and the Mohave Desert," replied his chief. "It is perhaps a little hard to send you into a hot section of the country at this time of year, but, you see, you cannot go too far away because of your engagement with the sun on a morning two months hence--by the way, if it is cloudy, which is so rare a contingency as scarcely to be reckoned on, signal the next morning at the same hour--so you must stay near by, and the most interesting work at hand is that being done in the waterless country."



Photograph by U.S.G.S.

TWENTY-SEVEN MILES FROM WATER.

Shelter camp in Great Dry Desert, life being sustained by constant relays from distant wells.

"Death Valley," the boy repeated, his eyes sparkling with excitement, "I have always wondered what Death Valley was really like."

"That will give you a chance to see it, and to find out for yourself."

"But how?" asked the boy surprisedly. "Isn't the air poisonous, or something? I had an idea that nothing could live in Death Valley."

Masseth smiled.

"You're mixing up some fairy story of the Upas Tree, or something of that sort," he said. "There's nothing very dangerous in Death Valley, except the lack of water. And even that is nothing like it used to be, because, while they have not found any more water, the places where pools do exist are carefully mapped out and made easy of access. But it is a grim and fearful place unless every step of the journey is carefully planned with relation to those few scanty wells."

"Then," said the boy, "if it is just lack of water, why was it called Death Valley?"

"A party of emigrants gave it that name," said the chief quietly, "and to them its sinister title bore a grim meaning. They had passed through the desert, suffering incredible hardships and were greatly weakened when they arrived at the valley. Still they pluckily journeyed on till they reached those salt and borax flats, where the surface is rougher to travel on than can be imagined, the salt having formed in sharp spikes and jagged scales with their edges at every angle, and shallow pans filled with dreadfully salt water. But it was water, and many of the party sought thus to quench their thirst."

"Although it was salt!" cried Roger. "I should think it would have made them crazy."

"It did," responded the older man. "The torture of an unquenchable thirst with no means to allay it, led first to madness, then to death, and the valley claimed a fearful toll. Some died outright, others became maniacal, several indeed having to be shot by their comrades in an effort to save the lives of those that remained. Few animals and fewer men found their way to the scanty water of the Panamint, and the tale as told by the survivors made the words Death Valley a name of fear to the 'Forty-Niners' and other early travelers in what was then known as the 'Great American Desert.' Death Valley it was called, and Death Valley it will remain until all memory of America's pioneers is past."

"And is the Survey working in there, too?"

"I happen to know that there is a short reconnoissance trip to be made to look into the question of the borax deposits of the Valley and the Mohave Desert, and if you start right away, you ought to be able to get to Daggett a week before the party reaches there, or at the slowest, in plenty of time. The borax industry is large, and as it depends in a great measure on the information furnished by the Survey, it might be a good thing for you to know something about."

"And how shall I get there?"

"I will lend you Duke."

"Your own horse? And what will you do, Mr. Masseth?"

"Oh, I'll take Black's mare, and let him ride one of the mules over. I am none too anxious to take Duke through the Canyon any more than I have to."

"And the route?" queried the boy.

"You will not find any difficulty there, I think, because all you have to do is to follow the edge of the Canyon. You go west and then south, over the famous Hurricane Fault, and beside that mighty gate a mile high through which the Colorado runs, passing from the grandeur of the Canyon to the dismal torrid lower Sierra country. You will reach the Santa Fe at Needles, where you can take the train for Ludlow, and changing there go to Daggett, to await the arrival of the party. It is not such a great distance, and there are trails all the way to Needles. But remember, you are still under my direction, and all this is merely incidental to the main piece of work I require of you, and that is, the heliograph signal on October 21st."

"I'll be there, Mr. Masseth," said Roger quietly. "You can bank on me for that."

The boy was so silent on his way back to camp that Masseth rallied him a little on his unusual reserve.

"Don't you want to go into the Mohave country?" he said. "Because if you feel that way, I will try to arrange some other plan. Only I thought you might wish to see that sort of country and get an idea of what the work is like out there."

"Indeed I do," said Roger hastily. "What made you think I didn't?"

"You were so quiet about it. And quietness is not your strong point."

"It isn't that," said Roger, hastily, "but I was just wondering whether I would be able to remember all the scenes and incidents of the year."

"Not all of them, of course," said the older man, "but you will find that their variety in experience is invaluable. You told me you were going to Alaska with Rivers later on. Now, if you have seen the Death Valley work as well as triangulation in the Grand Canyon and surveying in the Minnesota swamps, you will have a fair idea of the immense range of the work of the Survey."

"It is a contrast, all right," said Roger. "From the flat, boggy country of Minnesota to the high dry peaks of the Canyon, and from the intense heat of the desert to the ice-bound ranges of Alaska is certainly quite a jump. But I'm very glad to have the chance, Mr. Masseth, though I shall be sorry to leave you and the rest of the party."

That evening in camp, the chief announced his intention of returning to the far side of the Canyon, and stated that Roger would be left to send a heliograph message a couple of months later, and that in the meantime he would visit the Mohave country for a few weeks.

"Why," commented the frontiersman, when this plan was unfolded, "I was figurin' myself how it mightn't be so worse an idea to prospect some in that Silverbow country, now that I'm 'way over here. My two boys are working a small claim of mine near Oak Springs Butte, an' I've a notion that there's a heap of gold in that Kawich country. Guess I'll go with you part of the way to Daggett, pard; that is, if you're agreeable."

Nothing could have suited the boy better, and his exuberant delight in the prospect of his friend's presence throughout the long ride was obviously pleasing to the old man.

"That's a go then, bub," he said; "if you want to stick to the old trail I'll help you keep it, and if you want to find a new one, why, I'll just follow right along."

"But when are you going to break camp, Mr. Masseth?" asked the boy, who was growing a little tired of the continual reference to his crossing of the Canyon.

"The day after to-morrow, I think," the chief of the party replied, "as the work should be done by that time; so you can start the same day, only in the opposite direction."

In spite of Roger's interest in going to a new field, however, and though he had beside him his grizzled friend, one of the keenest twinges of loneliness the boy had felt while on the Survey came over him a couple of days later, as he saw the party which he had so long considered as his own, ride away from the site of the camp, leaving the frontiersman

and himself looking after them. He would much have preferred being the first to start, but as the main party had to cross the Canyon, movement at the earliest dawn was necessary. One consolation he had in the possession of Duke, the chief's horse and a great favorite with the boy.

As Roger and his friend started on their journey westward, the boy said:

"You were speaking of some mines out this way. Do you own gold mines?"

"No, bub, not gold. Wouldn't have 'em as a gift."

"Why not?" asked the lad, surprised.

"Cost too much to work, and there's no money in it. You know the old saying about gold mines, don't you?"

"No, what is it?"

"That 'A copper mine will bring you gold; silver, silver; but a gold mine will only bring you a few coppers!'"

"I never heard that before," replied the lad, "and it sounds queer, too."

"Well, it's true. I wouldn't mind betting," said the old pioneer, "that there's more gold been put into gold mines than ever was taken out of them."

"How's that?"

"Well, you take it all through. There's the time and money spent by the thousands of prospectors that spend all their lives wandering up and down the mountains trying to locate the gold. Then, when a vein is found, some fellow's got to put in a lot of capital to start to work it, and thousands have to be spent for machinery to crush it, before it is at all certain that the mine will pay. Then, in order to raise this money, brokers all over the United States are selling shares of these mines, and they make a good living out of it. And when you think how many tens of thousands of dollars are spent on each mine, and how many thousands of mines there are which have proved dead failures, and over and beyond this, how narrow the margin of profit is even on a successful strike, it doesn't look like much of a paying business, eh?"

The trail becoming too rough at this point for riding side by side, the boy dropped behind, thinking over the difference between the finding of gold as it really is, and as his adventurous ideas had supposed it to be. When the trail widened again the boy cantered up, and continued the former subject with the remark:

"Are your mines copper, then?"

"No, azurite."

"What's that?" asked the boy, who had never heard of it before.

"It's a sort of stone that they make up into all sorts of jewels that women wear. Of course it's not precious like sapphire and emerald and all that sort of thing, but that's perhaps because it is not as well known, nor as rare. It's just as pretty, I think. I'd rather have it than a gold mine or a copper mine, either, for that matter."

"Why?" asked Roger.

"Because it can be worked so easily. You see a small box of that stuff can be packed on a mule any distance and then shipped, and if a different point is used each time no one knows where it comes from and there is no competition. Now copper, you see, is only valuable in large quantities, and it needs a big industry to run it. And of this rarer sort of stuff, there's lots of it around for any one that wants to look for it."

"What sort of stuff?"

"All these rare mineral earths. The clay that's used in making gas mantles, for instance; or there's tungsten, which is worth a lot now for making the wires of incandescent light. I've a friend who's rich because he got hold of a deposit of tungsten from reading the Geological Survey bulletins. There's a lot more of it in the Snake Range of Nevada, just waiting for somebody who's got energy enough to go ahead and develop it."

Thus, throughout the entire trip, Roger found his interest in the work greatly whetted by this new view-point, looking at the Survey from the side of the shrewd Western man, seeking practical results, rather than the more professional and scientific aspect of the field worker himself. Indeed, it opened the boy's eyes immensely to the vastness of the importance of the department when he realized that there was scarcely a branch of manufacture that did not depend on some rare element, in some of its processes, and that these rare elements were brought to light in the very work that he

had been doing. So it chanced that when Roger and his friend reached Daggett, he was as enthusiastic concerning the economic side of the work as he had been regarding its opportunities for adventure.

Masseth had estimated the time of the party which Roger was to join with close accuracy, for the boy had not been in the little settlement more than three days when the party rode up, all on mules. Roger introduced himself and presented Masseth's letter.

"Oh!" said his new leader in surprise. "So you're the boy who crossed the Grand Canyon alone! I heard of that in San Bernardino, some tourists were telling the story."

"Yes, Mr. Pedlar," said Roger with a flush. "But there wasn't so much to it, I just had to get across."

"Well, I'm glad to have you. Now what is your idea in joining us, because I see Mr. Masseth says that you are still on duty with him."

Roger explained the two months' signal that had been agreed upon, and Pedlar, tall and light of hue, as though the desert had bleached him, whistled softly.

"He's always taking long chances," he said, "but to do him justice they generally come out all right. As I understand it, then, you want to come along for a few weeks and then get back to Bright Angel Point in plenty of time."

"Yes, sir," the boy answered.

"Well, that will be about right, only it's not going to take as long as you think. It will be just a hurried reconnoissance. I suppose you know why we're going in?"

"Mr. Masseth said something about borax," the lad replied, "but he didn't say just what you were going to do."

"It's this way, Doughty," was the reply. "Borax, you know, was first obtained by evaporating the water of some lakes in California. Later, in the beds of some old dry lakes, the borax was found already evaporated by the sun, and for years these marsh crusts formed the whole supply of the country. Then the Geological Survey pointed out that before these lakes were dried up the borax must have flowed into them by means of some small streams or just the regular drainage of the rainfall."

"You mean," said Roger, interrupting, "that there must have been a lot of it near by somewhere, and that each rain just soaked away a little and brought it along."

"Exactly. Therefore it was up to the Survey to locate these large deposits, and this was done. A large bed was found at Borate, about twelve miles northeast of here, and this proved so valuable that more surveying was done, especially in the region about Death Valley, where one of the old salt marshes was located."

"Then it was the Survey that gave to the country all the borax it is now using."

"It was," replied Pedlar. "Now, you see, I am making a hasty trip to the known deposits, so that other related beds can be pointed out, as each new find adds to the resources of the country, or, in other words, makes the United States just that much richer."

"How is that?" asked the boy. "The government doesn't run the mines."

"No. But don't you see, the United States means the people of the United States, and if the money spent on borax goes to American producers in American fields instead of to Italy, where so much of it went before, the country is richer to that amount."

Then, putting the matter as simply as he could, Pedlar explained to the boy how greatly the commercial prosperity of the country is due to some of the lesser known government bureaus, and pointed out the wisdom of the fostering of American industries. Even so, it was not until the tangible discovery of a hitherto unknown bed of rock salt, fifty feet in thickness, that Roger realized how, every day in the year, the prosperity of the country was being advanced by this patient scientific investigation. The new salt deposit was found at the extreme south end of Death Valley, a few miles before the trail went through a gap in the Funeral Mountains. Skirting the Amargosa Desert, a furnace of cactus and alkali, the party reached Grapevine Peak, from which may be seen perhaps the most desolate and forbidding view in the Western Hemisphere.

"Behind you," broke in the voice of the chief, "beginning at that peak you see fifty miles away in the distance, and which is known as Oak Springs Butte, is a section of the country containing over 3,000 square miles, equal in size to the states of Delaware and Rhode Island together, which is absolutely waterless. In that appalling land of thirst there is not a river, stream, or brook; a spring is a thing unknown; no well has ever been sunk, and even the Indian waterhole exists

only in imagination. At rare, very rare intervals, a cloudburst may come upon the parched land, but five minutes later there is no sign of moisture save for a cup in a ravine or a crevice in a rock, where water may lie for twenty-four hours. It is dryer and hotter than the Great Sahara Desert of Africa, and wild and rough beyond belief."

"And has that awful place been covered by the Survey, too?" asked the boy.

"I did one quadrangle," answered Pedlar, "and there's a party in there this season."

"But how do they manage for water?"

"They tote every drop. And," with a grim meaning, "they are not taking baths twice a day at that!"

"On this other side," continued the chief of the party after a pause, turning round, "is a place you know well by reputation."

"That is the famous Death Valley?" queried Roger.

"That," said the chief, putting his heels to the mule's side and starting down the slope, "is the infamous Death Valley."

Half-way down the slope Pedlar halted and pointed to a sign on a box lid, stuck into a pile of stone.

"Gruesome advertising, that!" he commented.

Roger read it. It was the signboard of a local undertaking company, and the implication of such a need for every one descending into the valley was to the boy more sinister than any of the stories he had heard about it. As they reached the valley, dunes twenty to thirty feet high surrounded them on every side, with a salt sand between, sometimes soft, sometimes with a treacherous crust through which the hoofs of the mules sank, often cutting their legs, into the wounds of which the alkaline dust penetrated, causing great pain. The boy tore his coat into strips to bind around the pasterns of Duke, but even so some slight scratches were unavoidable.

They journeyed on over this fearful traveling for many weary miles, till, suddenly, Roger's quick eyes, eagerly looking for new things, discerned at the entrance to a small rock-bound canyon a sliver of wood broken off and sticking upright in the sand. As wood in that country is as unusual as it would be to see a shaft of burnished silver protruding from the arid ground, Roger rode up to it. There, penciled apparently recently on the wood, were the following words:

"Have gone down canyon looking for the spring; have been waiting for you.--Titus."

The boy called to the chief. Pedlar came over and read the message, then quietly and with reverence removed his hat.

"Poor chap!" he said very softly. "There is no spring in that canyon."

He summoned the other members of the party and silently they rode up the narrow cleft. Roger and the chief were riding in advance, and after a few minutes' ride the latter pulled his mule in sharply, and pointed to the figure of a man lying near a rock in the full glare of the sun.

"Perhaps he isn't dead?" said the boy, his heart in his mouth.

"No use to hope that, my boy," was the grave reply. "See, he must have lain down in the afternoon, when that spot was shaded, and died before the next sun rose. No living man would lie exposed to such a sun as this."

They rode up. It was as the chief had said, and Titus's friend, whoever he might have been, would never see him more.

"Shall we make a grave?" asked Roger in an awed tone.

"Better in the little cemetery at Rhyolite," answered the other. "I will send word."

"But ought we not to make a pile of stones over him, or something?" suggested Roger, his mind full of thoughts running on the possibility of interference by wild beasts.

"Nothing can hurt him here," was the reply. "Not even a buzzard will haunt so desolate a spot as this. But still----" he paused. Then thinking that it might ease the boy's mind, as well as show respect for the dead, he gave orders to raise a cairn of stones over the body of "Titus."

The discovery cast a gloom over the party, and the penciled piece of wood, which was to be sent back to Rhyolite to be used instead of a headstone, seemed an uncanny thing to bear. The tragedy had given the boy a violent distaste for the bleak country, for he seemed to see a body lying under the lee of every cliff. He was glad when they reached civilization again, and he could turn his face away from the land of sage brush and alkali.



Photograph by U.S.G.S.

IN THE DEATH VALLEY.

Opposite the opening to Titus Canyon where the fatal guide-post was found.

When he came to bid farewell to Mr. Pedlar, however, the latter looked at him a little keenly.

"I could see," the older man said, "that the Titus Canyon matter worked a little on your nerves. Now, I don't want you to feel that you must get hard, for you will find that the finest and most daring men in the world are often as tender as a woman, but it contains a most important lesson for you."

"And that is?" queried Roger.

"That it is only the fool who over-estimates his own strength."



CHAPTER IX A FIRST-CLASS BUCKING MULE

As there was yet a month to elapse before Roger's "engagement with the sun," as Masseth had called it, and the journey to the Grand Canyon would not take more than eight or nine days, the boy felt little desirous either of waiting about the desert country or of going back to the Canyon ahead of time. It was practically a vacation for him, he had plenty of money in his pocket, a good horse between his knees, the prestige of a government appointment at his back, and the recollection of the gloomy Mohave country to wipe out.

The reconnoissance party had left him at Olancho, at the southern extremity of Owens Lake, a land of black volcanic lava and great beds of tuff. After the dazzling white of salt and borate deposits; the great sheets of black lava, and the heights of the Sierra Nevada behind, formed so strong a contrast that Roger could hardly believe that the two were but a couple of days' ride from each other. Towering over all, moreover, could be seen Mt. Whitney, the sentinel peak of the southern end of the Sierra, snow-capped and majestic, and Roger conceived the idea of riding thitherward to gain some idea of the life and scenery of the mountain-side.

A few hours' ride brought him to Lone Pine, where he put up for the night. In the course of casual conversation with some of the men in the little frame hotel, Roger mentioned that he was with the Geological Survey. This announcement he had found it necessary to make in a number of instances, for in that Western country a man's business is not regarded as a matter especially to be kept secret.

"Sho!" said one of the men, just in from a big cattle ranch. "I presoom, then, that you propose to hitch up with that peak-climbin' outfit?"

"Is there a geological reconnoissance party near here, then?" queried Roger interestedly.

"A what?"

"A geological reconnoissance party," repeated the boy, "a government survey."

"Geological reconnoissance is good!" exclaimed the Westerner. "If that salubrious phrase is a maverick, I reckon I'll brand it and inlood it in my string. But there was a bunch here the other day, with three-legged telescopes and barbers' poles, just like what you describe."

"How long ago?" asked the boy.

"'Bout a week, I surmise. An' they can't have got any thousand miles away, either, because, as I understood 'em, they was a-contemplatin' drawin' little picture-maps of the country as they went along."

Roger nodded understandingly.

"I know," he said, "that's just the delineation of the topographical contour."

The Westerner's jaw dropped for a moment, but he was game, and came right up to the scratch.

"Topographical contour I like!" he said. "This is our busy day on language. It may be a new sort of drink for all I know, but it sounds well. I presoom, partner, that you had better lend your valooable assistance to the delineation of the topographical contour on a geological reconnoissance!"

He looked round for the applause of the little gathering, which was readily and gleefully accorded him.

The boy laughed. "All right," he said, "I'll take my medicine. I hadn't noticed that it would seem like tall talk, but that's the way the men speak on the Survey."

"Which I've no objection, son," answered the other. "I'm allers willin' to rope and hog-tie a new bunch o' words, an' I has gratitood therefor."

"You all remember," broke in another speaker, "the time when Ginger Harry's gun-play was choked off by the vocab'lary Little Doc unloaded?"

And Roger, seeing the conversation pass into other hands, was glad to retire from the center of the stage in which he had unexpectedly found himself, and listened for all he was worth to the reminiscences of the days when cowboy life had not been spoiled by railroad tracks and barbed-wire fences.

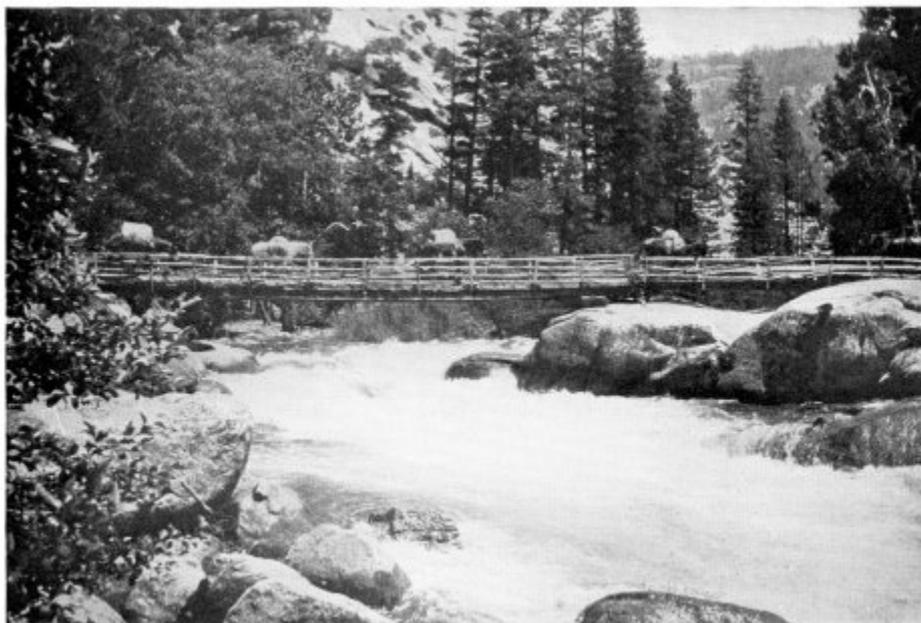
Early the next morning, however, taking with him a few days' provisions, Roger started up the trail which had been

pointed out to him as the one the survey party had taken a few days previously, and his now trained eye could easily detect where halts had been made and bench marks established for the mapping out of the contour of the country. At the same time he noticed that the party was pushing on rapidly, and by this he judged that the climbing of the peak was one of the objects of the expedition.

He had reached quite a sharp slope in the mountain, and was letting Duke take the trail slowly and quietly, when suddenly he heard above him a sharp blow, and then, far up the mountain-side a faint, "ting-ling-ling-ling" and a moment's pause, then louder, "crackety-crack-crack-crack" and then, with a tumult of crashes and whangs, a large tin pail went clattering down the mountain.

Roger looked up, and from the heights above him there floated down a vociferous and fluent torrent of language, which, even at that distance, sounded strange and barbarous to the boy's ears. Using his field-glasses, moreover, he could distinguish a figure leaning over a ledge some distance above, and by the long cue he could see it was a Chinaman. The sight gave him great encouragement, for he knew that the party he was following had with it a Chinese cook, named Ti Sing, well known in that region, and one of the most valued cooks in the Survey.

Realizing that he was near his goal the boy hurried on, and soon overtook the party beside a small river with a swollen stream, a recent cloudburst having filled to overflowing a creek usually fordable. The water would, of course, go down in a day or two, but the men did not want to wait. The building of a bridge seemed almost beyond feasibility, as the banks were flat and there was no way to get across with a rope even, for the first span.



Photograph by U.S.G.S.

CROSSING A SWOLLEN STREAM.

Bridge is a log hewed flat on one side, about three feet wide. Rail is flimsy and but a "bluff of confidence."

As it chanced, the head of the party, with the assistant topographer, had taken a little side trip off the trail, and the packers were annoyed by being stopped in this way.

"I reckon Saracen could find a way, all right," said one of the men, "but I shore do feel like a fool to wait for him to come up and show us old-timers what to do."

Numberless suggestions had been made, and Roger's presence as a stranger had kept him silent, but thinking perhaps that he could be of some use, he spoke in an aside to the first speaker and suggested to him a possible means, which he had heard as having been done in a similar case by Herold. He gave the packer the idea, and told him to go ahead with it as though it were a plan of his own devising.

"You see," said Roger, "it would seem like an intrusion if it came from me."

"Nothing o' the kind," said the other roughly. "I'm not going to steal another man's ideas and put them out as my own. What do you think I am? Here, boys," he continued, "this youngster has an idea that he says has been proved before."

Let's try it. Tell us about it, son."

Roger flushed hot at being brought before a group of men he had never seen till that day, but he spoke up bravely.

"It doesn't seem right, I know," he said, "for me to do any talking, but I know of a scheme that might work here, if you thought it would go. Work it just like you do a canoe in tracking. You know with a rope from bow to stern, going against the current, if you pull on the bow, it will swerve in and on the stern it will sweep out?"

"That's right!" agreed several of the men.

"Well," went on the boy, "it would be pretty easy to get a tree half-way across, wouldn't it? Drop a tree in the river, fasten the butt end to shore, and then let the top sweep out into the stream, fastening the rope when it was out at a sharp angle up stream."

"Any fool can do that," said one of the party scornfully, "but you might just as well be on this side as only half-way across."

"Dry up, Hank, and don't get grouchy," said the first speaker, "the boy isn't through."

"I thought then," continued Roger, with a grateful glance at his ally, "that another tree could be cut down, away up the river, butt end first. Two ropes on, same as the other. Then, keeping the top down stream and checking off the ropes gradually, the current would sweep the tree to the other side of the stream. Let it float until the branches of the second tree interlocked with those of the first, held tight in the middle of the stream. Then slack up the butt end of the second tree, and as it swung round it would hit the bank on the further shore, and there is your bridge made."

"That would read all right in a book," grumbled the discontented one, "but a river like that isn't any child's kite business."

"But I didn't get it out of a book," replied the boy, a little hotly. "Mr. Herold, the geographer, told me that, and said that it had been done on some of the swollen streams of the Glacier National Park in Montana, where the streams are hard to cross."

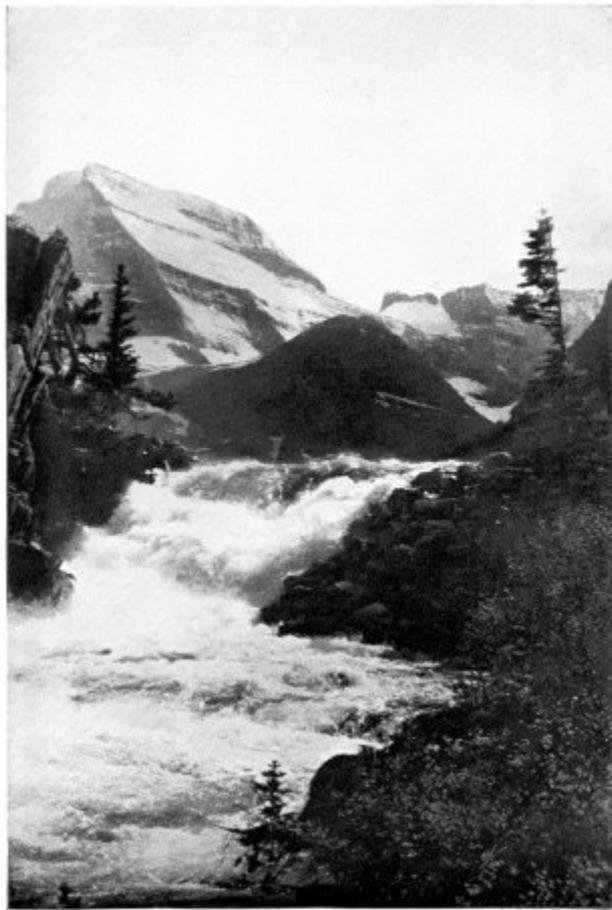
His former friend also came to the boy's support.

"There is a lot of chance work in it," he said quietly, "but the plan sounds all right to me. Of course, if the second tree behaves like you say it should it would be all right, but there isn't any guaranty that it will. But it's worth the trying, and anything's better than standing here like a lot of dummies waiting for somebody to come along and tell us what to do."

One of the members of the party having been detailed to look up two suitable trees, and another to find out the narrowest and most convenient place in the river, it was not long before the two trees were down and dragged to their respective places on the bank. Roger's friend desired him to assume direction of the work, which Roger refused to do.

"It isn't my plan, anyway," he said. "As I told you it is only something I heard, and I wouldn't dream of thinking that I know as much about the way of going at it as any of you," a modest speech which won him favor, even with the disgruntled packer.

The launching of the first tree, however, proved so easy, the current carried it to its place with so much readiness that all were encouraged. It was securedly anchored at the shore and pointed up stream, with little difficulty. But the second tree, owing to having been too short, proved a failure at the first attempt, and it was not until a tree of just the right height had been secured that success was attained. The second time, the tree drifted quietly down, entangled in the branches of the other tree, according to programme, and the butt being slackened away it landed fair and true upon the other shore. Without delay one of the most active of the men crawled out and lashed the two trees together, then crawled over the second tree and stood on the further shore triumphant.



Photograph by U.S.G.S.

BRIDGED BY "DOUBLE TREE."

Foaming mountain torrent, too powerful to cross for miles, and its source hidden in inaccessible ravines.

But it must be admitted that while the passage had been achieved, it was a perilous one at best. The current foamed over the trunks of the trees and fairly boiled through the intertwined branches. Bit by bit, all that the mules had carried in their packs was taken over, even the saddles being borne over this arboreal bridge. Great as had been the difficulty of making the bridge, scarcely less hard was it to make Ti Sing cross. He called on all his gods, in eighteen several and distinct dialects of Chinese, but the men were obdurate, and with one pulling him in front and another pushing him behind, he was at last brought over.

Then a rope was stretched from shore to shore, passing through a loose ring. This was fastened to the girth of a mule, one rope was tied to his head to keep him from drowning and another to his tail to make him keep his temper, for a mule can't get irritated with his tail tied, and thus, half-drowned and altogether weary, the mules were got across, just as the chief of the party came up. He said nothing until with his assistant he had crossed and seen the animals over safely, then turning to the packer:

"Whose idea?" he asked briefly.

The man pointed to Roger in reply, and the chief walked over to where he stood, watching the men chaff Ti Sing about the missing tin pail.

"That's an old trick of Herold's," he said, "but I never heard of any one else using it. Where did you get hold of the idea, boy?"

"From Mr. Herold, sir," answered Roger. "He told me about it before I started into the field."

"Oh, you're on the Survey, then. What party?"

"Mr. Masseth's."

"Then what in thunder are you doing up here?"

So Roger recounted to him his story, showing that he had to return to the Canyon in a few weeks, but that he couldn't see any fun in lying around waiting for the time to pass. He pointed out that he was especially anxious to fit himself for work in Alaska, and quoted Rivers' dictum as to the experience he would need.

"Well," replied Saracen, "I guess that's right enough. You've just come to see the Sierra country. We're not going to stay long on this side, and after I get through with this little bit of peak--which was the reason of the crossing that stream--we shall go to the other side of the mountain, where I can put you on the main trail. By that means you will have a couple of weeks up here, and still be able to get back to the Canyon to finish that bit of work you are pledged to do there."

Roger thanked him heartily, and began his ten days of mountain climbing, an experience utterly new, for even the scrambling up and down the terraced cliffs of the Colorado was a different matter from the scaling of apparently inaccessible crags, where the climber faced no little peril in making the ascent. Further, in order to do the drawing after he got up, he would have to be tied on and have the plane table tied, while working on a knife-blade ledge all day.

Some few days after his arrival, Roger had the unexpected opportunity of seeing a mule train possessed by fear, and watching a mule buck. Mules rarely buck, so the lad was conscious of the value of the experience. It happened on a fairly wide trail, but which sloped considerably to the side of the mountain, and Roger was riding beside the chief of the party. Suddenly a loud commotion was heard in the rear of the pack train, and Saracen and Roger reined up. Duke, always restive and nervous, began to prance about, showing evidence of real fear, and while Roger was a good horseman and kept his seat easily, he could not keep the beast on the trail, and the bay danced off to the side, where on the turf, three or four yards from the beaten track, he brought him, snorting and trembling, to a standstill.

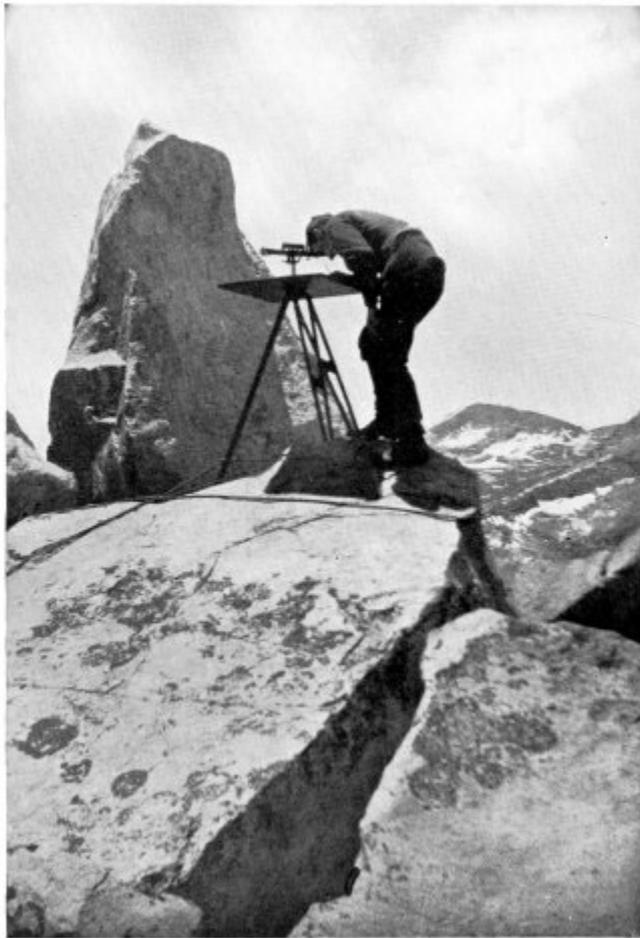
Then he had time to look about him. On the trail immediately above him, the lead mule, bestridden by Saracen, was performing evolutions that would not have disgraced a trick circus beast, cavorting and pirouetting and bucking, evidently longing to bolt, but held down by the iron hand of his rider. Just as the beast was a little quieted and Roger thought of resuming the trail, there came a clattering of hoofs, and whish! a runaway mule flashed by, arousing Duke and the lead mule to a new exhibition of bucking. Roger soon had his mount pacified, but Saracen was getting angry, and was applying whip and spurs without stint, to no purpose, for a couple of minutes later another of the pack train's mules came down tearing up the dust, then two together in a panic of stampede.

All the while the lead mule, held to one place by a grip that never relaxed for an instant, plunged and reared and strained every nerve to unseat his rider. Next came a salvo of shouts and objurgations, and two of the packers hurtled along the trail, sawing at the mouths of their animals, but utterly unable to hold them in, and indeed, narrowly escaping being ridden over by the rest of the pack mules following. Saracen always declared that his mule counted each animal as it went by, but certain it is that no sooner had the last of the pack train vanished in the distance than the lead mule steadied down. No damage had been done save that the rider's hat, though strongly fastened on, had been bucked off. A few minutes later, back came the other men, who curiously enough were in similar case. The three hats were found close together on the trail.

When an investigation was made, no known cause could be found to account for the sudden bolt, except that a white mule, one of the last in the train, had become suddenly frightened, possibly because there was a bear in the neighborhood, and had started to run, bunting into the mule next in the lead, and thus communicating the fright all the way along the line. Fortunately no mishaps had occurred, and though some of the packs had shaken loose, none had been thrown and nothing was lost.

The very next day after this, the mule in question, which, by the way, was the only white mule in the party, quietly slipped off the side of a cliff with a drop of one hundred and forty feet, landed upside down on the pack-saddle, bounced twenty feet farther, and then quietly got up, shook himself, and began to graze. Being white, the mule was easily visible, and as it was seen that he was not hurt and in the pack were certain things almost indispensable, it was decided to go down and recover him.

When this was pointed out, Roger, thinking that it might take some time to recover the mule, felt that he would be wiser to start on his journey for the Canyon, and finding out the nearest trail from the chief of the party, he started back to fulfil his "engagement with the sun." Having plenty of time, he took the trip quietly, reaching Lone Pine a few days later, and making his way south to the railroad at Mohave.



Photograph by U.S.G.S.

IF HE SHOULD SLIP!

The Chief Geographer making a plane-table station, 10,996 feet above sea level. Note how table is tied on.

There he encountered a young fellow on his way to Washington with some special news of the discovery of important fossils by one of the branches of the Geological Survey, and Roger, to his surprise, found another avenue of science covered by that department of the government to which he had become so proud of belonging. This young fellow had been working in the bone-bearing strata for several months, and some extremely valuable finds had been made which were to be placed in the Smithsonian Museum.

With this comrade to while away the journey it seemed but little time to Roger until they reached Needles, where the lad took to the saddle again. It was all familiar ground to him now and no trouble was sustained in reaching the little camp on the north side of the Canyon where he had been bidden signal. He arrived three days before the appointed time, desiring rather to be sure than to run the risk of some accident delaying him. He found the provisions cached safely and knew where to go for water. After making sure that the little instrument and the glass had not been touched, the boy having carried the key about his neck the entire two months, he settled down for his three days' wait.

The night before the date appointed, having a vague fear lest he might oversleep himself, though it was a thing he had not done in all the time he had been on the Survey, the boy lay down in front of the little glass, wedging himself in so that he could not move, and having the glass pointed so that the rays of the rising sun would be directed immediately into his eyes. It was not a comfortable night's rest, but the plan operated like a charm, for the sun's rim had hardly more than appeared above the horizon when the reflected rays shone directly into his face and wakened him instantly.

He got up without delay, and though considerable time was to elapse, prepared all before his breakfast. That meal done, he sat beside his heliograph to await the time. There was a variation of a minute and a half between the two watches, and Roger thought it better to take the later time, for, he reasoned, if Masseth was there he would be sure to wait, while if he flashed too early, his chief might not be ready.

Promptly at the hour, therefore, the light shining equally about the edges of the quarter-inch hole, he raised the cloth

shutter that had been in front of the aperture and three times let the strong light shine through. He almost fancied that he could see the reflection on the distant peak.

Five minutes elapsed, then he repeated the signal, three flashes of ten seconds' duration, as had been agreed upon. Then, suddenly and unexpectedly, he saw on the distant peak to which he was signaling, an answering triple flash. He waited the required time, five minutes, then gave the old signal, but followed it by three quick flashes of a second apiece. This was answered in the same manner, telling the boy that not only had his signal been seen, but also that his answer to the response had been observed and that everything was right.

Thus, across seven miles of the roughest country in the world, did Roger receive his official release and message of farewell from the Grand Canyon party he had served so faithfully.



CHAPTER X AMERICANS THAT ARE FORGOTTEN

The elation that Roger felt over the successful issue of the heliograph message with which he had been intrusted soon dwindled away under the realization that he did not know what was coming next. The only instructions he had received were that he was to take Duke to Prescott, Ariz., there to leave him with certain friends of Masseth's who would take care of him. Masseth had also told him to call for his mail, and of course the presumption was that he would there receive notice as to the next step in his Survey work. But for the moment he was masterless, and the boy felt a little lost.

So when Roger had packed the little heliograph instrument in as small compass as possible, in order that it might not be ungainly in the saddle, and gone to the edge of the Canyon to look over, the scene struck him with loneliness. In precisely the same place, two months before, he had stood and made up his mind to risk the peril of that single-handed journey, and his courage began to revive as he remembered how well it had resulted. Down below him he could see Bright Angel Creek, and far away, the peak to which he had signaled, all redolent of the interest of the summer now fast waning. Even the trail upon which he set out to return was full of the memories of his frontiersman friend, who had lightened the way with anecdote and information on his first journey there.

But while Roger was inly conscious of a feeling of isolation in being thus cut off from all the Survey parties, and looked forward to his ride to Needles with little anticipation, that sense was not shared by Duke, who, having twice before with Roger traversed the high Kaibab plateau, remembered well the succulent long bunch-grass, the fragrant lupine and the toothsome wild oats. For the Kaibab plateau, lying high and therefore being moister than the surrounding territory, is a veritable garden. The gently declining ravines, instead of being filled with boulders at the bottom, are decked with flowers and their bases are avenues of smooth, rich lawn; on the banks rise spruces and pines, with the white trunks and pale foliage of the quivering aspen; and on the table-land above in wild profusion grow every sort of herb and plant and flower.

The desert lies to the north, the inaccessible Canyon to the south, an alkali waste to the westward, and the desolate cactus land to the east, but the Kaibab plateau, 8,000 feet above the sea, is a sylvan paradise. Yet there is no running water, and travel over it must be well within reach of trails. Here alone, in this vast arid tract, it rains frequently, but the rains form no streams, for the whole plateau is pitted with cups or depressions ten to twenty feet across, into which the water runs, and through which by some underground passages it disappears only to swell in some invisible manner the swollen torrent of the Colorado, 6,000 feet below.

Through this plateau Roger rode slowly, enjoying its peacefulness the while. No great hurry consumed him, his present work was done, and until he reached Prescott, he was his own master. Duke, moreover, had fared ill in the hard riding of the past few weeks, and so it was by very easy stages that the boy crossed the Kaibab, and indeed, loafed one whole week in the wonderful De La Motte Park, in the midst of the plateau, to give his horse a rest and to let him fill out his bones a little on the succulent grasses. A most beautiful country to enter--and a hard one to leave. No artificial maze is more confusing, for enticing as the ravines are, they are all exactly alike, no landmarks exist by which a direction may be followed, and the valleys themselves wind and double like a frightened hare.

Roger, however, had crossed this forest the first time with the frontiersman, who knew the trails like a book, and he had learned the general lie of the country from him. Besides, the lad had imbibed enough woodcraft since his appointment on the Survey to enable him to follow a trail, no matter how faint or tortuous, a thing which even the Mormon herders who follow the mazes of the wood with a keenness equal to that of the Indians, and with more intelligence, admit is a difficult thing to do.

But idleness was in no sense a characteristic of Roger's make-up, and he was glad when he reached Stewart's Canyon, where the main trail took a direct road northwards to round the Dragon and the Little Dragon and to skirt the Virgin Range still further to the northward. But as the trail descended into the valley and the altitude became less, it was seen that Paradise was left behind. Instead of pines and aspens, the ferocious and forbidding cactus took its place. The yuccas or Spanish bayonets, the prickly pear, the gaunt Sahaura and the spiny devil, together with other truculent barbarians of the vegetable kingdom convinced the boy that he had left behind all the attractive part of his trip.

To the west, Roger quickened his pace and passed over the Shewitz plateau, crossing stretches of lava, black and recent-looking, as though they had been erupted but a few years before. Then, coming to the famous geological break in the rocks known as the Hurricane Fault, he turned sharply to the south through the plain uninteresting territory of Eastern Nevada and California and reached the Needles again with little trouble to himself or Duke. By this time Roger felt quite at home in and about the Canyon, and he was conscious of boyish pride when the proprietor of El Garces, the big hotel at the Needles, welcomed him as an old traveler.

Changing at Prescott Junction, it was not long before Roger found himself in Prescott, a thriving and flourishing town of the Southwestern type. There Roger found a large packet of mail, letters from home, notes from former school friends to whom he had written at divers times throughout his trip, and which had been sent to Washington, his field address not being known. But the letter that was first opened bore no stamp, being franked with the seal of the United States Geological Survey.

As before, there was inclosed with the letter of instructions a personal letter from Mitchon, to the effect that favorable reports had been received and implying that his next party probably would be the last before his start on the Alaskan trip. The last few words made Roger almost leap with delight, for it was evidence to him that if he continued as well as he had begun, he would be accepted by Rivers, which throughout had been the goal of his ambition.

The letter of direction, moreover, was fairly pleasing, though couched in the usual dry official terms. It was to the effect that he should join the topographical party under the leadership of Mr. Gates, present post-office address being Aragon, County Presidio, Texas, and that the party was engaged in mapping the Shafter quadrangle. Borrowing a large atlas, the boy promptly proceeded to look up Aragon and Shafter, and found, to his delight, that it was near the boundary line of Mexico.

After scampering through the rest of his mail, Roger promptly went to the little depot and asked for a ticket to Aragon. Leisurely the agent went about filling his request, then, looking at him with half-shut eyes, said, with the easy familiarity of the West:

"Folks down there?"

"No," said Roger shortly, "going down on government business."

The agent's eyes opened slightly with a gleam of amusement in them.

"Ain't you pretty young for the Pecos country, son?" he said.

"Why?" asked the boy, quickly.

"Wa'al, it's pretty wild down there yet. It's nothing like what it used to be in the days when the Apaches used it as a sort o' Tom Tiddler's ground for picking up scalps, but I wouldn't go so fur as to call it an abode of peace, right now."

"But the Indians are all in reservations now!" said Roger, surprised at the suggestion of danger.

"That's right, son, so they are. But the Greasers ain't all dead yet, more's the pity."

"What's a Greaser?"

"Guess you don't know much about that saloobrious portion of the world if you ain't had the pleasure of a Greaser's company. Why, son, he's a varmint that's about one-fourth Mexican, one-fourth Spaniard, one-fourth Indian, and the other quarter just plain meanness. He's as venomous as a rattler, as sneaking as a coyote, as bad-tempered as a bobcat, and just about as pretty to look at as a Gila monster."

Roger laughed.

"You don't seem to love them much," he said, "but I guess that description's coming it a little strong."

"Not a blamed bit!" answered the agent, handing the boy his ticket, "an' you'll find out that the rest of the people down there are just about as fond of 'em as me. I lived down in Tombstone for some years, and I wouldn't take the whole county of Cochise for a gift unless I could teetotally banish all those cusses. Prescott ain't any lily-fingered Eastern town, by a long shot, but it's a Sunday school compared to the Pecos country, you can bet on that!"

"Well," replied the boy, nodding, "I'll try to come out of there alive, just the same."

"Hope you do, son," was the reply, "an' I'll give you jest one piece of advice which may help that hope along a lot. It's this--don't let any Greaser who has a grudge agin you get within' knifin' distance, or your camp mates will be picking out a nice chaste headstone and sending your last lovin' messages to your friends."

"All right," replied the boy cheerfully, "I'll keep it in mind."

The day following, Roger, having regretfully bidden good-by to Duke, boarded the train for the Pecos country, but the trip was so replete with wonder that there was no time for lamenting even the absence of a favorite horse. Passing through Phoenix, which a few years ago was nothing but the desolate haunt of the dying consumptive, and which, through irrigation, has become one of the garden spots of the Southwest, they came to Casa Grande. Roger had never even heard of the place, but in the observation car an elderly man, who was traveling with his son, began speaking of

the wonderful ruins that lay north of the road, and casually showed that he was going to stop off and visit them. After a moment's hesitation, Roger, who had been sitting close by, turned to him.

"I beg your pardon, sir," he said, "but I felt sure you would not mind my hearing what you said about the Casa Grande ruins."

"Not at all, my boy," was the ready reply, "I am only glad if I was able to interest you."

"Immensely," said Roger. He paused diffidently, then went on, "I am on the Geological Survey, sir," he said, "and on my way to join a new party, but have a day or two to spare, as the Director has been so kind as to give me opportunities to visit different fields of work to gain experience for a trip to Alaska next year. You said you were going to visit Casa Grande, and--I hope you won't mind my saying this--I should like to go with you if I might, and learn something about a place of which I know so little."

The elder man held out his hand.

"Glad to have you," he said, heartily, shaking hands. Then, turning, he introduced him to his son, Phil, a young fellow about Roger's age, and but very few minutes elapsed before the train stopped.

"Of course you know," said Roger's new friend, when they were in the stage and bowling through the plain, "that this part of the country is just full of evidences of a civilization far earlier than the Indians and earlier even than the Aztecs or Toltecs."

"But, father," said Phil, "I supposed the Aztecs were the first people in the country!"

"So do many people, Phil," was the reply, "but they were not. They were a wandering tribe, as Indians might be, who conquered a people older than themselves called the Nahoas, about whom we know very little. But the Aztecs achieved a good deal of skill in working in stone, and the fact that their monuments are not perishable, makes their civilization enduring in fame."

"Then the Nahoas were the first?" queried Roger.

But his informant shook his head, smiling slightly.

"They may have been," he answered, "but it seems very doubtful. I think we have to go back a great deal further when we start to look for early Americans."

"Why?"

"Because of the evident age of the remains. For example," he continued, "I don't suppose either of you has been noticing this road?"

"I've been wondering at it this last half hour," said Roger. "It isn't like any canyon that I ever saw, and by the way it cuts through different levels of strata it can't have been made by water. And if it's made by hand, why should they cut a road, when it could have been made on the level above with half the trouble?"

"You are observant, my boy, and your eye has been well trained," was the approving reply. "But you don't seem to realize that this may be artificial and yet not have been intended for a road, although it is so used now."

"Oh, I know," broke in Phil, "it must be a canal."

"Hardly big enough for a canal," said his father, "though you are on the right track. This was an irrigating ditch, and if you will notice, at almost regular intervals, smaller dry ditches fork from it. This desert through here is just honeycombed with works of irrigation, great aqueducts, canals and lateral ditches, which at one time must have made this barren waste a field of blossoms."

"It seems a shame, somehow," said Roger, "to think of all that work being abandoned."

"Abandoned indeed! This place once possibly was the New York or London of its time, but ruins represent all that is left of the cities, and a thousand different kinds of cactus have taken the place of the cornfield and the vineyard. And," he added, pointing ahead, "of all the palaces of those unknown emperors, ruins like these are all that remain."

The boys thought it rather a strain on the imagination to picture palaces in the dry square adobe walls, but as they walked up close to them, some lurking hint of former greatness became felt. The Casa Grande must have stood some four or five stories in height and the rooms were rarely less than twenty feet square, so that the idea was given not only of size but also of extreme age, this being due in part, of course, to the softness of the material of which they were built.

Only a hint of greatness, but when, standing beside the ruins, the boys looked over the country below them, the real magnitude of the work became apparent. Following the pointing forefinger of the elder man, Roger could see what ninety-nine out of every hundred would have overlooked, the regular relations of green defiles, which, though veiled by the hand of time, were evidently artificial work. One great canal could be traced tapping the Salt River on the south side, near the mouth of the Verde; this, for three miles and a half, formerly flowed through a bed cut by hand out of the naked rock in the Superstition Mountains to a depth of a hundred feet. This canal alone, with its four branches and the distributing ditches, irrigated 1,600 square miles of country, and the engineering would be no disgrace to modern times.

"And how long ago were these canals dug?" asked Roger.

"No one knows," was the truthful and unhesitating reply. "It is a puzzle that so far archaeologists have tried in vain to solve. They must be older than the Aztlan civilizations----"

"What are those?" asked Phil.

"Aztecs, Toltecs, and that bunch, aren't they?" queried Roger, wanting to show his knowledge.

"Mayas, too," said the other, smiling assent, "and they must be older than the Nahoia empire, of which little is left except in the south of Peru. Just how old is impossible to say, and the only clew we have is that these canals and ditches are in part filled up with volcanic lava and debris from the Bradshaw mountains, and geologists are able to show that these eruptions cannot have taken place less than two thousand years ago."

"That's as old as Rome!" said Roger in surprise.

"That means that the end of it, at latest guess, was older than the beginning of Rome, practically. And, though this volcanic action has been later than these immense works of early man in America, there is left neither a tradition of the millions of people who lived then, nor even of the forces which led to the decay of the empire and the overwhelming volcanic disaster in which it may have closed."

On their way back to the train, the old traveler gave Roger a long account of the early settlement of that part of the country by the Spaniards, and pointed out, as they passed through Tucson a few hours later, the quaint mediaeval architecture of a town which claims its beginning as far back as 1560, and in which many houses three centuries old are still standing; the oldest town in the Southwest, with the exception of Santa Fe.

A mirage, or rather a succession of them, formed the basis for some thrilling African desert tales, with which Phil's father was well-primed, and when, passing round the mile-long horseshoe curve, the train pulled into El Paso, Roger was extremely sorry to leave the friends who had made his trip such a pleasant one.

A few hours sufficed for the boy to purchase some trifles needed to make up his equipment, and bright and early the following morning he started for Aragon, where he would find out the location of the party he was to join. It was quite dull after the jollity and interest of the trip to El Paso, and Roger began to wish that he had arrived, and was pining to get into action again. But the incident for which he was anxious did not fail him. As the train pulled up at Chispa, a station about fifty miles west of Aragon, it was seen that almost the whole population of the village was at the depot, a crowd numbering perhaps twenty people, and foremost among them a man carrying a little girl, about eight years old, in his arms.

In answer to questions put to him in Spanish, for he could speak no English, the father explained his trouble by pointing to six little marks on the girl's leg, three groups of two, all near each other. No sooner was it seen what the trouble was than a big six-footer shouldered his way through the car.

"When?" he asked.

In a torrent of Spanish and gesticulation, the man explained that the child had been struck by a rattlesnake three times, fortunately, a small one, just half an hour before the train came in, and that he was going to take her to the nearest doctor, who was in Marfa, a town some few stations down the line.

"Well," said the big man, "I can fix her, I guess. That is, I've got the regular serum here, but I haven't a syringe. Any gentleman got a hypodermic needle?"

But none of the passengers would confess to the use of a needle, because of its implication that its owner would be a "dope fiend," and the querist shrugged his shoulders.

"Are you a doctor?" asked one of the men in the car.

"I'm not a little girl doctor, I'm a cattle doctor," answered the big man with a laugh, "or at least I'm a government

inspector, and I haven't anything smaller than this!" He pulled out of his case a hypodermic syringe used for injecting fluid into cattle.

But the father sent up a cry of protest at the sight of the instrument, and would not allow it to be used. The matter was explained to him in Spanish, in English, and in half a dozen different dialects of each, but he only shook his head.

"Has anybody got a sharp knife? I mean really sharp," next asked the inspector, who had assumed control of the situation and was in no wise disconcerted by the opposition of the girl's father. There was a moment's pause and then Roger stepped forward.

"I was taught on the Survey," he emphasized the words to give them weight with the government official, "to keep a blade sharp, and I guess this is about as good steel as you can get."

The inspector took it, opened it, and ran his thumb along the blade.

"It's a good knife, son," he said, "but it's no surgical instrument. Some one lend me a razor, I use a safety myself."

Of the stock of razors that were handed to him, the big man took one, sterilized it in some boiling water from the dining car, and prepared to make an incision in the girl's leg just above the fang marks.

But no sooner had the blade touched the skin and drawn a little blood, than with a yell the father leaped straight at the inspector, flashing a knife as he did so. Not expecting an attack, the government man would have been taken unawares, but that is a land of quick action, and before the Mexican could bring his arm down, he found his wrist seized, and a revolver barrel an inch from his nose stopped his onward rush.

"That's a Greaser's gratitood, every time," said the holder of the gun. "Go ahead with your job, pard, and if this ornery cayuse so much as squirms, I'll give you an elegant opportoony to perform a little operation for bullet extraction."

The inspector, who, seeing that the danger was averted, had gone back to his task, merely nodded. He made several wide and deep incisions, thinking that scars were better than death, and then, despite the crying of the girl and the fluent curses of the father, rubbed soda in the wounds with a vigorous hand.

"There!" he said, as he completed the task. "I think she'll do all right now!"

"But is that a sure preventive?" asked the boy.

"No, son," was the reply. "To be honest with you, nothing's sure against a rattler, because, you see, some folks' constitutions are worked on more easily than others, but in a certain number of cases the soda fixes it. That is, if you're not afraid to cut deep enough."

"Then," Roger said, "it just means that you've probably saved the girl's life?"

"Well," replied the other, "that's putting it a little strongly. And, anyhow, if you're on the Survey, you know mighty well that when government men do that sort of thing they don't talk about it."



CHAPTER XI WHERE PRIMITIVE JUSTICE REIGNS

Roger had thought he had seen a few varieties of cacti in the Amargosa Desert, but as he stepped off the train at Aragon, he realized that all his previous ideas had fallen far short. To the eye unfamiliar with cacti, their cumbrous ungainliness looked unnatural and forced, and standing by the little shanty which was dignified with the name of station, the boy looked over a dusty plain wherein fantastic and thorny shapes ran riot. If the Grand Canyon was a bizarre dream of rocks, then the cacti of the Arizona plains looked to Roger the nightmare of the vegetable world.

But the boy, arrived at the point where he must strike off for the party, realized that the time for delay was over, and turning to the station agent, who had been eyeing him curiously, he asked for information about the government surveyors. There was no difficulty in finding out roughly the direction in which the party had traveled, but the description of the route over the apparently interminable cactus plains somewhat perturbed Roger, accustomed though he now felt himself to be to find his way over the faintest trails. But he was a boy, just the same, and the cacti looked forbidding and menacing, and the lad wished profoundly that the old frontiersman, who had been his companion on the first ride to Death Valley, were with him now. But there was no help for it, he had to join his party no matter what the trail was like or whither it led.

His next question, implying the desire to buy a good mule and the ability to pay for it, aroused considerably more interest, and the station agent so bestirred himself in the matter that Roger felt sure he had a commission in view. It was but a short time before three mules were brought for his inspection, all sound beasts so far as the boy could judge, and he counted himself fortunate to strike an agreement with the owner of the mule, whereby, for a little extra payment, one of the herders should accompany him on the trail to the Survey camp.

The ride was long and dry, and the boy was amazed to learn from his companion that a few years before these arid plains had been a grazing country.

"Where has all the grass gone?" he queried.

"Senor," replied the Mexican, "it was thisa way. Alla the grass has been eaten. There wasa too moocha the cattle on the land, they eata the grass moocha too short, and the grass cannot maka the seed."

"But," objected Roger, "aren't the roots still there?"

The herder shook his head.

"No, Senor," he answered, with a sweeping gesture; "if the grass get moocha short, the rain not soaka in but runa right away, the ground all same as dust, and wind blowa the earth away from the roots and alla dry up."

"I see," said Roger thoughtfully. "Then putting too much cattle on land is like cutting the forests on the mountains too heavily. Deforest the mountains and the water floods the streams and is wasted, crop the plains and they become a desert. I see."

The distance to the Survey camp was not great, being but little over twenty miles, but the country was not conducive to rapid traveling, and as the boy allowed his companion to set the pace it was almost evening when they arrived. The party had just come in from the day's work, and Roger immediately presented his letter to Mr. Barrs, by whom he was warmly welcomed.

Roger's new chief was a quiet man, as indeed most of his leaders had been, but Mr. Barrs bubbled over continually with a certain sedate humor. He promptly put the lad through a catechism with reference to his work and experience since he joined the Survey, and little by little, drew out from Roger almost the entire story of his adventures up to and including the incident of the rattlesnake-bitten girl on the train the previous day.

"That, my son," said Barrs, "is a fitting prelude to your stay here. This is the first and only original headquarters of the snake, spider, and insect tribe, and anything with the usual number of legs is out of place."

"And are they all poisonous, Mr. Barrs?" asked the boy.

"Not especially," was the cheerful reply. "At least I've managed to keep alive a whole lot. No, half these stories you hear about venomous reptiles are imaginary and superstitious."

"But if you geta the trantler bite," put in the Mexican herder, who had been listening, "you willa the dance until you drop down dead."

"Nonsense, Jose," answered the chief of the party, "that's just an old story. The tarantula's bite may be bad, as far as that goes, but I've never heard of any one having been bitten. Have you?"

"No, Senor, not myself have I seen it. But I have hearda of moocha the plenty, and they all die in the dance. There was Juarez Alvinero on the festa Sant' Antonio two years ago, Senor; he dance and dance in the Plaza until he droppa down dead, and when they runa to picka him up, a trantler let go his hand and run away, and there was two moocha large bites. Si, Senor."

"Probably frightened himself to death. Lots of these low vitality races do that."

"Yet you have seen plenty of tarantulas, Mr. Barrs?" queried Roger, "although you know of no one suffering from their bites."

"Yes, lots of them. Why, the boys often use them for entertainment, sort of a prize-fight business. It is a good betting proposition, for they are inveterate fighters."

"You mean, fight each other?"

"Yes, of course. If you get hold of two tarantulas and put them down on a large sheet of paper, they will try to run away until they catch sight of each other, and then you couldn't make them run. Neither will attempt to escape, but they will crawl close till just about six inches from each other, and will then circle slowly, looking for an opening."

"Sort of sparring for wind," commented the boy.

"That's it. Then, suddenly, one or the other will spring, and either will sink his mandibles in the body of the other, or will meet with a like fate himself. Whichever gets the hold, it is fatal, but I couldn't tell you whether it is due to poison, or just to the strength of the bite."

"It's just like a regular duel," exclaimed Roger in surprise. "I never heard of anything like that."

"And what's more," continued the chief, "I have heard of a man who had a pet tarantula, with which he used to visit places and organize fights, just as people do at a cocking main, but I can't say that I ever saw it done. It may be true, just as the dancing story may be true, but if it were I should have heard of some cases of it."

"But how did the creatures get the reputation?" asked Roger. "Surely there must have been some cause for it."

"There is, I believe," answered the chief. "So far as I can learn a convulsive twitching follows a tarantula bite, and as the best thing to do in all poison cases is to walk the sufferer up and down until he is ready to drop, the twitching at such a time might resemble St. Vitus's dance. This was exaggerated, as most travelers' tales were in the early days, but I don't think at worst, that it is much more dangerous than the sting of a black hornet."

"Then you have scorpions down here too, haven't you? Are they as bad as they are supposed to be?"

"The main trouble with a scorpion is his vicious make-up," was the reply. "He's about the wickedest-looking proposition that ever came down the pike, but his bite is not fatal. One of the fellows with me one year had a little experience with a scorpion that made me think they are not as bad as they look."

"You know the way they love to creep into the folds of cloth? Well, my assistant had just taken up his flannel shirt from the ground where he had been drying it in the sun, and after shaking it well and examining it thoroughly to see that nothing had crept into it, he laid it on the table a minute before putting it on. Then he slipped it over his shoulders and suddenly gave a yell, ripping the shirt off as he did so, and there across his chest ran a full-grown scorpion, which, as it passed above the region of the heart brought his devilish sting over his head and struck three times."

"Of course, I felt sure that the poor fellow was gone, because I knew nothing of scorpions then, except by reputation, and the place of the stings was so near the heart that I didn't care to try to cut them out or cauterize or anything of that sort. Well, the three places puffed up the size of pigeon eggs, and for a few hours the pain was very considerable, but they went down by night, and there were no after-effects."

"Why, Mr. Barrs," said Roger, "you are making out all these dangerous and venomous creatures to be comparatively harmless. I thought you said there were such a lot of them down here."

"Well," replied the older man, "there are enough. Leaving the snakes out of the question, there are several varieties of ants that it is wise to give a wide berth, and the centipede is a creature to leave strictly alone."

"Is their bite fatal?" asked the boy.

"They don't bite."

"Their sting, then."

"They haven't any sting," responded Barrs, smiling at the boy's bewilderment.

"Then what have they got?"

"They've got feet!"

"I know that," said the boy, a little scornfully. "That's what the name centipede means, isn't it, a hundred feet?"

"Yes, and some of them can beat out their name."

"But they can't sting with their feet."

"They do, just the same," replied the older man. "You see the feet of a centipede are like the paws of a cat, all furnished with claws, which are drawn in while the creature is walking about, but which can be extended and fixed firmly if disturbed. For example, if a centipede is walking over your hand and you go to brush him off, no matter how fast you strike, the moment your other hand has touched the little hairs all over his body that very instant all those little claws in each of his hundred feet sink deep into your skin, and Mr. Centipede can't be pried off with anything short of a crowbar.

"As a matter of fact, if you try to tear him off, the chances are that you will pull until you break the claws off, leaving them in the skin--for he will never let go--and then you will have an awful time. I don't know for sure if there are little poison sacs at the base of the claws or whether it is just blood poisoning that sets in, due to the fact that the centipede lives on decaying flesh, and his claws are covered with germs, but I do know that if the claws are broken in, it means trouble. If you leave the thing alone, however, and can keep from trying to annoy him, if there is no need for him to stick his claws into you, it is no worse than having a caterpillar crawl over your hand."

"But is it fatal if he gets his claws in?" asked the boy.

"I wouldn't say that it was. It often means the amputation of a limb though, and I suppose if it was on the body it might end in a case of blood poisoning that might prove fatal. But at best it makes a deep sloughing sore, which gets bigger and bigger all the time, the skin seeming to die about the edges. Of course, injury from a centipede is comparatively rare, as he is generally found about carrion, and in this kind of climate no one keeps carrion any nearer to the camp than he has to."

"Then there's the Gila monster," suggested the boy, "they were telling stories about them on the train coming down."

"He looks ugly, and I have been told some very bad things about him," said the chief gravely, "but so far as I am concerned, I have seen no warrant for them. I can hardly see how so lazy and sluggish a creature as a Gila monster can be called dangerous. I have tried to provoke them by shoving sticks down their throats in order to find out how they behaved when angry, but I have never been able to make them show fight."

"Only just the some times," put in the Mexican, who had followed the conversation with intense interest, "there is just the five, six days in each a year, the Gila is moocha bad, other times, nothing at all."

"That's possible," said Barrs, "but I guess I never struck those days. But I mustn't keep blatherskiting here all night, come along to the rest of the fellows. You want to get acquainted, I reckon, and you'll find them a mighty lively set of boys."

Most of the men had put in their time in the Southwest, and Roger heard more stories of the old days before wire fences were instituted and when the whole prairie was open to their herds than he had ever dreamed could be found out of books. It seemed good to the boy to be back in the harness again, after the lapse of a couple of months since he saw Masseth and the party ride away along the edge of the Canyon, and he was glad to find that he could take his place as a man and do a man's work, even in a new environment.

The agent's warning about the dangers of the Pecos country and the stories told in the evening of times past, however, never seemed real to Roger, any more real than the tales of history, until suddenly they were made grimly lifelike. One evening, sitting in Barrs' tent, talking with him, Roger suddenly heard a sharp report and a bullet came tearing through the cloth of the tent not eighteen inches above his head. Almost simultaneously, it seemed to the boy, Barrs had thrown down the lamp and put it out, grasped his revolver and leaped from the tent. The other man who had been sitting near by was lying prone, working his way along the ground to the other tent.

Roger had not seen him drop to cover, the whole had happened so quickly, but as soon as he realized, he lost no time in following suit. As he did so, and his ear came close to the ground, the boy could hear the sound of hoofs galloping at

topmost speed and receding into the distance. Suddenly, from far off, came the sound of voices, like to a challenge and response, and then a fusillade of shots broken by a shriek.

"Jones!" called Barrs.

The man called stepped forward promptly.

"Follow the trail in the direction that man went, and see if you can find out who fired those shots we heard. I'll overtake you in a moment. Wilkins, take Doughty with you and follow the trail to the north, to see if you can find out from any one who passed there a few minutes before. The rest can look after the camp."

Within three minutes all were scattered, and Roger found himself riding beside Wilkins with his gun ready in the event of further trouble. They had not far to ride. The very first house they came to was lighted up for a festivity, and there were sounds of merry-making within.

"Doughty," said Wilkins, "I'm going in here. You take the horses and turn them so that my beast is close to the door, with his high side handy. I may need to mount in a hurry. If I do, you wheel sharp as I touch stirrup and I'll cover the retreat."

He leaped from his horse, and seeing that his gun was handy, Wilkins gave a cheery shout and walked in. Roger waited excitedly, his heart beating like a trip-hammer. But there was no trouble, and a few moments later Wilkins came out, chatting with the host.

"It was Crooked Antonio who left here," he said to Doughty, as they cantered back on the homeward trail, "it appears he had been nearing trouble there and got a hint that his room was a whole lot more desirable than his company. We had trouble with him before. I'm sorry for Antonio, for he's gone so far now that Barrs will see he gets all that's coming to him."

Taking the road quietly, Wilkins and the boy reached camp just at the same time as Barrs and his assistant, save that the assistant was walking beside his horse, holding on the saddle a stranger who evidently had been wounded.

"They seem to think at Volaccio's that it must have been Crooked Antonio," said Wilkins as soon as he caught sight of the chief.

"Yes," answered Barrs, "that's who it was. Well, he's put this fellow into pretty bad shape, and it's lucky he didn't pot some of us."

"But what was it all about?" asked Roger of his companion.

"I don't know, son," was the ready reply. "Guess he was feeling a little good, any way, and then he thinks he has a grudge against the Survey over some cattle mix-up with a party that was here a couple of years ago."

"And what did this fellow have to do with it, Mr. Barrs," the boy continued, seeing that the chief was listening to Wilkins.

"Nothing at all, Doughty, so far as I can find out, except that he would make an awkward witness. You see, when Antonio shot at us, he probably thought that he had potted some one sure. Then, as he galloped away, this chap happened to be beside the trail and hearing the shot reined up, and seeing who was coming, said to him, 'What's up, Antonio?' Then the hunchback, seeing that he was recognized, gave his broncho a cut with the whip and fired. This fellow replied, but in the end Antonio got him in the knee, making a mighty painful wound."

"But will they catch him?"

"They will, unless he takes to the mountains and becomes outlawed. There are lots of those fellows around the border."

"But don't they get after them?"

"Not often. They don't do much, you know, and then if they get in trouble on the American side they skip across the line and *vice versa*, so that, as it would be pretty difficult to get both countries to take action at the same time, they are kept down by the simple method of shooting any of them at sight. You see, every one is known about here, and one of those chaps has no chance of getting away unobserved."

The wounded man having been sent to the nearest town, and the incident being closed, Roger settled down quietly to the routine work of the camp. He found Barrs very willing to help him, and as the country they were surveying presented no great difficulties for the rodman, the boy was not too tired to take up with interest the theoretical and

mathematical side of the work, and in a few weeks his help was a factor.

The daily round of the camp life was comparatively simple, but it made a long day. The men were called at half-past five and usually work was begun by seven o'clock. Sometimes the party took lunch along, sometimes the men returned to the camp, but little time was wasted until the evening, when a number of miles had been traversed and a host of calculations made and recorded on the plane-table by the topographer.

It was near the close of the boy's stay with the party when the camp was startled during the noon spell by a stranger, who rode in excitedly, crying:

"Is there a justice of the peace here?"

All the men looked at Barrs, who replied quietly:

"I am in charge of this government party, not a justice of the peace. What is the trouble?"

"There was a gang came down from the mountains and shot up a ranch about three miles north. But the boys fought 'em off, and though one of the ranch hands is dead and another dying, they caught one of the gang. They'll probably shoot him anyhow, but the old boss of the ranch wants it done legally. It don't matter much if you ain't a justice of the peace, it's just as good."

Barrs thought for a moment.

"You haven't any right to shoot that man without a trial," he said. "Of course if he was downed during the fight, that's all right and couldn't be helped. But now that it's all over, why you can't just go to work and shoot him. I'm no justice of the peace. You'll have to send him to El Paso, or somewhere."

"And who's goin' to tote him eighty miles to a railroad? I'd like to know. Not on your life. Either you come and give him a fair trial, or he'll take a short cut to the next world."

The chief of the party shrugged his shoulders.

"Well," he said, "if you put it that way, I suppose I'll have to go, that is, if it's to prevent murder being done."

So picking out three members of the party to accompany him, of whom Roger was one, Barrs rode over to the ranch. They found the man who had been caught tied to a fence-post in the blazing sun, while every one else was in the house. Barrs had the man brought in, and after the story had been told over three or four times, each in a different way, it was seen that a possible defense could have been put up. The man admitted that he was aware that the gang came to shoot up the ranch, but no one could swear that he had seen the captured man fire until shots had been exchanged, by which time, any gun-play could have been called in self-defense. The captive admitted, however, that he had shot the man who was fatally wounded, but denied the slaying of the rancher who lay dead.

A long and somewhat heated discussion followed, Barrs standing out against the application of lynch law, mainly because he felt as a representative of the government he could take no other attitude, but he refused positively to take up the question of moving the prisoner to the railroad or of getting entangled in the matter in any official way. The matter was debated pro and con for a long time, and then the brother of the man who had been fatally wounded, finding that it would be difficult for him to get legal vengeance, suggested that they go back to the old rule of the plainmen, and cut off the first and second fingers of each of the man's hands, so that he would not be able to handle trigger again. This, after considerable wrangling, was done, and the man, with blood dripping from both his mutilated hands, was set on a horse and started along the trail to pursue his fate, wherever that might lead him.

In the meantime, though events of that fairly rough and ready character were happening about them constantly down in that wild Pecos country, the party itself was singularly free from mishaps. Roger, however, had a narrow escape from what might have been a serious accident, the peril occurring in a very simple manner. He was galloping along at a fair speed when he saw immediately in front of him a couple of bad patches of low bisnaga cactus. The boy turned his mule sharply, when the animal put his foot in a hole and Roger went flying over his head, shooting not more than a couple of feet above those barbed spines, and striking the ground just beyond them. Barrs was seriously alarmed, and showed great relief on finding that the boy was unhurt.

"One of my men," he said, "once fell from his horse in just some such way as you did, and put out one hand--on which he chanced to have no glove--as though to save himself, and he went down with his whole weight on one hand into a bisnaga cactus. I took one hundred and thirty spines out of his hand."

"And was he permanently injured?" said Roger, realizing that he himself might have been very seriously hurt.

"Not a bit of it," was the reply. "He was back at work in about four days, and within two weeks after his hand had bothered him very little. But he certainly had scars enough afterward."

About a week after this narrow escape, Barrs told Roger that in a day or two the work on the quadrangle they were engaged on would be completed and that they would upstake two days later and strike for the next section to the westward, where the first mapping of the contour had yet to be made. Then Barrs turned to Roger.

"I don't quite know," he said, "whether that letter you brought me means that you are to stay as long as you like, or as long as I want you, or what. You have not received a recall, of course, but as for the next few weeks, we will simply be getting a general view of the country, I shall not need an extra man, and I think you ought to report in Washington. If you are really going to Alaska next year, I don't know what time they intend to start, and you ought to have a rest first. Don't think I'm driving you away, but it is better so, that is, if Rivers is really going to take you as you seem to think."

"As I hope," the boy corrected.

"Well, as you hope, then. You ought to be in pretty good trim for it, Doughty; you've had a fairly wide experience, and you don't seem to have grown thin under it. What's more, I've taught you a few of the things you will need to know in the theoretical side of the work, so that you can be some help to a topographic assistant, and Masseth has given you a start in geology. So, I think the best thing I can do is to give you a letter to Mr. Herold, and wish you good luck on your journey."

This farewell message, the boy thought, would be his last word in the Pecos country, but riding in to Marfa, the town on the railroad nearest to the point where the camp had broken up, he found great excitement. So far as he could gather, it was the winding up of a feud which had begun some two or three months before.

The prisoner, it seemed, some months ago had been shot in the knee by a man who was almost a stranger to him, and as a result of the shot had become paralyzed from the waist down. The man who had shot him had got away. Whereupon the wounded man, certain that the would-be murderer must return to his home some time, had rigged up a little tent in a cactus grove near the man's house, and although semi-paralyzed, had lain there for seven weeks, waiting for the time when his foe should pass along the trail. At last, late one evening, he heard horse's hoofs, and looking out, saw his enemy approaching. As he passed, the half-paralyzed man emptied his revolver almost at point-blank distance, and the other dropped from his horse, dead.

The story was so like scores of others that Roger had heard that he paid no special attention until the words "Crooked Antonio" struck his ears, and on inquiry, learned that this was the man who had been killed. Immediately the boy forced himself into the little adobe building, and found that the case was going hard against the prisoner because he could not give any reason why "Crooked Antonio" had become his enemy and shot at him in the first place. It made a sensation when Roger spoke from the spectators.

"Please your honor," he said, "I know something about this case," and the crowd gave way for him. Then, showing his credentials, he told the story of the manner in which Crooked Antonio had fired into the Survey tent, and later had shot at the prisoner to remove a possible witness. It was the only point needed, and as it was obvious that Crooked Antonio had been killed, the prisoner could not be acquitted. He was found guilty and fined one cent, that justice might be done, and five minutes later Roger was receiving the effusive thanks of the erstwhile prisoner.

"Well," said Roger to himself, as they parted, "helping a chap to his liberty isn't such a bad record to leave as your last act in the Pecos country."

CHAPTER XII THE ALASKAN TRIP BEGUN

It seemed to Roger that he was years older when he entered the gray portals of the Geological Survey building in Washington and walked past the big relief models on the wall, to face what he felt to be the crucial question in his career--whether his season's work in the Survey would merit his acceptance by Rivers for the Alaskan trip. He found his official superior, Mr. Herold, engaged, and so went in to thank his friend Mitchon for the interest that he had shown and the kindly letters he had written.

It seemed quite home-like to him, entering once more the offices of the Geological Survey, and he spent a pleasant half-hour chatting over his experiences, his later excitements in the Pecos country arousing special interest. He was about to go when his friend stopped him with a gesture.

"Wait till I come back," he said.

A few minutes later he returned, saying:

"The Director would like to see you for a moment." The boy looked up with surprise, and the secretary continued reassuringly, "There's nothing to be scared about, I don't think you'll consider it bad news."

Roger rose promptly and went to the Director's office, and the latter shook hands heartily and motioned him to a seat.

"I think I ought to tell you, Mr. Doughty," he said, and Roger straightened up at least one inch at the manly form of address, "that I have received some reports from Mr. Herold, relating to the various parties on which you have served, which touch on your progress in the work. You will remember, of course, your meeting with the President?"

"Yes indeed, sir," answered the boy.

"This plan to secure trained workers by picking desirable material from the colleges and schools, on which a well-known philanthropist was so keen, has aroused no little interest in the Survey. As you were the first to go out, I have been anxious to see how the scheme would develop, and I was glad, a couple of months ago, to be able to tell the President that Mr. Carneller's project was proving most successful." He paused a moment. "It is but right to you to say," he continued, "that you have fulfilled the hopes I had, and that your first year's work on the Survey is a beginning of which I think you may be proud."

Roger flushed hotly at this praise, and seeing that the Director awaited a reply, said simply:

"It is very good of you to say so, sir. I just tried to do my best."

"Of course," went on the Director, "you have a great deal to learn and are very new in the work, so I don't want you to think for a moment that you know it all--or for that matter, that you ever will. But those with whom you have been speak approvingly of your obedience to the call of duty and of your ability to continue hard work uncomplainingly. I am not sure," there was a twinkle in the speaker's eye, "that making believe to be lost when you are ensconced in the branches of a tree is particularly conducive to discipline?" He waited for a reply.

Roger looked at him, and taking courage from the lurking smile, answered:

"No, sir. But," he added, "perhaps as much so as a snipe-shoot."

"A fair answer," was the kind reply. "Well," continued the Director, a little more authoritatively, "I am not at all sure that you will achieve your desire to go to Alaska next season, though I should not wish to go so far as to decide against it. In any case, Mr. Rivers, as head of the Alaskan work, chooses his own men. It is not that I am afraid of your not doing your best," he added, seeing the look of disappointment on the boy's face, "but that I feel it might be a little too much for you. The Alaskan work is a great strain for young bones."

"Not more so, sir, than crossing the Grand Canyon, is it?" Roger felt emboldened to ask.

"Don't boast!" came the sharp rebuke, "I don't like it. But," he continued, seeing the boy wilt under the criticism, "I merely desired to see you to say that I am well pleased with your work, and that I hope the college assistants, hereafter to follow, will prove equally successful."

Roger left the office of the Director as though he were treading on air, a feeling enhanced by the cordial reception accorded him by Herold, the chief geographer. There he learned, to his intense delight, that he had been appointed by Rivers on the Alaskan party, which was to spend the entire spring and summer in a south to north reconnoissance of that great Arctic territory.

"I was afraid," Roger said to the geographer, "from what the Director said, that I would not get the appointment."

"Well," Herold replied, "Mr. Rivers seemed to feel that you were keen for it, and figured that if it were given you, you would strain every nerve to make good. But, you see, you will have to do your utmost to justify the stand that Mr. Rivers and myself have taken."

"It won't be for want of trying, Mr. Herold," answered Roger, his eyes shining.

"I am sure of that, my boy," said the older man kindly, "and that's what we are depending on. Now, let me see, this is the second of December, isn't it? Rivers sails from Seattle on February 15th, so that you had better reckon on being there about the 12th. Suppose then, you go home now for the holidays, take just a month, and report in Washington here on January 2nd, a month from to-day. Then we'll give you a few weeks' work here to learn something about headquarters, and then you can go right on to the Pacific Coast, perhaps spending a day or two at home before starting on the expedition."

Roger thanked him heartily, as much for his thoughtfulness about the vacation as for the appointment he had desired so long. Indeed his month at home, amid an air in which he was a sort of hero, passed rapidly, and as the idol of all the boys in the neighborhood, he had to spin yarns by the score, these tales being given reality by the dozens of photographs he had taken on the various parties of which he had been a member. Some of the photos were his own, but others were prints of negatives taken by the assistant topographers usually, for nearly every party in the field has some member whose skill makes him almost an official photographer. Indeed, nearly every one on the Survey is a master of photography, and few outfits do not contain at least one excellent camera.

On his return to Washington in January, however, Roger found it somewhat tedious to settle to indoor office work, but his interest grew in finding that the department had in operation scores of other lines of work that had not occurred to him. His surprise in the field at constantly encountering new avenues of work became amazement in Washington, when he first really gained an idea of the extent of the department's scope.

On the question of maps alone, he learned how important the Survey is to the country. Maps which should show a mining company in which direction ore-bearing veins should run, maps which should inform a railroad as to the comparative elevations along a proposed right of way, maps which should teach a farmer where to sink an artesian well for watering his stock, maps which form the basis of vast irrigation projects, maps which point the builder where to go to quarry stone, maps to form the basis of the special timber charts of the Forestry Service, maps dealing with coal-producing areas, and for a score of other purposes, for all these the Survey is called on.

And there, in Washington, the year through, Roger found expert and skilled men making these maps, compiling them from the sketches made in the field, correcting minor errors, comparing them with former data, and producing works of exactitude and immense value. Some idea of the exactness of the work was gained by the boy when it was pointed out to him that in the Bureau of Engraving the printing of all this exact drawing must be done in a room where the temperature and humidity are the same the year round, since paper will shrink in a dry spell and expand when moist, and the printing of such a map extending over a period of months, might thus be made fractionally incorrect.

Then it dawned upon the lad that the libraries of scientific records of which Survey workers are the authors must needs require time and labor, and the compilation of statistics needed in other parts of the government service also takes up time. So that Roger began to see that the proofreading of all geologic and topographic maps, all illustrations and all text of Survey papers have to be done and revised by competent men, in order that the scientific accuracy of these can never be impeached. He saw the scope of the annual reports, the monographs, the professional papers and the bulletins, and was not surprised to learn that these were in great demand, not only in the United States, but by foreign governments as well.

"But all this," said Roger to his friend the secretary, as they were talking together one day, "must cost the country a heap of money."

The other smiled.

"It has saved the country a great deal of money," he said. "In the first place the Survey is very economically run, and then besides, millions of dollars have been put into the hands of manufacturing interests by pointing out to them the value of by-products which formerly were wasted."

"For example, Mr. Mitchon?"

"Well, for example, the waste of the by-products of coke-ovens, such as coal-tar, ammonia, etc.," replied the secretary. "Here, come with me to the laboratories, and I'll show you."

In the large chemical and physical laboratories at Washington the boy found samples of metals and minerals of all sorts being tested and analyzed. He found that all the great works of the government are undertaken only with the advice of the Geological Survey, and he learned, moreover, that in certain branches the Chemical Laboratories stand higher than those of any government in the world.

As each day passed the lad heard of some new activity of the Survey. He learned that every ton of coal consumed and every ounce of gold mined, was duly recorded by the Survey, and to his amazement discovered that the due safeguarding of life in mines and quarries was not outside its province. The refining of oil was regarded as appertaining to minerals, and many difficulties of fuel in steam engineering the boy found to have been minimized by the Survey in the power and lighting plants of the government. And, if this were not enough, it was borne in upon him that even such structural materials as brick, terra cotta and the concrete bodies, had in some cases found their beginnings and in others their best development under a further division of the Survey.

Then, to cap all, it was shown to Roger, that this multifarious work required careful and prudent administration, supervising all the details of personnel, expense, purchase, and distribution of supplies and so forth, to say nothing of adjunct matters, like library and fossil work. Thus it was, that when the boy left Washington a month later, he had decided that an entire lifetime on the Survey would be all too little to grasp the vast and dominating usefulness that it bore to the country at large.

Thus the fated day arrived for Roger's start. He had made himself well-liked all through the building, and there were many to wish him luck on the expedition. A most hearty and cordial good-fellowship Roger found to run through all departments, and the good wishes of his superiors and companions were happy auguries for the start. The Director, too, called him into his office and gave him a most encouraging send-off, sounding no note of doubtfulness or regret, and Roger felt, as he left Washington, that no boy could ask pleasanter friends or more helpful comrades than those he had met on the Survey.

The chief geographer had accorded him an extra two days' leave in which to go home before he need start for Seattle, and Roger was full of pride, as his former schoolmates gathered around him to be able to speak loftily of traversing "territory on which no white man had ever set his foot." It was a little boastfully put, but as after events proved, it was true none the less.

The journey across the continent gave time for reflection, and now that there was no chance of drawing back, the warnings and advice that had been given to Roger rushed over him like a flood, and he had for a while a haunting fear lest anything should happen on the trail to shake the confidence his superiors had in him. But these fears vanished like a morning mist, when, arrived at Seattle, he went on board the gunboat, lying a short distance from the shore, and realized that he, Roger, had a right to board a vessel of the United States Navy.

Rivers was on deck, and he came forward promptly to meet the boy, saying, as he shook hands:

"So you made good, didn't you, eh? Well, I thought you would."

Roger laughed quietly.

"You said I had to!" he replied.

The boy's new chief gave a half-smile.

"Well," he said, "if you always do everything I say you have to do, I'll be quite satisfied. But it's not a summer picnic, by any means, and you may be sorry before you're through."

"That may be, Mr. Rivers," answered the boy cheerily, "but I'm not sorry yet. I'm mighty glad to be here."

"I've been sorry often enough that I took up field work, but----" he paused.

"But what?" asked Roger.

"But I couldn't get back to it quick enough the next year," answered the geologist.

"If the past summer is any test," went on Roger, "I guess I'll be the same way, for I never enjoyed anything so much in all my life. Why, I felt quite stifled back in Washington."

"If you've been caught with the exploring fever," rejoined the older man, "there's nothing more to be said, for that's a disease for which there is no cure, except----" He paused abruptly again.

"Yes?" queried Roger.

"Except old age, and that the explorer never reaches," was the steady reply. "And now you must meet the rest of the boys."

He turned to the topographer, who was standing near.

"Mr. Gersup," he said, "this is the boy."

"I see it's a boy," answered the other, smiling, "but I didn't know it was 'the' boy. I guess, Doughty, from the way Mr. Rivers talks, that you're only just a trifle less important in the Survey than the Director." He laughed out loud.

Roger broke in protestingly, but Rivers interrupted.

"Don't mind him, Doughty, he's always that way."

"Don't mind him either, Doughty," replied the topographer, "he's always that way." And Roger thought it promised well for the cheerfulness of the party to find the chief and the topographer on joking terms.

Later the boy found Gersup's cheerfulness and optimism to be invaluable on the trip. He had a short, thick-set, stocky frame and possessed to an extreme degree the power of seeing the best possible side of every situation. His persuasive powers were so great that, as one of the party said afterward, "he could talk a mule's heels down in the middle of a kick!" He had an unerring eye for the topography of a country, as was afterwards shown, and before they had been many days in Alaska, Roger would have unhesitatingly declared both the geologist and topographer of the party to be absolutely infallible in their own lines, though they would both promptly have disclaimed any such statement.

The assistant topographer of the party, to whom the boy was next introduced, was a great surprise. He looked like anything except what he was. Not particularly prepossessing, he had a large head, already nearly bald, he was slightly bow-legged and short and scant of speech. It was not until weeks later that the boy found out why he had been selected for the trip. His strength was herculean, and in spite of the fact that he was not slightly built he could put a mountain goat to shame at scaling an apparently inaccessible crag. As Magee, the Irishman of the party, described him, "Tie his hands behind his back, and he'll climb up the side of a house with his toenails and his eyebrows."

Of the two camp hands, one was an Indian called Harry, a fine specimen of one of the famous tribes which successfully resisted Russian rule in the early years, and who was regarded as one of the most expert canoeists who had ever been in the Survey.

The other was Magee. And Magee was sufficiently described by his full name, which was Patrick Aloysius Magee. He was a devil-may-care Irishman from Galway, who had spent fifteen years in the gold camps, and had tossed over the poker table and the faro layout the little bags of gold dust that had represented years of weary work. It was not that hope had died out in him, which made him leave prospecting and take to the Survey, but in his own way of putting it, "There were too many men of the female sex around the gold camps now." He had been a sailor for some years, too, in the old sailing-ship days, and had left the sea because of his contempt for steam.

As for the cook, his chief recommendation was that "he could cook an eight-course dinner out of a pair of old boots, and make a man believe he had had something to eat when he was still as hungry as when he sat down." Altogether, Roger thought, as the little gunboat got under way and steamed for Seldovia, near the southern bend of the Kenai peninsula, a more aggressive body of men he had never met, and he determined to hold up his end, no matter what should come.

The gunboat arrived at Seldovia on February 21st, and as the cable rattled through the hawse-hole Rivers took command of the party. His easy manner dropped like a mask, and orders sharp and incisive fell like hail. All the supplies and equipment for the first part of the journey had been sent there the summer before, and were being kept by the storekeeper. No sooner were they ashore than Roger was told off with Harry to "get the dogs," and the boy accordingly found himself before a yard where twenty-two "huskies" were "yapping" and howling to their hearts' content. Of these, six were "outside" dogs, imported from the United States, usually mongrel mastiffs, and the other sixteen "huskies" or native dogs, in this case nearly all Malamut, with a strain of Siwash. The reason for the two kinds of dogs, Harry explained to Roger in answer to a question, was that the outside dog is better as a leader, as he is more intelligent and less mutinous, but that the bulk of the work is to be done by native dogs as they require less food and care, and having a dense pelt, like the wolf, endure hardship far better, while on a rough trail they are less liable to fall lame.

The dogs being duly gathered together, the harness and sleds inspected, Roger assisted his chief in checking over the supplies and seeing that they were carried to the gunboat for transport to the other side of Cook Inlet. Everything was found intact and as had been ordered, so that little delay was sustained. The overseeing of these things, however, took the entire day, but by evening the dogs were on board and everything disposed for easy transshipment in the morning.

Bright and early the next day the gunboat got her anchor up and started across the Inlet, seeking a landing-place as high up as possible. In less than two hours from Seldovia the ice was reached, and arrangements were made for a landing on the western side of the Inlet. A small bay, which appeared on the charts as Snug Harbor, was chosen as the place for debarkation, which by noon was under way.

The landing was not easy, owing to the ice along the banks, and Roger got a foretaste of what was coming by having to jump overboard and wade through the water, breaking the ice, to carry the supplies ashore. In a short while everything was landed, to the satisfaction of Rivers, who had not hoped to be able to run as far up the Inlet. There, standing on the snow, with the dogs howling behind him, Roger stood beside the chief, unheeding that he was cased in ice above the knees, and watched the gunboat dip the Stars and Stripes once in token of farewell. The Alaskan trip was begun.



CHAPTER XIII WRESTLING WITH A MOUNTAIN GOAT

While the rest of the party was engaged in landing supplies, Rivers ordered Gersup and his assistant, Bulson, to strike inland a short way in the direction of the volcano, Redoubt Peak, distant about twenty-five miles, in the expectation of finding a trail near by. It seemed obvious that there must be a route along the coast, and that it must lie between the waterside and the foothills of the Chigmit Mountains. Less than an hour elapsed before the men returned with the news that the trail had been located, but that it was entirely snowed under. The dogs accordingly were hitched to the three sleds, one of the outside dogs leading, and the topographer going ahead on snowshoes to point out the trail.

Roger had always had the idea that "mushing" or driving a dog team, consisted of sitting in state on the sled and cracking a conspicuously long whip at the dogs, but he speedily found out his mistake. Instead of sitting on the sled he had to walk behind it, and in a great many instances to help the dogs by shoving it along. Instead of being able to take things easy and let the teams do the work, the boy learned that the "musher" had to labor far harder and more continuously than the dogs themselves.



Photograph by U.S.G.S.

A GRIM AND ICY BARRIER.

Alaskan glacier, causing an obstacle to travel, almost inaccessible, yet crossed at last.

They had not traveled far when Gersup called from in front:

"There's the trail!" and pointed ahead to the right.

Roger looked eagerly in the direction pointed out, expecting to see a fairly well-beaten road, over which the succeeding day they could travel with comfort, but look as he might he could see no signs of a trail. The chief's grunt of satisfaction, however, was evidence enough to the boy that the trail really was there, and as he did not want to expose his ignorance by asking any unnecessary question, he kept his wonderings to himself.

Having got fairly started on the trail, however, the boy found travel easier, yet he was glad when the word was given for a halt, near some heavy timber, affording the materials for a fire. The tents were quickly pitched, wood gathered for a roaring blaze, the animals fed and the sleeping bags laid out, and in a surprisingly short time the party was gathered around a savory supper prepared by the cook while the rest of the men were pitching camp.

The party carried a light-weight, sheet-iron stove, which was a great convenience inside the tent, but, of course, the food for the dogs was cooked on an outside fire. With slight occasional changes, the food given was rice with a little bacon, and usually dried salmon besides. Roger noted that they were fed but once a day, and could not help thinking how hardly used the petted dogs of civilization would consider themselves if they were to be subjected to such treatment.

Roger slept soundly, despite his new surroundings, and the night seemed all too brief for him when he was roused by the cook. Being February, the days were short, and though it was nearly seven o'clock when the camp was wakened it was almost full dark. But few minutes were allowed before George shouted, "Breakfast," and Roger fell to with the rest of the men, feeling as though he could eat the entire provision of the party at one meal. After breakfast, Rivers told the boy that he would be expected, at the breaking up of camp in the mornings, to help Harry, the Indian, in the harnessing and getting ready of the dogs, as most of the other men were more expert at loading a sled.

It sounded easy enough, but Roger soon discovered that it was far from being a snap. To harness a dog, or even a dozen, was not such a difficult matter, but to hitch them to the sled and to make them stay where they were after they were hitched, that was another question. The "huskies" seemed to take malicious joy in trying to get their harness tangled, and there was always the possibility of a scrap to be warded off. So it came about that the boy usually had his hands full in the morning, and was not sorry when the day's pulling was begun and the dogs settled down to their work.

The country over which they were traveling, moreover, was ideal for dog work. The land was flat from the waterside up to the sudden rise of the hills, which were lofty and rugged, 10,000 to 15,000 feet in height, snow-capped and glacier-bearing. Little though Roger knew as a geologist, yet he was keen enough to see that this wide channel must be the delta of a large river, and he was glad to get an affirmative response to his suggestion that in the summer time this might be a good agricultural country.

"The climate in summer here," said Gersup, whom Roger had asked the question, "is nothing short of heavenly, but you could hardly call it thickly settled as yet."

"But it will be some day? Do you suppose?"

"Most assuredly," answered the topographer. "There are thousands upon thousands of acres of land here, which would return immense crops, and all along up the river. All that is needed is a market for the produce."

"But how about moving it?" asked the boy.

"The Sushitna River is navigable for a hundred miles to steamers of light draught, and to barges. You'll see this all in farm like the Red River Valley some of these days."

The thermometer staying about ten degrees below zero made the thought of waving crops a strange one, but this very low temperature was the best of all possible advantages to the party, as it was good for dog traveling. Cold enough to keep the trails in excellent shape, it was not too cold for traveling in comfort. Two days sufficed to bring the party to the point of land jutting out in the sea that makes Cook Inlet a double bay, but at this point, which is known as North Foreland, a sudden drop in temperature, coupled with a gale of wind, delayed progress, so that in all six days had elapsed from the time of landing until they pulled into Tyonok. This is one of the oldest mainland settlements of southwestern Alaska, having been used as the mainland port of the former Russian capital, Kodiak, on Kodiak Island.



Photograph by U.S.G.S.

The most northerly harbor in Cook Inlet, usually reached by seagoing vessels. Prospectors' tents along the beach.

One day was spent at Tyonok purchasing and packing larger supplies of dog feed, of which only enough for a couple of weeks' journey had been taken from Seldovia. Dog-feed is the one article that can always be procured from the natives, but as there was no assurance that the Survey party would meet any natives up the river at that time of year, Rivers decided to complete his supply before he started. Despite the importance of Tyonok as a trading post, almost ranking as a prominent seaport, Roger found it to consist of about forty-five rude log shanties, only one, the general store, being more than one story in height. In summer, so the lad was informed, hundreds of tents are erected along the shore, but the winter population, for such an important point, is ridiculously small.

On March 1st, leaving Tyonok behind, the party proceeded along the western bank of the Sushitna River. The trail, which had been comparatively visible as far as Tyonok, now was problematic, sometimes the sleds were on it, sometimes not, but little difference could be observed. Rivers did not follow the winding of the stream, but as far as possible kept a straight course, though frequently diverted by impassable bits of brush. Over the Beluga marshes, which a month hence could not be crossed, the party skimmed readily, a firm crust having formed on the snow and the dogs being in good condition. Successive camps were made at the mouth of the Sushitna, at Alexander, and at Sushitna Station, the latter a post of the Alaskan Commercial Company for trading with the natives, and the next day at Kroto. This was the last settlement seen during the first part of the trip; and for many weeks, March 6th was the last date that Roger saw any human being except the members of his party.

Faint as the trail had been, it had been sufficient to point out to the men where conditions were favorable, or at least possible, but after leaving Kroto the signs disappeared entirely. For a couple of hundred yards, perhaps, there might be smooth going, then the party would be brought to an abrupt halt by a belt of forest, through which perhaps a way would have to be made, or around which a detour would be necessary, consuming a great deal of time.

Generally it was possible to make some distance on the river ice, though that was extremely rough and bad traveling, and days would be spent in passing from one form of progress to another, much labor being expended, but the party going forward all the time. What made it seem the harder to Roger was that it was still cold enough to require heavy clothing while going ahead on the trail, yet being so warmly clad rendered the labor at difficult places very fatiguing, and if he perspired, the cold wind afterward chilled him to the bone.

It was speedily evident that the rapid march of the first few days was no true index of the time to be consumed on the trip, for while the distance from Kroto to the mouth of the Chulitna, the great tributary of the river up which they were proceeding, was the same as from Kroto to Tyonok, it took the party exactly three times as long. It was not until March 25th that the Chulitna was crossed and the journey up the higher portion of the river begun.

But each day's travel now brought the mountains closer upon them, and the banks of the river narrowed. The flat plain of the lower valley was disappearing and the mountains sloped nearer the water's edge. On the farther shore the Talkeetna range, isolated from all other mountains, rose almost sheer from the water, while on the shore the party traveled, though beyond the Chulitna, the great Alaskan range towered up into the clouds, Mt. McKinley, the highest peak in the United States, rearing his 20,300 feet, snow-capped and glacier-bearing, statuesque above all lower eminences.

Rivers, however, silent and determined, wasted no time or energy, but pushed on relentlessly every minute of the daylight, and often in dawn and dusk, while the light was yet dim. With this persistence it was but April 10th when a halt was called at a little cabin, built at the mouth of Indian Creek, and which had been used by a former Survey party, who had ascended the Sushitna and Indian Creek in the summer by canoes. It had taken that party over three months, while Rivers had been less than half that time.



Photograph by U.S.G.S.

FAREWELL TO CIVILIZATION.

One of the dog teams leaving Kroto for the Sushitna River Trail.

From there the route taken branched off along Indian Creek, which could only be called a mode of passage by courtesy. They could not travel along the banks for timber, and rock came to the water's edge, and as the creek bed was a succession of boulders and rapids, half the time the sleds had to be lifted and practically carried over obstructions, in order that perhaps for twenty or thirty feet there might be a spot of good going. Three days it took them to cover the twelve miles, and April 13th found the party at the entrance of the Chulitna Pass, 3,000 feet above sea level.

Here, of course, it was practically blind going, but despite the hard trip the dogs were in fairly good condition and with Bulson's muscle and Harry's knowledge of the multifold peculiarities of the "husky," they managed to worry through the pass in four days, reaching the little cache and log hut at the mouth of the Jack River, which was their objective point. So far they had been able to go with dogs, and no further, whereupon the work of unpacking the sleds was begun, the two canoes duly inspected and found uninjured, the supplies redistributed, and the two Indians who had been picked up at Sushitna Station to take back the dogs, were promptly sent back upon the downward trail before the river should break up and make dog-travel impossible. Of course, as it was pointed out, rapid time could be made with an empty sled, and the drivers need rarely walk.

During all this time the whole energies of the party had been given entirely to making headway, and no time had been spent either in topographical or geological work, but the urgency had borne fruit. Rivers told Roger that he had allowed two months and a half for the journey to their present place, and they were ten days ahead of the schedule.

"And what is to be done now, Mr. Rivers?" asked the boy.

"Wait till the ice breaks, Doughty," replied the geologist, "and in the meantime some little investigation of the range may not be amiss."

The third day after they had made their semi-permanent camp Rivers took the boy with him on a geological trip back to Caribou Pass, the most practicable opening in the entire Alaskan Range. He spent some time in explaining to the boy the general configuration of the range, and taught him a good deal about the glacial conditions of the region. Happening to observe a curious immense boulder in the pass, in the form of a rock almost flat on the top, about twenty feet square and nearly as many high, it occurred to Rivers that he might discern distinct striated lines of glaciation if he could get up there on the rock to see. The boulder was somewhat difficult to climb, but by getting on Roger's shoulders, the geologist was able to reach a point where he could get a grip of the rock.

But, just as he worked himself over the edge of the boulder, what was his amazement to see a mountain goat, evidently descending from the cliff above, land with a clatter of hoofs on the rock not ten feet away from him. Rivers promptly scrambled to his feet, and the goat, apparently thinking himself cornered and facing boldly an unknown danger, rushed at him with lowered horns. A quick sideways jump was all that saved the geologist, and the goat nearly went headlong over the edge with his rush.

For a minute or two Roger was in utter ignorance of what had happened, for being immediately under the rock while the chief was standing on his shoulders, he had not seen the goat leap down to dispute the supremacy of position with the unexpected intruder. Not till he heard Rivers call to him did he know that anything was wrong.

"Doughty," he heard him say, "put a bullet in this infernal brute, will you?"

The boy ran back to get a perspective view of the top of the boulder, and by climbing up the cliff a little way saw what had developed. In the meantime the position of the geologist was precarious in the extreme. A succession of short rushes he had narrowly escaped by dodging, but he knew that in a chase of this kind, he could not but lose, and if the goat should catch him with his horns not only would the injury be serious enough in itself, but probably he would be thrown from the rock to fall a distance of twenty feet to the icy and frost-bound ground below.

Suddenly Rivers saw his opportunity, and as the goat paused to turn at the end of a futile rush, he seized his horns sideways with a firm grasp, in such wise that the creature could not get a purchase with which to butt, and determined to hang on for dear life. He purposed, if it could be managed, to drive the goat to the edge of the boulder, and then, by twisting its neck, force it over the edge. It was a doubtful chance, but the only one he could see.

In the meantime Roger was cudgeling his brain for some means of climbing the rock, but to no purpose, and he could have bitten his nails in sheer vexation of spirit at his inability to give any aid, with his friend in so great peril a few steps away.

The boy watched and waited in the chance of getting a shot at the goat, but found it difficult to find an opportunity. Once, indeed, he fired, feeling sure that he could hit the animal's flank, but he was not certain enough of his prowess with a revolver to risk a shot when he was just as likely to hit his chief as he was the goat. Once, indeed, the boy thought Rivers had his foe, for he forced him to the edge of the boulder and put all his strength into a violent wrench. But a mountain goat, though not large, is possessed of considerable strength, and in his effort to free himself almost sent Rivers over the edge.

Then suddenly an idea occurred to the boy, and watching a chance, with a gentle toss he pitched his revolver up on the rock, hoping that the chief might be able to find some way of picking it up. A wild and vigorous scrambling could be heard, and a moment later the boy saw the couple again perilously near the edge of the rock.

"Thanks for the gun," he heard Rivers sing out, "I'll get hold of it in a minute."

But evidently the chief did not dare to let go the goat's horns, lest he should be caught before he had the revolver, and two or three minutes elapsed before the welcome sound of a shot came to the boy's ears.

Then Roger, looking up, was relieved beyond measure to see Rivers appear at the edge of the boulder mopping his forehead.

"Guess I'll throw him down," he said. "Of course we can't load ourselves down with the head, but the cook may want a steak or two," and suiting the action to the word, he dragged the animal to the side and flung him over. The boy noted immediately that the bullet had entered behind the ear and under the roots of the horns, so that the combat had been settled then and there.

The goat having been disposed of, Rivers made arrangements to come down, in the same way as he had gone up, by standing on the boy's shoulders, and both were glad when the chief reached the ground.

"That was nearly as good as a bull-fight," remarked the elder man when he had descended, "and it's about all the wrestle I want. I wish it had been Bulson, though; he would have given that pesky animal all the scrapping he looked for. But that gun of yours came in very handily, Doughty. I guess we'd have been up there until night if it hadn't been for that."

"I was wondering," said the boy, "how you were going to pick it up, after I did throw it to you."

"So was I," replied the chief, "but I knew I had to risk it, so when the right time came I let go with one hand and reached for the gun with the other. That old goat was almost too quick for me, though, for he turned in my grasp and was just gathering his muscles for a butt when I let him have it right behind the ear."

"It was a nasty encounter, all right," said Roger, shaking his head, "but you're not hurt in any way, are you, Mr. Rivers?"

"Only in my feelings," was the reply.

CHAPTER XIV BREAKING THE ICE JAM

Roger speedily realized the wisdom shown by Rivers in forcing the march through the entire first part of the trip, for whereas the weather had been favorable, two days after the argument with the mountain goat, the sky, which had been dark and gray for days, suddenly seemed to drop to within a few hundred feet of the heads of the travelers, and a tinge of slaty blue came into the over-hanging masses. A hollow booming sound filled the air, and the Alaskan old-timers hastened to make everything fast, laying provision close to hand and insuring all the outfit against the coming storm.

All through the day the clouds hung so low that it seemed to Roger that he could touch them, and the stillness and silence became painful; it was so quiet that the weight grew oppressive, yet speech or sound of any kind grated on the nerves. Throughout the entire day Rivers scanned the sky closely, and the afternoon was well advanced when he called out suddenly:

"It'll be a little east of northeast!" and pointed to the direction.

Roger's gaze followed and turning, he saw a little swirl of the clouds. Then, as though some gigantic hand had suddenly unclenched and pointed an accusing finger at the little group that had defiantly dared the dangers of its domain, a spume of snow was whipped from the gray above, and with a shriek whose vindictiveness seemed almost personal the tempest struck.

"Get under, Doughty," called Rivers, who, standing in the lee of one of the small trees, was closely watching the nature of the storm, "get into the tent!"

But Roger did not want to miss the sight of his first big gale in the northern mountains, so risking a reproof for not obeying, he crawled along the ground against the wind to where Rivers stood.

"I never saw a real blizzard before," he shouted in his chief's ear, as an excuse for his presence.

The older man smiled grimly, but seeing that there was as yet no danger, permitted the boy to remain. He pointed, however, to the peak above them, which sheltered the camp from the full fury of the storm.

"How would you like to stand up there and watch it?" he shouted back.

Roger's reckless spirit prompted him to reply that he wouldn't mind, but before he could formulate the words a sudden gust tore up a large tree whose roots had been too near the edge of a precipice and sent it thundering down into the chasm below.

"I'd like to," he yelled, "but I guess I'd have to be chained down."

Then one blast, stronger than any that had come before, eddied back from the cliff and struck Roger full in the face just as he had stepped forward to reply to Rivers. Some instinct led him to throw both hands over his face, which, leaving him at the mercy of the wind, caused him to be knocked flat like a ninepin, with the same feeling as though he had been struck by a solid object. But it was the last impulse of the squall, and before Roger had arisen to his feet, the white glint at the point where the gale had been born had disappeared, the clouds fell together, and quietly and without hurry the snow began to fall.



Photograph by U.S.G.S.

WHERE AN ETERNAL GALE RAGES.

On the topmost crests of the Alaskan Mountains. Working out fine calculations in an icy storm.

"Not hurt, I suppose?" queried Rivers as Roger scrambled to his feet.

"Not a bit," said Roger breathlessly, "but it seems like a week and a half since I got my wind."

"But why did you let go?"

"I don't know, Mr. Rivers; it felt as though some one was going to hit me in the face, and I just threw up my hands to defend myself."

"A man's got to be a pretty good prize-fighter who will go in the ring with an Alaskan blizzard," said the geologist, amusedly, "and the worst of it for you is that all your wounds are in the back. I should think you would have a few bruises in the morning, for you went down like a Jack-in-the-Box goes up."

The snow was falling steadily and heavily as the two walked back to the tent, and Roger remarked:

"This will make the trails heavy going, won't it?"

"It looks to me," replied the other, "as though it would make all travel impossible. If this storm had struck a few days earlier, or had we been a few days later in getting here, the chances are that the delay would have been considerable."

"How much, do you suppose?" asked the boy.

The leader of the party shrugged his shoulders.

"If it should prove a heavy snowfall," he said, "and had it struck us on the Sushitna, it might have gone far to spoil the entire season's work. You see a snowfall of four or five inches on the level can be whipped up into drifts fifteen and twenty feet in height, not only hiding the trail, but making conditions through which the dogs cannot flounder until a crust is formed.

"Then you see, Doughty, it's getting late for a good snow-crust, and we might have had to wait down there until the break-up. Then, instead of going on down the Jack River as we shall be able to do now, we would have had to track our way up Indian Creek against all the force of the spring floods, portage across the pass with the ground in bad condition, and then find little water in the Jack River instead of reaching here comfortably by 'mushing.'"

"It's lucky then," said Roger, "that we're not later in getting here."

"It's not," objected Rivers. "It may be lucky that the storm didn't strike earlier, but it isn't luck that brought us to this place in so much shorter time than had been allotted. That wasn't luck, that was work. I've noticed, too, that luck and labor go together oftener than luck and loafing."

On reaching the tent they found everything snuggled down for winter quarters, and Roger was subjected to some mild chaffing over what Magee called his "one round bout with a gale," but the lad took it good-naturedly enough, knowing from previous experience that his turn might come. He promised himself, however, that before the trip was over he would notice some slight misadventure on the part of others which would enable him to return the compliment of banter.

But while Roger had been out when the snow started and had seen the dense clouds and felt the weight behind them, he was not prepared to see, the following morning, a sheet of snow several inches deep over the entire landscape. Other members of the party had been up during the night, but the boy had not wakened, and when, stepping outside the tent, his foot sank in soft snow halfway to his knee, his amaze was great. Twelve and a half inches of snow had fallen in the single night, and the bright May sun shining over the glittering expanse made necessary the snow glasses with which each member of the party was hastily equipped.

"I should not like to be without glasses to-day," said the boy to Gersup, as they stood by the door of the tent.

"There would be fewer skeletons on the Alaskan hillsides," replied the other, "had it not been for the madness caused by the intense pain of snow-glare on the eyes."

"Is it so acute?"

"It is torture unendurable, because any light, no matter how faint, aggravates it, and it is not possible to live without light. Don't make any mistake, snow-blindness is an awful thing."

This gave Roger pause, for he saw at once how many fatal errors he had been saved by being connected with a party wherein all the details of travel had been so carefully arranged, and all sorts of contingencies, which would have been unforeseen to him, provided against. He had been inly contemptuous of the smoked glasses, when a pair had been given him at the beginning of the trip, but now he realized their immense importance, for by this time the May sun had begun to make itself felt with intense heat and the days grew long.

It seemed as though the snowstorm had been the last effort of winter, a sample to show what it could do if necessary, a comparison against the heat of the summer days to come. The rays of the sun soon honeycombed the snow and Roger realized how rotten it had become and saw that Rivers's thankfulness that they did not have to travel over it was well founded. Keenly alive to the interests of the expedition, and not having learned the patience of later life, he chafed a good deal under the delay and was continually asking the chief when they should start.

"Doughty," said the chief to him on one of these occasions, when the boy's restlessness was intense, "you can't expend energy until you have accumulated it. Now in worrying and fretting over not being able to start you are expending energy at a time when, as far as possible, you should be gathering your strength for the time when you will need it. And, what's more, every one reckons on losing a couple of weeks during the break-up; that is a part of the consumption of time on the trip."

But the rapid advance of spring added a new source of surprise to the lad. From the stillness and silence of the days when they first made camp at the head of the pass, the air became filled with the myriad voices of life, and the primal solitude became vibrant with tiny songsters. The golden sparrow was there with his piercing plaint, made musical by distance, and the trilling warble of Townsend's foxsparrow, and the varied strain of the hermit thrush, seemed quite homelike. Before the snow was gone the rosy finch was to be seen, his quick flight giving a gay spot of color to the landscape, and that the more utilitarian side might not be omitted, the snowy ptarmigan formed a welcome addition to the larder of the camp.

Quite a torrent was beginning to flow over the ice in the Jack River, and on the morning of May 16th, when Roger had gone out with Gersup the topographer, to map out with greater detail a little piece of country which had been passed by on a previous expedition, he saw that the center of the ice in the river was bulging up like a hog-backed bridge.

"What makes it bulge that way?" asked the boy.

"You should have been able to figure that out," was the response. "When the ice thaws it increases the volume of water under the ice. The edges are frozen solid to the land, the middle is more or less elastic, and so of course the sides stay solid and the middle heaves up. In warmer climates, it is the edge that thaws out first, but up here the rivers, strictly speaking, do not thaw free, the ice is forced from them by the spring floods. It is strictly a break-up rather than a thaw, although it gets warm thereafter very rapidly."

"It certainly does," replied Roger, mopping his forehead. "It's hot enough now, and this is only the middle of May; while two weeks ago it was snowing like Billy O."

On May 18th the ice broke, moved down about a mile and jammed, and a few hours later broke again, finally clearing from the upper reaches of the Jack River on the 19th. Rivers was delighted at the opportunity to get out so soon, as he had feared it might be as late as the first week in June before he could get away.

"I think, Doughty," he said to Roger, "that we can count easily now on accomplishing what we set out to do, and probably get into the Arctic Ocean in good time for an early return."

"That is, barring accidents," put in the topographer.

"We will make up our minds not to have any," replied the chief of the party.

The following morning, therefore, the canoes being all packed, the party bade good-by to the little camp on Broad Pass, where they had spent so many quiet, uneventful days, and plunged into the grinding forced march that was to occupy every waking moment for so many months to come. The stern reality of Alaskan work became potent to Roger before they had been half an hour on the trail. The Jack River, though swollen by the spring currents, had worn an erratic bed, and was filled with bars on which the canoes stranded. Then there was nought to do but wade into the snow-fed stream, with large chunks of ice roaring down at him, and the chill of the water such as to make the boy gasp and turn everything black before his eyes, while his legs became numb and hurt cruelly. But he gritted his teeth and buckled to it, well aware that the other members of the party were watching him, awaiting a sign of weakening.

The entire morning was spent wading, helping the canoes over a series of small bars with a fairly steep gradient, but the work was slow, and Rivers seized eagerly any chance to increase the pace. Shortly after the midday halt, a reach fairly free from obstacles presented itself, and the party climbed into the boats and shot down the stream. Although Roger had not done any canoe work since he had been on the Survey, he was brought up beside a stream and had handled a paddle nearly all his life, and his delight was great when he found that he had not lost the knack. Not only was he quite at home in a few moments, but he found that his toughness and maturer strength told in every stroke. Harry, the Indian, who was in the stern, nodded approvingly, after ten minutes' work.



Photograph by U.S.G.S.

The camp on Broad Pass where the party awaited the break-up.

"Heap nice," he said, as he found how keenly the boy judged the weight of the stern paddle and followed his intentions; "light weight and good paddle, go through rapids all right, sure."

And Rivers, who had kept a close eye on the boy, gave a snort of satisfaction.

"I guess you did learn what I bade you," he said, referring to their conversation in Washington a year before; "I think I told you that you should know how to handle a canoe."

"Yes, Mr. Rivers," said Roger, smiling at the remembrance, "but you implied that the Alaskan streams were a whole lot worse than Niagara."

"You won't complain of their not being bad enough, before long," said the chief grimly, "and from the general look of the place right now, I think we are going to run into rough water."

The warning served to sharpen the boy's wits, and it was time. The river was rushing about ten miles an hour over a winding bed, where the bow could not see ahead for more than twenty or thirty yards, a space covered in a few seconds' time. Suddenly Harry gave a mighty back stroke, and Roger following suit almost instantaneously, the canoe was brought up with a jerk as though some mechanical brakes had been set. There was not much room to spare, for across the river a big tree had fallen, and behind it the ice had jammed, not enough to dam the water absolutely, but affording no possible passage for a canoe.

A landing was made, though it was extremely difficult, and the canoes portaged past the obstruction, Rivers having found that the tree had jammed on a harsh and shallow rapid, over which they could not have taken the boats. Then the chief ordered two of the men to cut through the jammed tree so as to break the dam.

"Why?" queried Roger of Bulson, as he was cutting and shaping a gigantic wooden crowbar for himself, while a couple of the other men were hacking through the tree; "why is it necessary to take all that trouble after we have got by?"

"Supposing we got some distance down the river," was the reply, "where it wasn't easy to make a landing, and this jam broke above us and came pounding down the river, where would we be?"

"But it wouldn't be going any faster than the stream, and we could keep ahead of it with paddles."

"And if you came to a portage?"

"That's true," said Roger, "I hadn't thought of that. We might get nipped between the ice behind and rocks in front."

"You see," said Bulson, as he stepped on to the jam, "it's never wise to leave dangers at your heels."

The tree having been cut through, all save a few inches, one of the choppers returned to the shore, while the other stood ready, watching Bulson. The latter, who was standing on the blocks of ice behind the tree, was studying their positions, how they were jammed, and what was the best way to free them without getting caught himself in the resultant turmoil.

Presently he seemed satisfied for, inserting his huge crowbar between two pieces of ice, he yelled:

"Cut!"

The axman brought down his blade with his full strength three times, and the fibers of the tree cracked and began to give way. Back over the slowly moving tree came Magee, leaving Bulson alone on the jam. Suddenly the tree parted with a sharp crack and as it did so there arose a grinding roar, and the blocks of ice which had been jammed behind the tree seemed to leap up and fling themselves over the rapid. It did not seem possible that any man could ride that furious clashing of the jam, but Roger noticed that Bulson, making his way to shore over the grinding ice, yet had coolness to stop and give a shove here and a heave there, unlocking the jam, as it were, until, standing on the ice nearest the shore, he gave one last mighty shove and sprang to the bank just as with a seeming disappointed roar the whole jam broke and sped down the foaming river.

"That, Mr. Rivers," said the boy, as Bulson quietly threw his impromptu crowbar into the river, "is one of the things I did not learn to do."

"Bulson's very good at that sort of thing," was the chief's quiet comment.

But the river below the jam was far less kind to the travelers than it had been above. Progress was only possible by careful paddling and short portages. Half the time was spent in the icy water and half on the frozen bank, and though the water was cold beyond belief, and hands and feet were heavy and numb, the sun burned fiercely upon head and

shoulders as though it were the height of midsummer, a condition the harder to be borne because it was so early in the season that no one was as yet acclimatized to the heat.

It was the most fatiguing day Roger had yet spent on the Survey, not even excepting the famous trip across the Grand Canyon, for in the latter the pace had been his own, while in this he had to play an equal part with exceptionally vigorous and seasoned men, coping with a mountain torrent. The dusk was falling as, once more in boats, and passing through a small gorge, the party reached the confluence of the Jack and Cantwell Rivers. Although the distance traversed had been but twenty-eight miles, and the party had been traveling with the current, so arduous and rough had been the way that eleven hours had been spent in making the journey.

After supper Rivers came to Roger and said to him, not with criticism, but in a kindly manner:

"Are you tired, Doughty?"

The boy would have longed to be able to reply "No," but he knew he could not do so with any pretense at honesty, and so he replied fairly:

"Yes, Mr. Rivers, I am a little tired, but I'll soon get toughened up."

"Well," said the chief of the party, "I just wanted to let you know that this really has been a hard day, and that no one need be ashamed of feeling tired. We are all conscious of having done a day's work. I thought perhaps you might worry a little at the thought that, if it was to be all like this, you would not be able to keep up. But it won't, and you did well."

So Roger lay down to sleep and tucked himself in his sleeping bag with absolute happiness. The next day proved to the boy how right the chief had been. For the first forty miles of its passage the boy found the Cantwell River, into which they had run, to have a fair channel and good banks; and of course, at this season of the year it was full to overflowing, so that the only difficulty of its upper reaches, shoals, was set aside by the volume of water in the stream. That day's trip was rapid and easy. Camp was made that night beside the river, just where another tributary called the Yanert joins, leaping a twenty-foot fall just before reaching the main stream.

The turbulent manner of the Yanert's union, however, was an augury of trouble. It seemed as though the larger river had been led into bad habits by the new arrival, for it became a wild scramble of water, rushing through the canyons and gorges of the Alaskan Range with terrifying speed. Two or three nasty rapids had been shot, in each of which Roger acquitted himself very creditably, but the water had grown rougher and harder to deal with at each successive step, so that when a short beach a few miles long closed in a harsh and ragged-edged canyon, Rivers called a halt and went forward to reconnoiter from the summit of the gorge whether it were safe for passage. Taking Roger and Magee with him, he followed the west bank of the river, sending Gersup, Bulson, and Harry, along the other bank to determine the possibility of the rapid below, and also to find out which was the better side for a portage, should that be deemed necessary.

To Roger's uninitiated eye, the water below seemed a seething witches' caldron of confusion, but he could see that the chief did not regard it as being impossible. Suddenly the geologist turned to him:

"Doughty," he said, "do you think you could run that rapid?"

"If you told me to," answered the boy sturdily.

"You mean that you would try to do it, whether you thought it possible or no, if I told you?"

"No," said Roger, "that would be unreasonable. What I mean is that if you told me to go it would be possible, and if it is possible I am quite ready to try it at any time."

The older man said no more, but tried to force his way along the dense growth by the gorge's edge. The underbrush was very thick, and if a portage was to be made on that side the road would have to be cut almost the entire distance. So the three turned back to the canoes and waited the return of the topographer.

"Well?" inquired the chief as the party hove in view.

"I shouldn't care to tackle it," said Gersup, "but Harry says he can take the boats through, but not loaded. They would have to go down light and the loads portaged. There is a fair carry on that side, but it's through small trees pretty close together, and the canoes would be awkward to take through. It's about a twelve-mile portage, too, as I should judge, before we can strike a place where the boats could land."

"That's just about what I expected you to say," commented the geologist. "I thought so, too, but there's a bad carry on this side. Well, I suppose Harry and Bulson had better take the boats through."

But when the canoeists were approached Bulson shook his head.

"Of course, if you say so, Mr. Rivers," he replied, "there's no more to be said, but as I understand it, the boats have got to go through light. Now I tip the scale at a trifle over two hundred and twenty pounds, and you couldn't very well call that light. Besides, if it comes to a portage, I can carry a whole lot more than any one else could do. If I might suggest--"

"Go ahead, man," said Rivers impatiently.

"Send the boy, then. He knows just as much about a canoe as I do and he's seventy-five pounds lighter. That's an awful difference in the bow of a canoe. Then, too, he isn't as hefty for the carry. I think you'd better let Harry and the boy try it."

"But it's a man's job. What do you think, Harry--because, after all, you will lead the way?"

"Bulson heap good in canoe. Boy all right. Boy light, man heavy, take boy."

"You think you can take the boat through all right?" The Indian nodded. "I'd like to go with you myself, but I'm nearly as heavy as Bulson. All right, then, let it go that way; it's only a chance, but we'd better try it with one boat, rather than spend a week or two cutting a twelve-mile road through the timber for the boats."

Orders having been given for the unpacking of the canoes, an early stop was made, and Harry went off with Bulson to con the rapid from the other bank. He did not come back till after dark, and then, simply saying to Rivers:

"Sure, can do it all right," he tumbled off to the tent and rolled up for the night.

The chief of the party then turned to Roger, and said kindly:

"I don't want you to do this, Doughty, unless you feel quite up to it, because confidence is one of the most important things needed. However, I have great faith in Harry's knowledge of rapids, and if he says they are passable I don't think there is any cause to fear. But if you are in the least afraid of it, don't hesitate to say so."



Photograph by U.S.G.S.

RESTING AFTER A LONG PULL.

A good place to stop for dinner, though hundreds of miles from any white settlement.

"I'd be afraid to tackle it alone, Mr. Rivers," the boy said truthfully, "but I feel that with Harry in the stern I could take the rapids of Niagara, and the whirlpool into the bargain."

CHAPTER XV FACING DEATH IN A CANOE

Early next morning, the first boat, having been stripped of everything movable, was made ready, and Harry got in the stern. He had taken off the more cumbersome of his clothing and had bidden Roger do the same, so they started off with only enough on for comfort, but wearing their shoes, for the return journey would have to be overland through the forest.

"This heap bad," said Harry as they started out, "but I in plenty worse. Keep eyes open much."

"Right you are, Harry," sung out Roger cheerily, and a moment later the canoe shot into the mouth of the canyon, the other members of the party watching them with some anxiety, as, aside from the question of danger, the loss of one of the boats would mean a great deal of extra work on the trip. As the canoe entered the canyon Roger could feel the whole frame of his companion quiver with the intensity of attention, and he heeded every move of the canoe so closely that he felt as though he knew before every movement of the stern paddle just in what direction it would be, and of what weight.

The boy had learned well the lesson of following orders, and his confidence in his companion was so absolute that he was untroubled in mind, which went far to make him alert and able. Suddenly, the boat gave a little jump and the current leaped to double its speed, and for two hundred feet they rushed down a smooth plane of dark water with a seethe of foam awaiting them at the bottom. Just as they reached it, Harry shouted:

"Now!" and bore outward with all his strength.

"Sure!" came Roger's ready answer, as he followed the action almost simultaneously, but his confidence received a sudden check when they plunged into blinding foam which drove across the boat so that the Indian could hardly discern the lad kneeling in the bow. Angry little cross-waves leaped at them, naked scarps of rocks thrust bared fangs at them, but threading, this way and that, a channel of almost unbelievable intricacy and appalling narrowness, the little boat went through.

At the base of the second of these, in a moment of comparatively still water, the Indian called:

"Plenty heap good paddle," he said, "but too much beefsteak. More easy stroke." He broke off suddenly, "Ah!"

The warning was needed, for the vicious spite of this rapid began at its very mouth, and once the boy heard Harry grunt as he put his whole strength into a double stroke which, Roger could have sworn, made the frame of the canoe bend and wriggle like a snake. There followed then a greater rapidity of current again, and the walls of the gorge closed in until it seemed to the boy that if they got any nearer the boat would be shooting through a tunnel, and the prospect of a subterranean tunnel was not pleasant.

Just at the narrowest part, when it was difficult sometimes to avoid the paddles striking the rock on the side, the torrent boiling through and both men backing water, the canyon took a sharp turn to the right. Harry threw her head round, but not far enough, for there, not fifteen feet away from the angle of the bend, a black rock rose sheer from the water, with a spur sticking out, exactly like the spur of a fighting cock. The boat could not clear, and though Roger got the bow by, the current crushed the side of the canoe against the rock, and with a cry the Indian leaped for the spur.

"Jump!" he yelled to Roger.

But Harry's leap from the stern of the boat, just as she crashed, threw the canoe off sufficiently to prevent its entire demolition, so, though the frail craft grazed the sharp edge of the rock with the speed of an express train, crushing in its upper part, it was still seaworthy. Roger noted that the Indian had not reached a footing on the spur, but was hanging by a hand-hold to a ledge which it would be almost impossible to climb.

The thought passed through Roger's mind that Rivers would blame himself for having let him go, in the event of anything happening, but there was little time for speculation. From the bow he could see the dangers that were before him, but not being in the stern, the canoe was hard to paddle, and almost as in a desperate nightmare, he paddled and swerved and dodged rocks that sprang at him out of the water as though they were alive. Though his heart was in his mouth, and he expected every moment to be his last, the training of the past year stood him in good stead, and his eye never wavered nor did his hand become unsteady until, five minutes later, he reached in safety the gravel flat below the last rapid.

There he held the boat to regain his breath, and found time to wonder whether Harry had managed to climb on the spur, and if he had, how the party would be able to release him. But scarcely had this question formulated itself in his mind

than, close by the canoe, two hands thrust themselves out of the water, followed by a shock of coarse black hair, and with one side of his head bleeding profusely from a scalp wound he had received on his way down the rapid, the Indian made his way to the boat. Roger helped him in over the stern and they paddled to the shore.

"Heap fine," he commented, "thought you gone sure, that time."

"You were politer than I was," replied the boy, laughing with a catch in his voice, "I was too busy even to think of you till I got down here." He went on laughing, but harshly and with a curious clang in the tones.

The Indian looked up sharply.

"Stop," he said, "you no laugh."

Roger, brought to a pause by the abrupt command, found he was choking over his laugh, and that his nerves were badly shaken. He felt a wild desire to laugh and cry alternately, but he gulped down a few times, straightened up and looked Harry squarely in the eye.

"I'm all right now," he said.

The Indian looked back over the rapid down which they had just come, and shook his head.

"Well, we got through any way," commented Roger.

"Yes," answered Harry slowly, "but we heap near not get through."

"Oh, well," replied the boy with all the recklessness of youth concerning a danger which is past and over, "a miss is as good as a mile, any way."

"So," replied the Indian, "but when it is my scalp," pointing to his head, "I like mile, every time."

This drawing attention to the cut on Harry's head, Roger looked at it, and found that although it had bled freely, it was but a superficial cut, and would afford no trouble, at least until they got back to the camp, where the chief would see that it was attended to. But they were a long way from the camp, as the two speedily found when they started on their homeward journey.

The trip down the rapids, Roger found, had taken a little less than fifty minutes, and he thought that perhaps it might take a couple of hours for them to make their way home. But even Harry underestimated the distance that they had come, and the way back, climbing over fallen trees, scrambling through thickets, stopped by underbrush, scratched by thorns, and caught in brambles, was a fearful task, and it was eleven o'clock at night before they got into camp, having taken fourteen hours to come back the twelve miles they had done in the canoe in fifty minutes.

They found the camp waiting for them, and Rivers growing very anxious at their non-return. He realized, of course, that the rapid might have proved far longer than had been expected, and that the two would have some difficulty getting back, but there was a fear of possibly worse consequences. The cut on Harry's head revealed that everything had not gone well, and the Indian, nothing loath, told in his short and jerky way the story of the perilous passage, giving the boy due credit for bringing the boat through the last few hundred yards of the rapids, and averring that he was all that could be desired as a comrade.

Roger's exhaustion from the long tramp back to camp was such that the chief of the party gave orders that he was not to be awakened early, and it was eight o'clock before the boy rolled over and sleepily opened his eyes to find the camp work well advanced and breakfast over. He jumped up hurriedly, looking for the various members of the party, but found only Harry and the cook there.

"Why, where's the crowd?" he asked.

"Waal, son," said the cook, "Mr. Rivers he reckoned that a good sleep wouldn't do any harm, seeing the job you tackled yesterday, and you won't have much to do to-day. The rest of them have started packing the grub over the carry to where you left the first boat. They're loaded down good and proper, for I don't believe one of 'em has less than eighty pounds, and Bulson's got one hundred and ten, all right."

"There's a lot of stuff here yet," commented Roger, looking around, "and that's no small walk. How many trips do you suppose it will take to get it all down there?"

"Just one trip more, to-morrow. You see on to-morrow's trip Harry and you and I will have a load, and three extra men can tote a lot."

"But why were we let out of it to-day?" queried the boy.

"We take other boat down," put in the Indian, who had been listening, "this time we do it heap easy. No get knocked on the head."

"I hope not, for your sake," said Roger, who, though no coward, had been secretly hoping that some one else would look after the other boat. "But it's quite a trick to have to tackle again."

"No," replied Harry, with a quick negative shake of the head. "Heap easy now. I draw map every rock, know when stop canoe."

"Yes," said the cook thoughtfully, "it isn't much of a job to run a rapid when you know what's ahead of you; the trouble is generally that some fool rock shows up when you least expect it."

"That's true," said the boy thoughtfully, "even the rock we nearly went to smash on,--the one you jumped, you know,--we could have dodged that if we had known that it was there and had hugged the right-hand shore."

"No strike rock this time. You no want try jump?"

"Not on your life, Harry," laughed Roger. "I'm not aching for excitement as much as that. Going through that rapid again will give me enough to think of for one day, at least."

In the meanwhile, the boat having been got ready, the two shoved out into the stream and headed for the rapid. As the other men had suggested, the passage lost some of its terrors when it was known what lay beyond, but Roger found that his companion possessed a memory for every little turn of the river which was to him incredible. He felt that he would have to go through it a dozen times before he could begin to act as a pilot through, but Harry had the whole stretch of boiling water as clearly in his mind as though an immense chart were stretched out before him.

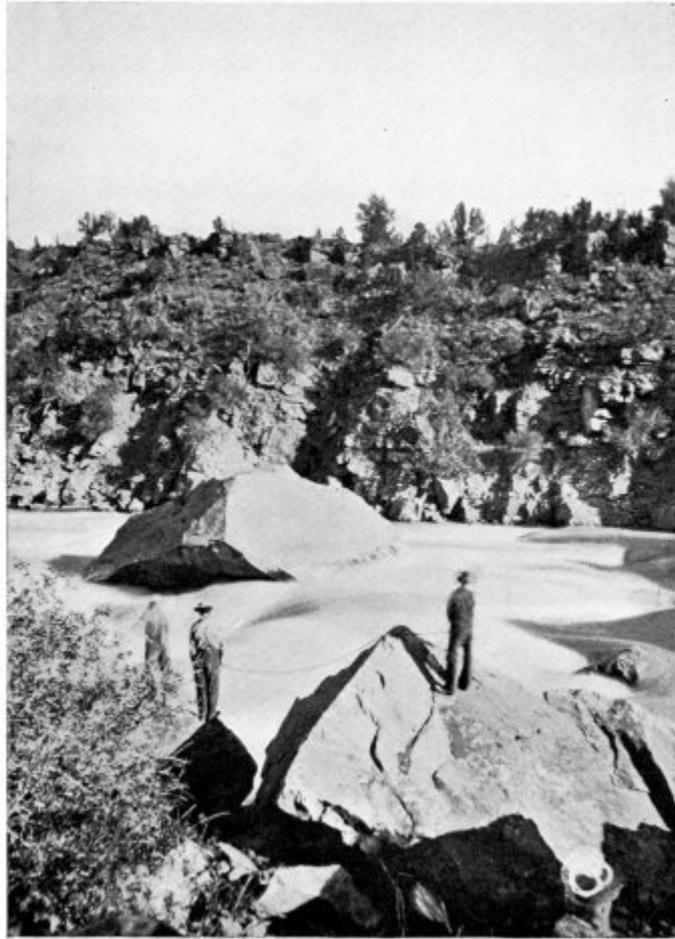
The second rapid with its smother of foam, moreover, looked almost as bad to the boy on the second trial as it had on the first, and his heart beat more rapidly as the boat shot into the narrow gorge, in the midst of which, a little lower down, the sharp and jagged spur lay awaiting the unready traveler. But the Indian was on the alert, and just at the right moment he drove the canoe over beside the bank, so close that Roger feared a slight eddy might crush in the eggshell sides of the canoe. But even with every inch gained at the turn, the old black spur suddenly appeared around the bend, grim and perilous athwart their path. Then Harry put his muscle into the paddle, Roger following suit, and they flew across the river with such speed that the current driving them on the rock had little chance to catch the boat, and they shaved the danger with about two feet to spare. The rapid beyond, which Roger had run himself, was none too easy, and as the boy noted its difficulty, he felt a thrill of pride that he had managed to take the first boat through that alone.

"Heap bad rapid," said Harry, when the second boat had been drawn up beside the first, and he had examined both the canoes carefully to see how much damage they had sustained on the trip.

"Have you ever run any that were worse than this?" queried Roger.

"No. Plenty longer, rougher, but rock in middle much bad."

Questioning his companion Roger heard many stories of difficult and dangerous canoe trips, told with the unimpassioned utterance of the Indian, and in his broken English, and he was able to see that the canyon through which they had passed was almost as bad as any of them. They did not have to wait long for the arrival of the party from the upper camp, for the latter had cut the trail the preceding day, while Harry and Roger were taking the first boat down and returning, so that when they started the next morning before breakfast, it was fairly good going. Shortly before noon, the canoeists, waiting beside the boats, heard shouts to which they responded, and a few minutes later the packing party came crashing through the trees to the riverside.



Photograph by U.S.G.S.

A SHORT BUT DANGEROUS RAPID.

In tracking canoes to save time of portage, great skill is needed in these swirling currents.

Harry, without waiting for any conversation with the other members of the party, busied himself in getting together dinner, knowing that the fellows, who had toted heavy packs over the carry, would be sufficiently hungry and tired. The meal being over, the whole party, including Harry and Roger, started back for the camp, and the boy was surprised to find how short and easy it seemed after the difficulty he had experienced the day before in forcing his way through the bush, where a trail had not been cut. They reached the camp at the upper end of the canyon, where the cook had been left, late in the afternoon and made all ready for the start the following morning.

The next day the entire remainder of the supplies and equipment of the camp were made up into packs and the party started over the portage to where the boats had been left lower down on the river. Roger, being accommodated with a pack weighing about ninety pounds, felt as though he were back in the Minnesota swamps, with the tump strap over his forehead. His familiarity with packing, and his ability to take the trip without feeling any physical inconvenience, was a source of gratification, as Roger's pride was keen not to be thought in any sense a less able member of the party than the oldest and most seasoned hand. The journey down to the lower end of the canyon did not seem so long, and, as on the previous day, the party reached the lower camp about noon. In the afternoon Gersup and Bulson, taking Roger with them, took advantage of the half day to make a survey before descending into the beaches of the lower Cantwell River.

As it was expected that the going would be easy for a while lower in the stream, Rivers readily acceded to Roger's petition that he should take his rifle along. There had been such a lot of caribou about, that the boy felt he ought at least to get one.

"We haven't space for the head as a trophy, of course, you know," he said, "and I don't approve of shooting for sport, but caribou is good eating, and it is always wise to conserve supplies."

"I've never had a chance at any big game, before, Mr. Rivers," joyfully said the boy.

"All right, then," said the chief, smiling, "I guess you won't reduce the visible supply of caribou in Alaska enough to hurt."

Immediately after dinner the three started, and Roger's luck was with him, for as they rounded the corner of a mountain slope, Gersup halted, and pointed with his finger to four specks about three miles away. Raising his field glasses, he said:

"There you are, Doughty; there are your caribou. You've worked pretty hard and ought to have some fun out of it. We can get along all right, and you go after them. You can't very well get lost, but don't try to track them after dark."

Roger nodded, and skirting the slope until he was hidden from the animals' view, he started on a run for a couple of miles, until he thought it would be necessary to exert more prudence. A long and weary progress through the rough country, with the endeavor not so much as to crack a twig or rustle a leaf, brought the lad at last to the little valley where he had seen the caribou, and there the shelter stopped, except for sundry large boulders, which did not afford a complete cover. Roger had worked round, of course, so that he was coming up wind. He had come within about half a mile of them, when he found cover absolutely gone, so lying prone on his face, and just wriggling forward by movements of his knees a foot or so at a time, he spent at least an hour advancing a quarter of a mile on the objects of his quest.

Suddenly, when he was about four hundred yards away, though he was not conscious of having made a sound, and though he had not been able to discern any change in the direction of the wind, the nearest of the four stopped feeding and threw up his head. The boy had been careful, throughout his crawl, to change the sight on his rifle to the distance he estimated he was from the game, and so, when the caribou stopped, he was ready. He waited a moment, hoping that the animal, seeing and hearing nothing, would resume feeding, but instead, the alarm seemed to communicate itself to the others, and they appeared to prepare for flight.

Like a flash the thought shot through Roger's mind that if they once started to run he would not be able to stalk them again that night, and determining to risk a long shot, rather than none at all, he laid his rifle across a boulder which he had been using as a cover, and taking a careful aim, fired. The distance seemed to him tremendous, and as the rifle cracked the four leaped into full career, but the one at which the boy had fired gave a jump, which, to his excited idea, seemed to show that he had been hit. Away started Roger at full tilt after them, but they were speedily out of sight. Tearing along at topmost speed over the uneven ground, Roger's breath began to give out and little black spots danced before his eyes, but when he reached the trail of the fleeing caribou and found a spot of blood in the tracks of one of them, he would not have changed places with the Director of the Survey. On he went, following this track, and noting that the leaps were growing shorter and shorter, but his endurance was beginning to give out, when he saw before him, not more than half a mile away, a solitary caribou. Knowing that those which had not been hit were probably four or five miles distant at this time, and that they would not stop under fifteen miles or so, the boy knew that this was his victim and he redoubled his energies.

The sight of the pursuer seemed to revive the flagging energies of the deer, and for half an hour he increased the distance. Then Roger saw that he was gaining, although the dusk was coming on fast. Fearing to lose his game, he decided for another long shot, and was again successful, for at the crack of the rifle the caribou fell, staggered to his feet, gave a few convulsive leaps, and fell again, and when, ten minutes later, the boy stood beside the object of his quest, a magnificent Barren Ground Caribou, the animal was dead. Roger knew that it was no use trying to skin the caribou, and greatly though he desired its head, he had been told that the party could not bother with it, so cutting off as much of the meat as he could carry, he started for the camp, which he reached four or five hours later, and displayed his evidence, and told his hunting story with infinite zest and relish.

A couple of days later, while the men were enjoying an after-dinner smoke, Roger noticed Rivers stooping by the edge of one of the river bars, flicking water out of a gold pan in regular cadenced jerks. Seeing the boy, he beckoned to him, and carefully pointing to two or three tiny particles of metal that lay on the rock beside him, he held out his hand to the boy.



Photograph by U.S.G.S.

SKINNING A CARIBOU.

Within the Arctic Circle, animals are slain for food, rarely for sport.

"Gold!" he said.

"You have found a gold mine?" Roger inquired excitedly.

The geologist smiled at the boy's sudden conclusion that unimagined wealth lay exposed before them.

"Gold does not come in quarries like building stone," he said with a laugh. "Did you think it came in great masses of rock?"

"No," answered Roger, "but I thought it came in veins through the rocks."

"So it does, but you can find it in sand. What is sand?"

The boy thought a moment. "Why," he said, at length, "sand is rocks ground small by the action of wind and water."

"Very well," said his chief. "Now if some of the rocks ground small contained a vein of gold, what would happen to it?"

"The gold would be turned into sand, too," answered the boy.

"Only in part," said the older man. "The gold is hard and heavy, and when it is eroded from the rocks it comes in flakes rather than small particles. Then, you see, when sand is washed this way," illustrating by a cradling motion, "the gold sinks to the bottom as the sand is washed away from it, and you can take out the pieces of gold with comparative ease."

"Then it ought to be very easy to get gold!" exclaimed the boy with visions of Arabian Nights wealth floating before his eyes.

"Don't you believe it. There is gold on this river bar, as I have shown you, and, indeed, gold has been reported by the Survey on nearly all the bars of the Tanana River and its tributaries; but the geological history of the region is far from perfectly known yet, and the tracing to their original sources the debris of the Cantwell and Tanana Rivers is an excessively complicated subject. Of course, if you found the original vein of gold from which these flakes came, it would pay big, but near its source it may be in sufficient quantity to pay well, even in placer form."

"But if you can wash it right out of the sand," objected Roger, his imagination fired by the sight of the particles of metal, "why not get it that way?"

"Nothing easier," replied the geologist. "Thousands of people might come up here and wash the sands of this and

other rivers, the White River in particular, but it doesn't follow that they would get enough to pay them for their trouble. Just think what it would cost to get up here! I suppose from the 'colors' in this sand, each one of us could wash from six to ten dollars' worth of gold a day through the summer, but what use would that be? It wouldn't pay the expenses of the trip; still hundreds have made small fortunes by such methods."

"Then prospecting for gold's not so easy after all?"

"It's one of the hardest lives I know," was the reply, "and the most dissatisfying. If you happen to strike a 'pay-streak,' as it is called, it may be very profitable."

"But if you strike the original vein?" asked Roger. "Isn't it pretty good then?"

"Only under certain conditions," answered the older man. "You can't crush the quartz rock except with heavy machinery, and you can easily see that it's no light job getting huge crushers up here. And that's not all: after you have spent thousands of dollars in buying the machinery and more thousands in moving it to this forsaken spot, you then have to spend tens of thousands building up a water power development, or else face the still more difficult problem of transporting coal to run your engines. Then high wages are a big factor, too!"

"Then, if it's so hard to get at, what drew the crowds at the time of the Yukon and Nome 'strikes?'" asked Roger.

"The desire to get rich quick," was the reply. "It is safe to say that not more than ten per cent. of the thousands of people who came to Alaska in the gold rush succeeded. Alaska is no Eldorado to pick up wealth idly, though the gold industry, properly capitalized, is important and worth \$20,000,000 annually to the country."

"But surely some one made money in the Klondike and Nome fields?"

"There was a lot of gold near the surface, and the first-comers got that without much trouble, as well as getting the richest claims. There is plenty more there, but it is in frozen gravels and hard to get out. Prospecting for gold is the best thing I know to keep away from, unless you are willing to live in solitude and disappointment all your life, living on the bare hope that some time you may be lucky enough to strike a rich 'pocket.'"



Photograph by U.S.G.S.

THE END OF A HARD CLIMB.

A station made in the Land of Snow, the seated figure on a bank which never melts.

CHAPTER XVI DECLARING WAR ON UNCLE SAM

The broad lower reaches of the Cantwell River, the perfect weather, the smoothly flowing current had made the couple of days prior to the finding of the gold almost a pleasure trip and compensated to Roger for the hardship through which he had gone in the rapids above. But one evening, while at supper, one of the men suddenly smacked the top of one hand with the palm of the other, then held it out silently for inspection. On it was a small mosquito such as are seen in thousands during the summer all over America.

"They've come, then," was the only remark, "but it's early for them yet."

"What is it, just a mosquito?" asked Roger.

"Just a mosquito," repeated Gersup, with a curious inflection in his voice, "just a poor innocent mosquito."

"Do you have many of them up here?" asked the boy, struck by the note of satire in the topographer's voice.

"Yes, we do," he replied curtly.

"Many of them?" put in Magee. "Why, a week from now you can wave a pint pot over your head and catch a quart of mosquitoes in it, and a month from now we'll have to cut our way through them with an ax."

"Oh, come off, now," said Roger, laughing.

"Laugh all you want to," continued the Irishman, "but it's a fact. Why, when they were building the Yukon railroad, during the months of July and August as the men went to work, they had to send the snow plow ahead of the gang in the morning in order to break a way through the banks of mosquitoes, and sometimes they had to put two engines behind the plow--make a double-header of it."

"Pretty good yarn, Magee," said the boy, "but if they're no worse than that I guess I can stand it."

Here Rivers broke in. "You will do well if you do stand it," he said, "because Magee is not so very far out. You will hardly believe it, but I would rather face a country of hostile Indians than hostile mosquitoes. That little mosquito you saw to-night means hundreds to-morrow, thousands the next day, and from that until cold weather hundreds of thousands all the time. Magee isn't exaggerating much, because Baron Munchausen would find it hard to do the Alaskan mosquitoes justice, when they get busy."

"Are they especially venomous, then?" the boy asked, growing serious.

"No, but they are especially numerous. Many a man has gone mad on the trail because he had no protection from them. That, practically, wiped out of existence one of the largest gold-hunting parties that ever came to Alaska."

"Tell us about it, Mr. Rivers," urged Roger.

"Well, I will," the chief replied, "if it is only to give you a due respect for your enemies. This party of which I am speaking had landed on Kotzebue Sound, and having heard of an alleged Indian trail to the Koyukuk, somewhere near the Selawik River, and having found out beside that it was tundra and flat, they thought it would be easy traveling."

Here Magee chuckled audibly at the idea of tundra being easy going.

"It wasn't long," went on the chief, not noticing the interruption, "before they reached the tundra and discovered that it was scarcely as pleasant as they thought. Walking on tundra is like, is like,--tell him what it's like, Magee."

"It's like walking over slippery footballs half-sunk in slime," said the Irishman promptly.

"Well, that will do," said Rivers. "Any way, they were tramping over this and losing heart fast when the mosquitoes began. They had nothing with them which would serve to keep off the insects, and some of the party were stung so fearfully that a superficial form of blood poisoning set in. Others, unable to endure the torture night and day, killed themselves; others again went insane and became violent; of that large party but two returned to the coast, one who by some freak of nature was immune, and his chum, who had become half-witted by the experience."

"You bet," commented the topographer, "the Alaskan mosquito is a matter to be taken very seriously."

In spite of the general opinion so strongly expressed, Roger felt a little scornful about being bothered with a few pesky mosquitoes, and he was inclined to think it an utterly foolish precaution when he was given an arrangement of netting to put over his head and let it hang down well over his shoulders, but his scorn vanished rapidly. Within an hour his

hands, unprotected by gloves, became puffed and swollen from bites, and he found it necessary to put on thick buckskin to preserve him from the bites and to keep his sleeves rolled down. Even then he was not entirely free, for in some mysterious way the insects would work themselves into his clothes, and at night, although the tent was placed on a canvas which fastened to its sides like a floor, so that the mosquitoes could not come up from underneath, a few of them always were to be heard--and felt. So that, before many days had passed, Rogers was convinced that the Alaskan mosquito was a very important factor in life on the trail.



Photograph by U.S.G.S.

THE ONLY BIT OF ROCK FOR MILES.

A landmark in the vast treeless tundra. The chief of the division drawing in contour.

Five days after leaving the portage, having covered over one hundred miles of very easy going, the party made camp at Harper's Bend on the Tanana River. So far as buildings went, it was quite an imposing place, no less than nine huts being in evidence, but they were all vacant and deserted and a sense of loneliness and desolation hung over the place. The sight of human habitation, after so many weeks in the wild, ought to have given a sense of homelikeness, but instead the boy was conscious of an eerie sense of estrangement.

At supper that evening Roger mentioned this feeling, and added:

"Somehow I feel as if this place were haunted. It doesn't so much seem abandoned to nothingness as it does given to some uncanny ghost."

Magee crossed himself.

"Saints preserve us!" he said. "Don't talk like that, or ye'll bring the night-riders here."

"Nonsense, Magee," reproved Rivers, "a man of your experience so superstitious! But the boy might be right, for all that."

"By the power of good luck, why?" asked the Irishman.

"You tell the story, Gersup," replied the chief, "you know more about it than I do."

"Alaska's a pretty new country to be starting a ghost crop," the topographer began, "and, so far as I know, there aren't any here yet; but, if any place ought to have one, it should be Harper's Bend, right where we are now, and in this very house in which we are sitting."

Magee shivered and looked about him apprehensively.

"There was once," Gersup continued, "a trader at this place by the name of Bean, William Bean. He came in the year 1879, and established a post for the purpose of trafficking in the furs of the Tanana Indians. He found the tribes peaceful enough, their furs were of high quality and, as he had no competition, he was able to get them cheaply and to

make a big profit out of it. The natives seemed to be so friendly and the opportunity for making money was so good that he determined to make it a permanent little settlement; he brought his wife to the place, and made arrangements for other families to follow.

"But it chanced, one day, that some natives from neighboring tribes, who had visited trading posts, came by the Tanana Indian camps, and when they saw how little their allies were getting from Bean for their skins, they suggested either visiting other posts or demanding more from their own trader. But Bean, so far as can be learned, was harsh and arrogant, and instead of offering a little more, which would still yield a handsome profit, he refused to consider the matter at all, and sneeringly pointing out that they were so far from any other post that they would have to come to him, he drove them away with gibes.

"Now the Indian usually has a sense of justice which is peculiar to himself. To us it may at times appear distorted, but it is a sense of justice none the less, and this sense Bean had offended. He made the further mistake of supposing that their quiescence under his sharp rebuff was an evidence either of cowardice or of ignorance of the true values of their furs. So, lulled into a false security by his own conceit, he remained there. One morning, while the whites were at breakfast, a war-party came and attacked the blockhouse, an Indian shooting Mrs. Bean from the doorway. The trader leaped up, seized his small child, and dashed through a rear door to a near-by boat, followed by an Indian servant. Some days later a party came up from the Yukon and buried Mrs. Bean, but the trader never returned.

"The country was not settled enough at that time for any question to be taken up of punishing the Indians for the crime, and there is no doubt of the provocation that the trader had given them. But this single incident in the history of the tribe is all too little to brand them with the reputation of treachery which they have borne ever since."

The following morning the canoes passed through a section of the country which, as Rivers pointed out to Roger, could be made the garden spot of Alaska. Well timbered, well watered, with a favorable climate and easy of access by steamer up the Yukon, the lower Tanana could be made a fruitful agricultural country.

"Some day," the chief of the party said, "an enterprising man will start a big farm here, to supply the posts all along the Yukon with provisions, for which they now have to pay big prices on being brought by steamer all the way from Seattle. That man will make ten times as much money as any of the gold mine operators, and besides, will be living in security and comfort."

They halted for the midday stop, a few miles above the junction of the Tanana with the Yukon, and about four o'clock the canoes shot into that great river of the north. Surprised as the boy had been at the size of the Alaskan rivers, he was by no means prepared for the body of water where the Tanana joins the Yukon.

"Why," he said in amaze, "I had no idea it was as big as this."

"Heap big river," commented Harry, who was in the stern.

The chief was in the boat, and hearing the lad's exclamation he turned to him.

"This is the fifth largest river in North America," he said.

"What are the others, Mr. Rivers?" the boy asked. "The Mississippi comes first of course."

"Yes, and then the Mackenzie, the Winnipeg, and the St. Lawrence, in that order. But the Yukon and the St. Lawrence are just about the same size."

"Well," Roger said, "it certainly is big enough."

Harry grunted. "Plenty big to paddle up," he said.

Then the boy noticed for the first time that there was quite a current in the river and that it was necessary to paddle up against the stream instead of rushing down as they had been able to do on the Tanana, and he buckled to his work. But they had not been breasting the current for more than an hour when one of the men in the rear boat gave a shout and pointed down the stream. Every one looked, and there, far down, could be seen a faint smoke like that of a steamer.

"That looks like a steamer's smoke," said the boy. "I wonder what it can be."

"Why not a steamer?" queried Rivers.

The boy looked bewildered.

"I don't know why not," he said, laughing; "it just didn't occur to me that any people lived about here. Are there any steamers on the Yukon?"

"Lots of them. There's quite a little traffic on the river and it is good for navigation for hundreds of miles, indeed, all the way to the Canadian boundary and above. Now you see, we will get this fellow, whoever he is, to take us up to Fort Hamlin. It's just as well to save one's strength when there is no need to exert it."

So the canoes took it easily, just paddling along quietly, not trying to make much headway, but on the other hand, not drifting down the stream, and commenting on the approaching steamer, as soon as she came in sight. She was a small vessel, but quite trim and ship-shape, and to Roger's eyes had a curious look of being civilized and out of place in the environment.

As soon as the steamer came close, Rivers gave orders for the leading canoe, in which he was, to drop behind, so that he might speak to the captain, and as the steamer forged up beside them the canoes got full way on, to give a chance for the steamer to pick them up.

"Ahoy, there!" shouted Rivers as soon as the little vessel was within hailing distance.

The captain of the vessel picked up his speaking trumpet.

"Well, what's the trouble, what do you want?" he roared back.

"Going up to Fort Hamlin. Take us on board."

"Can't stop," the captain shouted, "this is a government boat."

"So is this," replied Rivers, a little nettled, "slow up and take us on board."

Now, as it chanced, the skipper was a choleric little man with a very quick temper, which had not been improved on the trip by the presence of a party of tourists, who had been grumbling at everything American all the way up the river. So he was anxious to magnify the importance of his post and not be at the beck and call of every tramp on the river. Irritated, therefore, he shouted back:

"Get to Fort Hamlin the best way you can, I can't spare any time."

By this time Rivers was warming up, and he did not want to be discomfited before his party, so he yelled back in an authoritative voice:

"Do as you're told and stop that vessel! I want to go on board."

"Oh, you do, do you," sneered the skipper, "then you can want," and he rang the telegraph for full speed ahead.

Rivers was ready with a retort, but Bulson, who on occasion could become furiously angry, suddenly blazed, and picking up a rifle that lay on the boat, he fired across the bows of the steamer as she forged up to the leading canoe.

The captain picked up his speaking trumpet again.

"What in Creation do you think you are doing?" he roared, with all his force. "This is a United States mail boat," and he pointed to the mail flag flying at the stern.

Bulson made no reply other than sending another shot across the steamer's bows.

Then if any man was wild it was that captain. That a government ship, flying a government flag, should be fired on in American waters by a party of tramps in two battered canoes! And that those tourists should have seen it! He fairly danced with rage. It was too much for flesh and blood to stand.

He swung the ship round sharply, volleying invectives as he did so, and vowing by all his gods that he would put every member of the party in irons until they reached port, and then would see them in jail for treason. And the more he fulminated, the more the tourists chaffed him, until when the boats sheered alongside, he was purple in the face with temper.

"What do you mean, sir," he began, stuttering in his speech; "what do you mean by firing across our bows, sir? Are you aware that this is treasonable conduct, sir? It is infamous, sir, treasonable and infamous! Thirty years have I worn the uniform of the service, sir, and I have never even heard of such insolent and high-handed conduct.

"Do not answer me, sir," he thundered, as Rivers prepared to answer him, a smile lurking behind the shaggy brown beard. "I will not be answered. Consider yourself under arrest, sir, and you will be handed over to the authorities at Fort Gibbon."

"But I think, Captain," said Rivers, enjoying the amusement visible on the faces of his party, "that you will take us to

Fort Hamlin. I presume you are going that far."

"Take you to Fort Hamlin? Are you the commander of this vessel, sir, or am I? Answer me that, sir! And," he continued, with unnoticing inconsistency, "if you do so much as answer me, I shall clap you in irons. In irons, sir, and every man Jack of your party with you."

"Your threat does not disturb me in the least," was the unmoved reply, "because you would not dare to do it."

"Not dare?" exploded the little man, and turning, he was about to give an order, when Rivers stopped him.

"You had better wait," he said, "before you do anything for which you may be sorry. I have told you several times to take us to Fort Hamlin, and you reply with threats of arrest and what not. You cannot arrest any man without some cause, and no cause has been given."

"No cause, sir? You have given cause enough to be strung up at the yardarm, sir, strung up without any resort to the civil authority. Did you not fire across my bows, sir? No cause, indeed! Do you not know, sir, that such an action is a declaration of war, sir, and that in times of peace, it is privateering and piracy, and a dozen other things besides, sir?"

"And who has more right to fire across your bows than I have?" queried Rivers with a fine assumption of authority.

"More right," cried the captain, his voice rising to a perfect shriek, "you have no right, no one has any right--"

"Nevertheless I have," continued Rivers, but before he could explain his mission, the little officer broke in again.

"You have? If you were the Czar of Russia, sir, and every one of the scarecrows with you was a crowned head, sir, you would have no right to stop an American vessel in American waters. On American waters, did I say? On any waters, sir. Wherever that flag flies, sir, she shall not be stopped by any one. And whoever fires on that flag, sir, is an enemy to me and my country, and I should have no hesitation in shooting him down like a dog. Like a dog, sir, the dog that he is!"

"Well, Captain," said Rivers, thinking that the matter had gone far enough. "I am sure you would be sorry if you shot me down like a dog, as you say. I am on government service, just as you are, and am just as loyal to the United States as you can be. My name is Rivers, of the Geological Survey."

"Rivers, the head of the Alaskan work?"

"Yes. The navy department was kind enough to place a gunboat at my disposal for the trip from Seattle to Cook Inlet, and a revenue cutter has been ordered to meet us at Point Barrow in the autumn, so I feel sure the Postal authorities will not complain of your affording us facilities as far as Fort Hamlin."

"And why did you not say so before, sir?"

"You didn't give me a chance," answered Rivers, smiling.

"If I had known who you were, sir, that would have been an entirely different matter. I should have esteemed it a pleasure, sir, to have been able to assist you in any way."

He turned to the passengers, who had been listening to the altercation with great zest.

"Gentlemen," he said, "you see that only the American government itself can dare to delay a United States mail boat. Gentlemen, let me introduce Mr. Rivers, chief of the Geological Survey in Alaska."



CHAPTER XVII CLAWED BY AN ANGRY BEAR

The first day of June saw the party safely in Fort Hamlin, having landed from the mail boat. The captain had shown a very great eagerness to be rid of them, as their presence reminded him of an incident in his trip which he preferred to forget.

"I am glad to have met you, sir," said the little officer to Rivers, as the geological party went over the side to their two canoes, "and to have been able to assist you thus far. But, sir, I trust the next time you have occasion to board a United States vessel, sir, you will not deem it necessary to adopt such summary proceedings."

"I am sorry, Captain," said Rivers, "but there really did not seem to be any other way of stopping you, and it was necessary."

The little skipper waved his hand.

"The incident is closed, sir," he said, "and I wish you good luck on your trip to the Arctic Ocean. I am only sorry that my duty will not permit me to take you at least part of the way to Dall City, but, sir, I am due in Fort Yukon on the sixth of the month."

An appropriate answering expression of good wishes having been made by Rivers, the little steamer started off and in a few minutes was only visible as a cloud of smoke around a bend in the river. A busy day was spent at Fort Hamlin, making the last preparations for the next lap of the journey, namely to Bettles, at the junction of the John and Koyukuk Rivers, a long and by no means easy trip.

But the days were growing long, indeed the nights were excessively short, and as everything was ready for the trip by a little after three o'clock, Rivers gave the word to start, and a few hours' paddling brought the voyagers to the Dall River, where it plunged its muddy waters into the north fork of the Yukon. There, immediately across from an Indian village, the party made its first camp on the third stage of the journey.

The Dall River was full to overflowing, as the spring floods had not all come down, and, so far as the boy could see, it hardly looked like a river at all, but a large flat marsh, with a sluggish current. Over this the boats made good time, sometimes following a blind channel only marked by the trees sticking up out of the water, and sometimes making a short cut over the submerged land. Several times, in the doing of this, the canoes grounded, but the bottom was of mud and no harm was done, the men jumping into the icy water to pull them clear.

Higher up the stream, however, the ground rose a little and these short cuts no longer became possible, so that the tortuous channel had to be followed, and as the valley of the Dall is extremely wide and the stream winds from side to side, a long day's traveling did not cause so great an advance. Twenty miles of this irregular going was rarely more than ten or twelve miles of progress, and the eighty-five miles between the mouth of the river and Coal Creek consumed an entire week. Here Rivers called a halt, as he desired to examine the lignite or soft coal of the region.

Taking Roger with him, the geologist ascended Coal Creek for a little over a mile above its confluence with the Dall, and there they found a large outcrop of lignite, of which one half the thickness of the seam showed coal of a firm, bright quality.

"I should think," said Roger, "that this ought to be more valuable than a gold mine, for Alaska would be all right to live in during the winter, if coal was cheap and easily obtained."

"It would make an immense difference," his chief rejoined, "for coal will go further to build up the greatness of a country than any other factor. That was largely the cause of England's rise, and the United States would never be what they are to-day if it were not for the anthracite and bituminous beds of Pennsylvania. If we could lay bare a big anthracite field, Doughty, it would be better for Alaska than all the gold that's ever been struck, though the soft coking coals, used in steel-making, etc., also are extremely valuable."

"Perhaps we may," suggested the boy, his eyes alight with the thought of a possible discovery.

"I think not," was the conservative reply. "This is the only coal-bearing horizon, and though it does crop up all over the country it is a soft coal strata. You see anthracite is a coal much older and subjected to much greater pressure, so it does not usually occur in the same strata with soft coal."

Returning to camp in time to complete the remaining five miles assigned for that day's trip, Rivers told the boy that they would spend the night in Dall City. When a couple of hours later the canoes stopped in front of three or four

abandoned prospectors' cabins, the boy was correspondingly disappointed.

"Is this Dall City?" he said aloud in disgust.

"Sure, this is Dall City," said Magee. "The Mayor would have come out to present us with the freedom of the city on a silk cushion, but as he couldn't get a quorum of the aldermanic council, he decided to go away and let us take all the freedom we can lay our hands on. On to freedom!" and the jokester jumped out of the canoe to aid in running her up on the bank.

Above Dall City the river becomes absolutely impassable, and there was no thought of trying it, but Rivers knew that there was a long and heavy portage from Dall City, although it was over a well-made and often-used trail. But the pass was immensely steep, the mosquitoes were incomparably bad, Roger's feet were tender, and that two days' portage nearly crumpled him up.

At the end of the first day he felt pretty well exhausted, but he had not shown a sign of letting up throughout the work. He hoped to be toughened up by next morning, but when daylight came his muscles were so sore and tender that he could not bear to touch them with his finger. None the less, he gritted his teeth and settled down to his work, remembering from past athletic experience that in an hour or so he would limber up.

The noon day stop was what nearly finished the boy. The moment he sat down to rest before dinner, he felt as though he could never get up, and even the food seemed unable to revive his flagging energies. When the start was called, however, he caught a glance that Rivers cast first on him and then to Gersup, the topographer. That was the stimulant he needed, his pride was touched, and he leaped to his feet although he felt as though it were the last effort he would ever make.

But he was fortunate in having a considerate crowd, and though all could see that the lad was nearly beaten out, they admired his pluck and grit in saying nothing about it, and would not dishearten him by letting him see that they realized how near he was to giving up. On the trail, however, his pack on his back, and nothing to do but walk, following Bulson, who was immediately in front of him, his will-power showed stronger than his legs and back, and though he felt numb and without the power of thought, he still went on. For the first time he realized how brutalizing exhausting physical labor can be. On and on until a shout from the cook, who had been left at the further end of the portage the night before, told Roger that the carry was over and supper ready. As they reached the spot and Bulson turned to help the boy unstrap his pack, he said briefly:

"Bully good work, Doughty; that was a long, hard carry."

"But I had nothing like your load," answered the boy, remembering that his companion had toted at least forty pounds more in his pack.

"You're not quite so old yet," answered the other, then with a smile, "maybe I'm a little stronger than you are, too."

Supper was very welcome and the boiling hot tea seemed to put new life into the boy, but a proposal made by the topographer for a hunting trip fell on deaf ears.

"If you don't mind, Mr. Gersup," he said, "I think I'd rather not. Now that the portage is over, I don't mind confessing that I'm a little tired, and I think a good night's sleep will seem a whole lot better than any kind of shooting you can think of. I want to be ready for work to-morrow, and any way, I wouldn't walk half a mile to-night to shoot wild elephant."

"You're wise," answered the older man. "I wouldn't have taken you any way, but I wanted to see if you'd have the nerve to say, 'No.' I reckon for your size and age, son, you're about as good an article as I've ever seen on a first trip."

"You've been over this ground before, then?" asked the boy, lying down and resting his head on his elbow.

"Right over this trail. I made a reconnoissance once from Fort Yukon to Kotzebue Sound, and it's because I know the ground so well that we're making such good time now. That portage often takes three days."

"What a wonder Bulson is on the trail," said Roger, trying to stifle a yawn, "he must have had a hundred and thirty pounds in his pack to-day."

"Well, he's as strong as a grizzly," replied the older man, "and he just eats up the trail. You're stronger in a canoe. By the way, there are some rapids on the Kanuti River, down which we start to-morrow, and I suppose you'll have a chance to shine there. But it's nothing like that fearful mess on the Cantwell."

"It's a pretty wild country up here, just the same," suggested the boy, "and, speaking of hunting, there must be lots of

big game in these forests."

"Plenty of it. It's not more than ten miles from where we are now that I came across the only man I ever met who had been thoroughly clawed by a bear and yet lived to tell the tale."

"The story!" demanded Roger peremptorily.

"It wasn't so much of a yarn. I got it from the half-breed guide. It was quite early in the season," he began, leaning back against the trunk of a tree, "and we had just made camp, a little further on than we are now, because the water in the Kanuti River was not as high as it is this season, when we heard a shot fired, then after a regular interval another, and another, and so on."

"Meaning a signal of distress?" questioned the boy.

"Right," rejoined the older man. "Well, of course, we responded the same way, and half an hour later there staggered into the camp a wounded man on horseback, and a half-breed holding him in the saddle. The injured man was a sight, and as I know quite a little about surgery, I looked after his wounds, took a few stitches here and there, pretty much all over at that, and started them off on the trail to Fort Hamlin, a couple of days' ride away, and thence to Rampart, a couple of hours down the Yukon.

"But before they left I learned in a vague sort of way how the whole thing had come about. It appeared that the poor fellow had gone up to Caribou Mountain to shoot some big game, and had taken the half-breed along as a guide. The luck had been bad, nothing had been shot, or even sighted, and the two of them had started for home.

"One day, however, the same day that he met us, on turning the corner of a rock, the half-breed being a little distance away, the hunter saw a bear. Not knowing much of the bears in this part of the world, it simply seemed to him like a smaller species, and, dropping on one knee he pumped three shots into the brute and it fell a few steps away. Then, foolishly laying his rifle down and taking out his hunting knife, he walked up to the beast to see what his prize was like.

"Stooping down, he saw that it was but a large well-grown cub, and he stood looking at it for a moment, when a sudden feeling of danger flashed into his mind. A cub--then the old bears must be near by; he turned swiftly to get and reload his rifle. As he turned, he saw, charging upon him from the direction in which his rifle was lying, the mother of the cub. The bear, which was coming like an express train, was not seventy-five yards away, and the rifle was ten.

"Then the fellow did what seemed to me a mighty plucky thing. He knew he could not outstrip the bear, and he was sure that if he were treed that would be the end of it, so instead of running from the bear he tore up the hill to meet her face to face."

"Did he expect to get to the rifle first?" asked Roger, full of interest.

"He thought that when the bear saw him charging for her it would cause her to pause, and a few seconds' delay would enable him to get his rifle and he ran a chance of dropping her in her tracks. It was his only hope. But the brute never stopped in her rush, and when the hunter reached the gun she was only twenty feet away.

"Bringing the rifle to his shoulder with a single motion, he pumped three steel-jacketed bullets into her at point-blank distance, then, throwing his rifle up, he caught it by the barrel, prepared to club the bear over the head with an aim to catch her in the eyes and blind her, so that he could make a get-away."

"That was plucky," said the boy, "to face a mad bear with a clubbed gun."

"Plucky enough, but foolish. He knew nothing of the strength of a bear, and even as he brought down the clubbed rifle with all his force, she rose suddenly upon her hind legs and swept away the descending gun with her paw. I found it later, bent almost double with the force of that blow. The hunter jumped aside, but as the bear rushed past she threw out her other paw with claws outstretched, which, catching him on the neck, laid open his right arm from shoulder to wrist.

"Dazed and incapacitated, he was an easy mark for the bear, who turning, with a growl at the pain of her wounds from the three bullets, seized him in her teeth. Then, apparently suffering acutely herself, she dropped him to give a vicious bite at the blood dripping from her side, where one of the bullets had entered.

"The hunter, who had been thrown several feet when the bear dropped him, was still game. He staggered up with some vague idea of finding and using the rifle, when, with an angry snort, she rushed at him again. But one of the steel-coated messengers of death had found a vital part and her eyes were growing dim, so that though her claws lacerated his thigh, her jaws came together a foot from him, and in her overreaching rush she knocked him down without further injury.

"There, then, crouched bear and man, almost within striking distance of each other, and yet both too weak to get up. Prudence bade the hunter lie still, but seeing that the eyes of the bear were glazing fast, he thought he might make shift to defend himself in the event of a final rush, and he reached out his hand for his hunting knife, which had fallen a few feet away. But the brute was still conscious of danger, and she reared with a roar of pain and thundered down upon the man, who struck with the knife as she fell upon him, the blade striking the snout, the tenderest part of the whole body. She buried her teeth in his shoulder, but relaxed the pressure almost instantly from her own pain and rolled over him leaving him free.

"Once more she lurched heavily to her feet, and the man lying on the ground in a frenzy of pain, closed his eyes, only hoping that the end might come quickly. Once he opened them, and there, not three feet away, stood the bear, apparently blind from the approach of death, rocking and sawing unsteadily on her feet, and then toppled over, dying. Three or four times, even then, she tried to rise, but fell back each time with a low growl, her bloody jaws snapping with fury scarcely a yard from the hunter's face, but the bullets had not failed to do their work, and with a last roar she fell back, dead.

"The hunter declared, but is not sure whether he was conscious or no, that hardly had the she-bear fallen dead, than out from the woods stepped another immense bear, almost twice the size of the female. Quietly he walked to the cub, and smelt it with a growl, next smelt the body of the she-bear with another growl, and with his hair bristling, walked to where the hunter was lying. The man was paralyzed by fear and pain and did not move, whereon the bear, showing no hurry, shambled into the woods again and was gone.

"The whole affair, from the first shooting of the cub to the appearance and disappearance of the parent bear, had not taken five minutes, and when the half-breed, who had heard the shooting and the growls, reached the place, it was all over. The hunter, dazed and scarcely conscious, was lying beside a stone with the dead cub a few feet behind him and the dead mother a few feet in front of him. Apparently the man had not moved since the bear died, and probably was not aware of his escape, but was lying there, awaiting death in a most horrible form, not realizing that his foe had passed beyond revenge."

"But how did he get to you?" asked the boy.

"The half-breed brought him, as I told you. In some unexplained way he lifted him to the saddle, and had the good judgment to let him fall forward on the neck of the horse, thereby closing the wounds in the neck and shoulder, which were the worst of all. But the hunter was terribly lacerated, for the claws of a bear rip right to the bone, sinews, tendons, veins, everything being shorn clean through.

"I doctored up his wounds as well as I could, but he did not regain consciousness all night, and I thought he would never pull through. But just as he had shown plenty of pluck in his fight with the bear, so he also showed a good deal of vitality in his fight with death. Though time was very precious to us, we stayed there three days to give him a chance, and then we sent him down to Rampart."

"I should have thought that the ride would kill him," said the boy.

"There was certainly a chance that it would," replied the topographer. "But he could not have gone down the Kanuti River with us, and he could not stay up there alone with the half-breed. Then I thought there was less danger of some blood poisoning or infection setting in if he was somewhere that he could be watched by a doctor, and the journey was worth the risk."

"Did you ever hear of him afterwards?"

"Oh, yes. He is recovering, though, of course, he will never be the same man again."

"That," mumbled Roger, his voice thick with sleep, "was a close shave," and a moment later his heavy breathing told the topographer that his audience was asleep.

"He's a plucky little customer himself," he commented, as he left the tent.

CHAPTER XVIII FIGHTING FIRE IN THE TUNDRA

The next day, June 12th, with Roger at the bow and Harry at the stern of the leading canoe, they started down the Kanuti River. The stream was swift, shallow, and full of boulders, and for the first couple of days more of the work was done wading in the stream than by paddling. The second day, particularly, it seemed to the boy that he had not been out of the water at all during the fourteen hours of the march, except for the brief halt at noon.

The next day, however, was travel of the kind that he liked. Two small tributaries of the Kanuti, mere mountain streams, flowed in and raised the water to a height where it was possible to shoot the rapids instead of wading them, carrying the canoes. Ever since the canoe slide on the Cantwell, Roger had felt quite proud of his powers as a canoeist, and this pride was considerably heightened as he found how able he was to handle the boat on this new stream. It was different, too, for while the first set of rapids had been a torrent foaming between jagged upstanding crags of rock, this was a swift river running over heaps of boulders, and the Indian had to judge by the swirl of the water just what was below.

A broad valley, through which the river wound in a very crooked way, afforded a quick day's journey, but bad rapids were then met with, which taxed the resources of the party to the utmost, and proved all in vain to prevent the boats from being swamped. Twice the boats went over, once the leading boat to Roger's great chagrin, and the second time the second boat, which in consequence made the boy feel much better. No serious harm resulted as the supplies were always packed in watertight bags. There was a fall of eight hundred feet in the thirty miles of these rapids, so that, as Magee said, "it was a case of whistling for brakes all the time."

The mosquitoes became very bad in the lower reaches of the river, the only redeeming feature of which part of the trip was the immense abundance of ducks and geese, which, being shot, were a welcome and toothsome addition to the larder. With this to aid the quiet progress, the party soon arrived at Arctic City, at the junction of the Kanuti and Koyukuk rivers, and thence one day's paddling up the latter broad stream brought them to Bergman. This is a central trading post, and there again they secured supplies for the last stage of the journey.

As it was already June 23d, and the hardest stretch was yet to come, little time was lost at Bergman, and three days later the voyagers crossed the Arctic Circle and touched at Bettles, at the junction of the Koyukuk and John (or Totsenbet) rivers. There Roger saw the last white face he would see, other than the members of the party, until he had crossed the great Arctic Divide, made his bow to the not-distant North Pole, reached the frozen ocean, and returned to civilization.

But when they came to the John River and Roger saw the force of the waters of the stream, and learned that there was one hundred and forty-five miles of up-stream work against that current, he realized that all his previous experience of labor had been child's play compared to it.

"That's going to be a pretty stiff pull, Mr. Rivers, isn't it?" said Roger to the geologist, as he was standing by the edge of the river just as the boats were being launched.

"It would be, Doughty," was the answer, "that is, if it wasn't for the milking."

"Milking?" questioned the boy in surprise, doubting if he had heard the word aright.

Just then Magee replied over his shoulder:

"Yes, milking, of course. Didn't you know they had cows here to do all the work? Sure! You've read of the cleverness of ants? Well, they're no better than fools compared to John River cows. They have a regular system. The cows up here have immensely long horns and two of them catch the end of one horn in the bow of the canoe, and another one, a mooley cow, shoves behind, and there you are. That's what they call milking--milking the brush, up here. Don't you expect to go up the John by milking the brush?" he added, turning to Rivers.

"Certainly," replied the geologist, then, seeing the lad's confusion, he continued, "but you mustn't mind Magee; milking the brush isn't quite that. It's a term used to specify that way of traveling which consists of pulling the canoes up stream by the boughs of branches along the bank. You see the John River is so swift that, if we were to depend only on paddling and poling, progress would be extremely slow."

"But how about tracking?" suggested the boy. "What is to prevent the canoes being pulled along by ropes from the shore?"

"The timber and brush come right down to the water's edge," was the reply. "There are no bars and level banks such as

there were in the upper part of the Dall River, just before we came to the portage, and of course it is almost out of the question to pull or tow a canoe, when the banks are so thick that you would have to cut a trail in order to get through yourself. The trees and undergrowth overhang the river for quite a distance. Therefore all that can be done is to pull the boats up along the branches, hand over hand, one man poling in the stern. Of course, every few yards the boats get entangled and have to be pushed and pulled out. It's the only way, but it's back-breaking work."

It was, there was no doubt about that, and Roger added another chapter to his ideas of what hard work meant. The current of the river was so swift that it was useless to try and paddle up against it, while keeping in the middle of the stream, the banks were so thick and wooded that tracking was impossible, and "milking the brush" required incredible labor, because it meant keeping the canoe so near the bank that it was grounding or striking snags or becoming entangled in roots constantly, or misbehaving itself in some way.



Photograph by U.S.G.S.

IN ICY WATER UNDER A BURNING SUN.

Taking a canoe up a glacier-fed current in the height of an Alaskan summer.

Then to make a change, a long rapid would appear, and the only way to negotiate it was to lift the canoes shoulder-high, all the party together under the one canoe, and climb up that rapid with the ice water perhaps up to the waist, and a cruel, drenching spray whipping into their faces. In the meantime, if the mosquito veils were thrown back--and few things are more uncomfortable than a wet mosquito veil flopping about the face, why, then those torturing pests got in a full day's work; the while that a hot Alaskan summer sun blazed above them and blistered face, arms, and neck, exposed alternately to vivid sun and icy spray.

On July 5th, the spruce, which had thinned out rapidly during the couple of days preceding, came to a sudden end, the northern limit of timber having been reached. Nothing seemed to impress on Roger so clearly the fact that he was now in the Arctic Circle as the thought that he was in a climate so rigorous and gale-swept in winter that no tree could grow. A few stunted willow bushes, here and there, still remained, when sheltered on the bank of the river, but trees, as such, worthy of the name, there were none of any sort whatever.

"I never realized," said Roger, "that there was no timber of any kind in the far north. What do the Eskimos burn for fuel?"

"Have you ever seen pictures of stoves or fireplaces in the Eskimo snow hut?" was the answer. "They depend on the heat of their own bodies in a hut without any ventilation, on the flame of blubber lamps, and occasionally, on a little driftwood which may have come down into the Arctic Ocean from some immense stream like the Mackenzie, which, flowing thousands of miles, has passed in its upper reaches through a timbered country."

But by the time that the boy had reached this northern limit of spruce he had lost all idea of time. The days and nights seemed one perpetual nightmare. When asleep he dreamed that he was wading, or tracking, or poling, and when awake he felt as though he were working in his sleep. It seemed to him that he had spent years and years on an icy river, and

that fate had tied him to it for ever and ever. By the time that two full weeks of it had passed by, the boy no longer had any thought of reaching the summit, that this toil could stop was a thought incredible, and though his muscles, stiffened and well-trained, continued to do their full man's share of the work, the mental strain was intense.

Rivers and Gersup were considerably troubled over the fact that the boy's strength showed no signs of giving way, and they would almost rather have seen him break down physically than continue his work doggedly, yet like a machine. It became hard, toward the end of the trip, to make him answer a question, and it would have to be repeated several times before the boy could grasp it. Orders regarding the work he seemed to understand at once, but other matters fell on deafened ears.

The older men tried to sting him into life in many ways. They attacked his pride, they endeavored to insult him, they reasoned with him, but there was no response, the heavy and sunken eyes regained no luster, the hard-set jaw never relaxed, and the channels of speech seemed frozen. This went on as the river shallowed until, when the John had become so small that further work by water was impossible, Rivers gave word for a portage.

But the chief was far too wise a leader not to be prudent as well as urgent, and he knew that there were times when a rest would be wise for most of the party, and imperative for Roger. He had not dared to give anything to the boy, because of the need of travel the next day, but now that a short rest was in sight, he mixed up from the little medicine chest a sleeping draught of triple strength, and made the boy take it down. Through the entire night and the whole of the next day Roger slept unmoving, and when evening came, Rivers and Gersup discussed whether they should wake him.

"Let him sleep, if he wants to," put in Magee, who had heard the talk; "sure he can't be gettin' into any harm while he's asleep, an' if it's rest he wants, I think it's better not to wake him."

"But, Magee," said the chief, "sometimes a man gets into one of those sleeps and nothing will rouse him after."

"Of course, there's a risk, but if the boy's brain needs sleep so bad as all that, I should think the shock of waking him would be bad."

And so it was decided to let the lad sleep as long as he would. All through that second night he slept, though it was almost full daylight the whole night through, and all the next morning, till about three o'clock in the afternoon, when he stirred, looked around languidly, and fell to sleep again. He woke at five o'clock, and sat right up, his eye clear and the leaden weight upon his tongue loosened.

The men crowded round with questions, and Roger learned that they had reached the head of the pass, but he had retained no memory whatever of the last ten days of the trip. He buckled to and ate steadily for an hour and a half, to the huge joy of the cook, and then curled up for some more sleep, awakening the next morning bright and chipper as though he were in Washington before the trip had been begun.

On July 17th, therefore, the lad being quite himself again, three days after their arrival at Anaktuvuk Pass, at the head of the John River, Rivers gave the word for the portage to be begun. It was a twelve-mile portage and hard going, for though, unlike all the previous carries, there was no timber to intercept, and through which a trail must be cut, the entire work was over the tundra.

The moss-plains of the Arctic slopes, brilliant with wild flowers and fragrant with heather and gorse, which surround the Polar Seas the world around, come almost first in the list of objectionable travel. Even in the blazing heat of a summer where the sun shines for twenty-two hours out of twenty-four and the heat is nothing short of tropical, two feet below the surface the spade would touch perpetual frost, a factor of no importance to the branching-rooted tundra moss. Centuries of centuries of growth and decay have created a network of roots, rotten, spongy, and wet, so that walking over it resembles treading on soaked sponges two feet deep.

But that nothing may remain to be thought of in the viciousness of that footing, every six or eight inches apart, tufts of grass and moss, known as "niggerheads," hard and round, stick up a foot high. If the unwary traveler decides to walk on these as on the stones of a ford crossing, he finds them slippery and insecure, they turn under his foot, and give him the experience of a twisted ankle; while, on the other hand, if he should endeavor to walk between them he runs a fair chance of tripping upon those hummocks and falling headlong in the oozy moss. Indeed, he can hardly walk at all.



Photograph by U.S.G.S.

THUS FAR WITH THE BOATS, AND NO FARTHER!

The beginning of a portage at the summit of a divide; often a road must be cut through the brush.

The portage took two days, Rivers making a forced march, and the cook was left at the new camp with the first day's supplies, the carry being to Cache Lake, a large slough which forms the headwaters of the Anaktuvuk River. Early the next morning the rest of the party returned to the old camp, where they had left the canoes, to bring them over to the Lake for their trip down to the Arctic Ocean.

Towards evening, as they were returning, and had just ascended a little knoll, Roger hurried up to the chief of the party.

"Mr. Rivers," he said, "there seems to be a lot of smoke over there, in the direction of the camp."

The geologist looked up sharply and then turned.

"Quick, boys," he said, "take the boats to that pond"--the tundra was dotted with small stretches of water--"and anchor them in the middle. The tundra is on fire, and if it's going to spread the boats must be saved. Harry, you go ahead to the camp." He dropped his pack and broke into a run.

Bulson, grasping the situation, stuck one of the punting poles deep into the shallow bottom and made fast the canoes to it in the middle of the slough. Then, with the rest of the men he followed the Indian and the chief for the camp. Roger's light weight and his training on the track had made him a good runner, but he did not try to outdistance the other men, and of course Harry was out of sight.

Plunging over and through the tundra, however, with veins swollen almost to bursting with the heavy going, the men kept on, no one speaking, though once, as a sheet of flame shot up, Gersup pointed with his finger. It was a welcome sight, on topping a small rise, to see in the distance that two of the three tents were still standing, though ringed round with a smoldering fire; in the foreground the blackened figures of the cook and the Indian, working for their lives, and the chief just pounding into the camp. With never a pause, save when some fellow tripped and fell, the men tore over the rough ground until they reached the flames. Under the vigorous work of all hands an impression began to be made, and two hours later the fire was under control.

"How did it happen, George?" the chief asked.

Twice the cook tried to answer, but the pungent smoke and the exertion had made him almost speechless, and he could only whisper hoarsely. Though the fire was officially out, every few minutes a puff of smoke would reveal a smoldering root of moss, and all night through two men watched, two hours apiece, to see that it did not break out anew. And these men never had five minutes' quietude, for the fire, which had been burning unseen in the network of roots for hours, would suddenly send up a flame, and the whole line of that smoldering glow would have to be beaten and drenched out.

As the cook described it later, the fire did not appear for over an hour after the party had left, and when the smoke first

arose, he did not pay much attention to it, merely thinking that it was one of the circles of "smudges" which had been lighted the night before all round the camp to keep the mosquitoes away, and which had not been properly put out. He looked up a couple of times, but not for another hour did he notice any change, and then he saw a faint vapor rising near the first.

Thinking by this time that it might be as well to go and keep the fire from spreading, he strolled over to the column of smoke. But he had not come within thirty feet of the place when he found that he was walking over a glowing furnace, the tundra being red hot between the green moss above, which would not burn, and the wet roots below. Each step he took, of course, put out the fire under his footstep by pressing the glowing moss into the substratum of water, but it created a current of air to the moss around that footstep, and looking behind he saw smoke arising from every impress of his foot.

At this point he became alarmed, and instead of making a circle around the camp of moss thoroughly beaten down and soaked, he started to try to beat out the existing fire, an almost hopeless task, for the reason that the flames crept under the surface unseen and almost unfelt, only betraying their presence by a faint film of vapor. By the time that he realized that he should have devoted his energy to making a fireguard around the camp, the tundra was burning too close to the tents for him to be able to dare stop checking it long enough to start protective remedies.

In spite of all his labor, however, the fire reached one of the smaller tents, where some of the maps were kept, and the dry canvas and mosquito netting, catching alight suddenly, went up in the air as though it had been a fire balloon, and blazing fragments of the tent, falling on the tundra about, gave source to a dozen more fires. George rushed over the red-hot tundra and carried the maps, which, though scorched, were not badly injured, to the main tent, and then devoted himself to encircling that tent thoroughly with beaten and wetted moss, watching to see that no spark crossed and that no treacherous fire crept along between the roots of the moss.

Matters were at this point when the Indian appeared, and with one man watching the tents and the other beating out the fire progress was made, the danger being entirely averted when the whole party arrived. The peril over, the other members of the party went back for the canoes, bringing them into the camp late in the evening.

The next morning all boarded the canoes to cross Cache Lake, which, connected with a score of other sloughs, led to the initial streams of the Anaktuvuk, the main tributary of the Colville, which latter river flows into the Arctic Ocean. They had paddled perhaps two miles when the Indian gave a guttural grunt and pointed to the shore that they had left. There, rising high in the clear air, was a column of faint blue smoke.

"They say you can't put out a tundra fire," said Rivers, "and I begin to believe it."

"Then how long do you suppose that will burn?" asked Roger.

"Until the winter puts about a foot of snow over it, I suppose," the geologist answered, "and it'll hate to quit even then."



CHAPTER XIX RACING A POLAR WINTER

The comparatively flat plateau country, dotted with sloughs, on which the party had embarked after leaving the camp on the tundra, where they had been forced to fight with fire to save their possessions, lasted but a short while on the journey. Before evening the edge of the table-land was neared and the scattering rivulets drained into a narrow and swift stream, which Roger learned was the Anaktuvuk. Rivers, though conservative in manner as always, was obviously delighted at the thought that all the hard up-stream labor was at an end, with the expedition well ahead of its time, and many important details, topographical and geological, discovered.

It was a matter of absolute ease to float down the smoothly flowing Anaktuvuk, and for the first two days the only disadvantage to life were the clouds of mosquitoes. But the third day these pests disappeared in time to allow the voyagers to pay due attention to a troubled piece of water, as the stream shot down the northern slope of the Arctic Rockies through gorges and canyons of no little height.

The pitch of the stream Roger saw to be very great, but his skill as a canoeist was not heavily drawn upon, since the bed of the stream was little impeded, save for a few boulders at scattered intervals. But despite the smoothness of the stream, the banks overhung the river so far as to cause a most unpleasant sensation of fear. It seemed to the boy every minute as though the pendent masses of earth and rock would fall and overwhelm them, and the boy could tell, from the anxious glances cast overhead by Rivers, that the same thought was disturbing the chief of the party.

About two o'clock in the afternoon of the third day they ran through a long gorge of this undercut character, and one, moreover, from which little trickling muddy streamlets showed that the frozen ground was thawing under the hot August sun. Roger, as usual, was in the leading boat with Rivers and Bulson, the Indian being in the stern. Suddenly the boy heard a warning cry from the other boat, and looking overhead, saw a mass of snow and earth detach itself from the top of the cliff four hundred feet above them and thunder down directly for the boat.

Simultaneously the boy felt Harry reach forward for a long stroke and, turning, saw Rivers dive from the boat. Bulson, who was also paddling, put his superb muscle into his stroke, and though Roger felt like following his chief's policy and taking to the water, he stuck to his post and made his paddle bite hard on the water. The canoe sprang ahead like a cannon ball, but a second later, with a dull roar the landslide struck, just the edge of it catching the boat. Roger was conscious of a grinding crash, and then a blank.

When he came to his senses a few minutes later he found himself stretched upon the bank and Rivers bending over him. He lay still for a moment and then became deathly sick, noting the looks of concern on the faces of the party. In a few moments he felt better and tried to sit up, but Bulson placed his large hand on the boy's shoulder and bade him be still.

"Where's Harry?" was Roger's first question, his last impression before he went under with the ruins of the canoe having been that of seeing a piece of rock falling straight for his comrade's head.

"All right," answered the Indian composedly; "jump heap quick, though."

"You certainly did, Harry," said another of the members of the party. "I could have sworn that the rock hit you."

"No hit at all," was the quiet reply.

"And Bulson?"

"Bulson liked it," broke in Magee; "sure the whole Rocky Mountains could fall on him, an' he'd like it for a regular exercise before breakfast."

"I guess I'm all right, too," said Roger, and seeing his anxiety to sit up, they let him rise. He patted himself all over and then laughed. "I suppose I'd feel it if anything was broken," he said, "so it must be O. K." He got on his feet.

"Did you get out of it all right, Mr. Rivers?" went on the boy, turning to his chief. "I'm not sure, but I think I saw you dive."

"Yes," answered the geologist, "and it's lucky I did, for one of the rocks struck the very spot where I was sitting. I thought it was coming, and that's why I jumped. You're sure you feel all right?"

"Sure," said the boy. "I lost my wind, that's about all."

Rivers smiled. "You're lucky," he said, "in having been stooping over when the slide struck, because if it had taken you

in the ribs or chest instead of the back, you'd have had some internal injury for sure. But since it struck you in the back, and you don't feel any special pain, your spine hasn't been hurt and nothing else can be, you must be all right."

"I suppose the canoe is smashed!" the boy said questioningly.

"The boat's at the bottom of the river, with a few tons of earth and rock and snow on top of it."

Roger's expression changed suddenly.

"But the maps, the plane table, all the work!" he exclaimed, "you don't mean that everything is lost!"

"Do you suppose," answered the chief, "that I should be satisfied if those were gone?"

"Then how were they saved? I don't understand," put in the boy, mystified.

"I grabbed the oilskin bag with the maps when I went over the side," replied Rivers, "and Bulson hurled the plane table backwards over his head, so that it fell in the water for the other boat to pick up. But all the instruments are gone, of course, and a good many of our specimens."

"It's a good thing," put in the topographer, "that I made a little duplicate for my own collection."

"Yes," answered the chief, "it might be a whole lot worse than it is. It's a mighty fortunate thing that no one was badly hurt."

"And I'm mighty glad," said Roger, "that my camera and all the negatives were in the other canoe. But now that we've only got one boat, how shall we get down the rest of the way?"

"In the boat. We shall have to throw everything away except what we can't do without, and live on short rations. One of the guns is left, and there are plenty of fish in the river, so we probably will get along all right until we strike the Eskimo settlement on the delta of the river."

"And if we don't strike it?" asked Roger.

"Well, if we don't, you'll be pretty hungry. But we'll strike it, all right, you'll see."

So the party proceeded to lighten their only canoe. Everything which was of weight and not absolutely essential was cached and a cairn built over it, not with any intention of coming back, but so that it should be available if any other traveler should ever pass that way. Since it was so difficult to transport provisions and camp conveniences at such a distance, it was felt that it would be sheer wickedness to let anything be destroyed.

"But people might steal it!" exclaimed the boy.

"To take what you need isn't stealing in this country," answered the geologist. "You are supposed to help yourself if you are in need, and you are expected to give to the uttermost if you find any one else in need. This part of the world is too far away from civilization for any 'dog eat dog' methods. Here, being uncivilized, men are more or less charitably disposed toward each other."

"That's a cynical speech, Rivers," said the topographer.

"Cynical or not, it's true," the chief answered.

"Sure, it's true," commented Magee, who had been listening. "If I'm hungry in a big modern city, and I open a man's door, walk to his pantry, feed myself and a dozen hungry men; and what's more, walk away with enough provisions for a month, where would I land?"

"In jail," said Roger.

"Sure, an' I would. But that's what you can do out here."

"Well," said the chief, "I wish I were sure of being able to do it at Nigaluk."

Travel, however, was very different in the one over-loaded canoe, and Rivers was not willing to allow any chances to be taken. The slightest evidence of shoal, rapid, or boulders meant wading. For the next three days, therefore, two men, each at one of the bows of the canoe, waded down the stream, finding out, with their shins mainly, where were boulders near enough to the surface of the water to strike the canoe.

On the second day of this sort of work, moreover, the temperature dropped fifty-two degrees in about six hours, and from a hot sun and humid air with a thermometer at eighty-eight degrees at noon, by dusk it was only four degrees

above freezing with a driving gale and a stinging rain. While many camp conveniences had been left behind to lighten the canoe, a strip of canvas had been retained, and this was propped up with willow sticks in such wise as to keep some of the rain off.

But through the night the gale howled from the north, and the rain drove in with the sharpness of a whip-lash, so that the first faint light of dawn found every one ready for the start, as at least it was warmer moving about than lying under that pitiless sky. The only gleam of comfort was that it gave one day's respite from the eternal mosquitoes. The second day the norther abated, and fair weather returned, bringing with it, of course, the close personal attention of the mosquitoes of the lower tundra, though these were rapidly thinning out.

A couple of days of smooth water enabled the use of paddles and fair time was made, but after the junction with the Telugu River more shallow rapids and boulders were encountered, leading to more days of wading, continuing until they struck the main stream of the Colville, a river with a big head of water. But these various difficulties had delayed matters considerably, and not until August 10th did the divergence of the channels of the river show that the delta of the Colville was reached, where they hoped to find the Eskimo village of Nigaluk.

"What kind of a place is it?" asked Roger, as they encamped for the night.

"It is the metropolis of the Arctic Ocean," said Rivers with a smile; "the biggest city between Point Barrow and Hudson's Bay."

The boy was not taken in by the description, for he had a lively remembrance of Alaskan centers of population, and knew that anything more than four huts was considered as a post of no small importance, while one hut, all by itself, was deemed worthy of a place on the map. But though he did not expect a large place, he watched eagerly enough the next day for this Arctic city, wondering what kind of houses would be built to withstand the rigors of an Arctic winter.

But the solitary canoe went on and on, up this channel and down another, and still no village was seen. All the next two days the party searched, but to no purpose; apparently the Arctic metropolis was not there. The matter was extremely serious, for the provisions were almost exhausted, and on the evening of August 12th the wind switched again to the northward, and the first of the winter's snows hurled itself at them.

"If this is the middle of August!" exclaimed Roger, shivering, "what must it be like here in the middle of January?"



Photograph by U.S.G.S.

WINTER'S THREAT ALMOST FULFILLED.

The shores of the Arctic Ocean, where the tundra-covered coastal plain extends unbroken for thousands of miles.

"Nobody knows exactly," was the geologist's reply, "for no white man has ever wintered here. We shall be the first unless we find Nigaluk in a hurry. And I doubt if we can spare the time, so to-morrow we will have to go down this channel to the ocean. I don't like this weather, for if the winter sets in early we may be caught even yet."

But when, the next day, the party arrived at Harrison Bay, at the mouth of the river, Roger's heart sank within him at the prospect. Cold, bleak, and gray, the waters of the Arctic Ocean stretched before him, a steady swell breaking on the tundra shores that line it without a break for hundreds of miles. The wind, blowing from the north, was kicking up a vicious, snappy sea, the tops of the waves showing their teeth, and upon the horizon the white blink of the ice.

Bad weather, a choppy sea, an Arctic winter setting in, and nothing but an overloaded Peterboro canoe to hold seven men, it was a bad outlook for the party. It was over two hundred miles to Point Barrow and the time of storms was at hand. Rivers called the men together.

"Boys," he said, "so far the trip has been very successful, but owing to that pesky landslide on the Anaktuvuk, with the loss of a boat, it looks as though we were going to have a tight run for home, and we shall have to show a burst of speed. Now there are only three possible things to do, and I'm going to put them before you and see what you think about it, because whatever is done must be done without delay."

"And what are those three?" asked Gersup, as second in command of the party.

"The first of these is to make a camp here, and to chase up and down the various channels of this delta until we find Nigaluk. If we locate it, we can get provisions and boats, or if the weather is bad, dogs and sleds; and, by one means or the other, can get to Point Barrow, or even down as far as Cape Smyth. The objection to that is that we have no definite data as to where Nigaluk is. It may not be on this river at all, but on some other stream flowing into the ocean near by, which has been confused with the Colville."

"Not only that, Mr. Rivers," answered Gersup, "but the channels of this delta may have changed and these Eskimo settlements are not very permanent, in any event."

"That's true," rejoined the chief. "Well, it is obvious that the canoe is not enough for us to get to Point Barrow, but it might serve to carry provisions, so that if we could track along the shore, with, say, one man in the boat to keep her out of the surf, it might be possible to get there, though, with rounding the indentations of the land, it would be over three hundred miles. What do you think, Harry?"

The Indian shook his head.

"No can do," he said, "wind drive boat on shore. Smash."

"The only thing that's left then," the chief of the party continued, "is to pack the entire distance, depending for food on what we can catch or shoot. I suppose we'd have to portage the canoe because there are several small streams along the way. Of course, in a couple of weeks, the frosts will set in, and the tundra won't be so bad to travel over. But it's a long way."

"It's the longest way, but the surest," said Gersup; "as long as we don't run short of provisions. How about it, George?"

"Not counting anything you bring in," replied the cook, "I can give you rations for ten or twelve days. But there seem to be signs of caribou, and though the geese and ducks are thinning out, they are probably good for a couple of weeks yet, before all are gone. Then there's always fish. If everything goes right, we ought to be able to make it."

"Very well then," decided Rivers, "this is what we will do. Unpack the canoe, let Harry and Doughty take provisions for two days, and with the canoe light, spend every minute of daylight searching for this place Nigaluk, returning to camp by nightfall the day after to-morrow, if they have not found it. In the meantime we will do some hunting and fishing, and try to build up a store of provisions."

"But how shall we be sure of finding you again?" queried Roger. "If this Nigaluk is so hard to find and the channels of this river are a regular maze, we might lose the camp, and then we would be stranded without any grub and without a gun, and you would be left without a boat."

"We'll keep a big smudge going, of course," said the chief; "I had thought of that. Now you two had better turn in, and we'll unpack the canoe and get it ready. I'll have you called early so that you can have breakfast and start off even before it gets light, because for a few miles, anyway, we know Nigaluk isn't there."

The next morning, before it was light, Harry and Roger were in the canoe, and they started off on their hunt for Nigaluk, up this channel and down the other. Harry was paddling for all he was worth, and the boy found it hard labor to keep up, but at their noon stop nothing had been found. As it was growing dusk, however, the Indian gave a grunt and pointed ahead, and Roger, giving a shout of joy, saw before him the outlines of a structure. But on arrival, they found nothing but an Eskimo grave, erect on four driftwood spars. Near by a tiny channel meandered through what appeared to be an island, and though it was now almost dark, Harry turned into this, and in a few minutes there sprang into view

a group of not less than twenty huts.

But no dogs barked as they came near, no fires smoked, no boats lay on the beach, and Harry, even before they landed, gave a disappointed grunt.

"Heap gone," he said, then as his keen eye discerned through the shadows evidences of recent occupation, he added, "not gone long!" He stooped down as they landed, and picked up a little fish, only a few inches long. "This caught to-day," he said.

Roger's heart gave a bound.

"Then they can't be far away," he answered.

"Not far. Find to-morrow," and the Indian went on to explain to the boy the usually slow movements of the Eskimo, and their readiness to camp every few miles. He pointed out also that the channel through which they had come had an abandoned look, and that therefore the route to this camp must have been in the other direction. Since winter was drawing on, moreover, he argued that the natives would not be going up the river, and therefore, if they followed the other channel and turned seaward the next day, they might overtake the Eskimo.

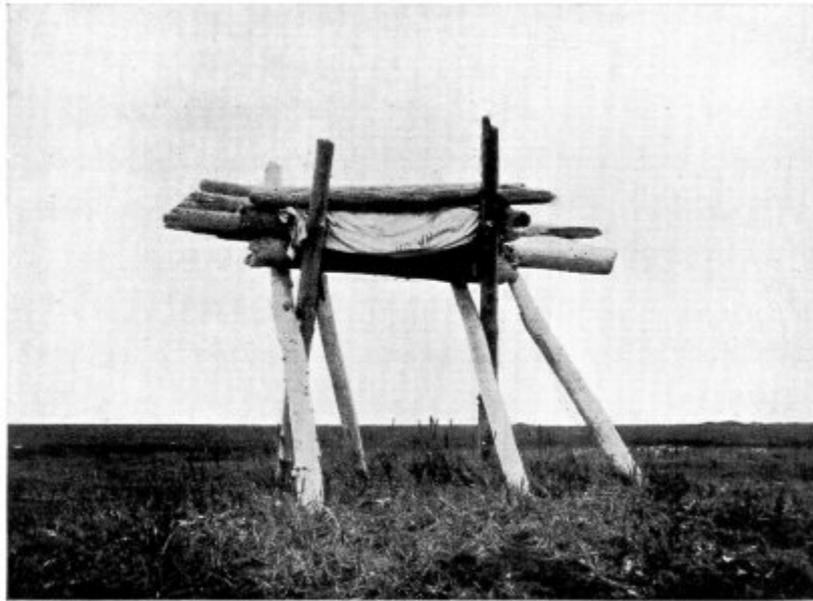
This was a stern chase, and Harry routed the boy out when it was still pitch dark, and they started slowly down the other channel, looking for the first turn seaward. Just as the first faint gray showed in the sky, the opening appeared and the canoe shot down it. Dawn is very gradual in those latitudes, and steadily the light grew clear and the canoe began going through the water like an express train. Confident in his own idea, Harry turned neither to right nor left but made the light boat fairly fly.



Photograph by U.S.G.S.

ESKIMO SAVIORS.

A group of the tribe that took the party in their umiaks, near the prized canoe.



Photograph by U.S.G.S.

POINTING AWAY FROM WINTER.

The Eskimo grave that led the party to the village, and thence to rescue and safety.

By midday Roger was ravenous, but the Indian shook his head when a moment's stop was suggested and an hour later, when the boy was ready to drop, they turned into a large inlet and saw ahead of them a party of Eskimo in their umiaks, eleven boats in all, each containing from three to six persons. The umiaks, large skin-covered boats made for the Arctic Ocean fishing, are extremely staunch and fairly swift, but as compared to a light well-seasoned canoe in the hands of two experts, they were little better than mud scows.

The sight of the umiaks and the knowledge that this might make or mar, to a great extent, the resources of the party, put ginger into Roger, and the way in which that little boat was urged over the water was almost incredible. To the natives, who had never seen anything but craft of their own making, and the heavy staunch boats of whaling steamers, the speed was little short of magic. Harry and Roger overtook them as though they had been standing still.

The party of Eskimo was on its way to Point Barrow, where most of the natives expected to winter, and as they planned to trade, had an interpreter with them. To him Roger explained their needs. But the natives showed little desire to take the travelers in their boats over the long sea trip, and the boy, knowing the urgency of the case, was at his wits' end. Indeed the Eskimo were just about to paddle away to the open sea, where the little canoe would scarcely dare to follow them, when Harry said suddenly:

"Good. You offer give canoe."

"You mean in exchange for a passage to Point Barrow?" said Roger, seeing the plan. "Good scheme, I'll try it."

He turned to the interpreter, and pointed out that if they would give them provisions and take them to the cape, not only would they get money, but that the great chief would give them the swift boat as a token of kindness. But the boy hardly expected that the offer would create the excitement that resulted.

The very thought that this magical, fast-speeding little boat might become the property of the tribe excited the occupants of all the umiaks. Boat races, it appeared, were the only sport in Arctic waters, and if this tribe had such a boat as that they could be the champions of the Arctic seas. There was no further hesitation, and with eagerness the whole party hastened to where the camp had been pitched, the smoke leading the way without much difficulty. On the way they learned that Nigaluk was further west, on an arm of the delta which branched off quite a distance higher up the river, and that the settlement they had found was a comparatively new place, as yet uncharted.

Bad weather came, and several days were lost by storms, so that the trip, even in the Eskimo umiaks and under the conditions the natives knew so well how to overcome, was by no means easy, and Roger shivered at the thought of the terrible experience he would have had to face, if they had not overtaken the Eskimo boats. The canoe, which was being towed behind the largest umiak, was almost a fetish for the natives, and the way it rose to every wave, never shipping

even a drop of water, to them was a constant source of delight. They jabbered the whole trip through of their sure success in the races of next season.

Camping along the shore was difficult, as no wood except a few occasional sticks of driftwood was procurable, and the water, while plentiful, was uniformly brackish. But trouble was not to let them go so easily. A steady and heavy gale set in from the northeast and the ice-pack began to drive.

Then the Eskimos gave a taste of their staying qualities. For fifty-four consecutive hours their paddles never ceased a second, one man in each boat eating and resting while the others paddled. The Survey men took their turn at the labor, and trained to endurance as they were, they competed well with the untiring swing of the Eskimo paddle, and gained the admiration of the natives. For the last four hours it was a flight for life that kept every nerve alert and tense, and the ice-pack was not fifty yards from shore when the boats, paddling furiously, rounded Point Barrow. Half of them ran into the little Eskimo village of Nuwuk, just at the extremity of the point, but the others took the Survey party to the main settlement, where a store, a mission church, and a post-office bespeak the habits of the white man.

With steam up and all ready to start, lay with her anchor on a spring the little revenue cutter, fearing the ice, now only stayed from further advance by the projection of Point Barrow, the easterly bent of the wind having so far left open water. The steamer's boat was waiting as the umiaks ran in, for they had been sighted some hours before. The few necessaries of the party, the maps and records were trans-shipped without delay, the natives duly paid and rewarded, mail secured, and in less than ten minutes from touching the shore the men were on board the cutter.

As they went up the ladder and set foot on deck Rivers turned to Roger, who had followed him, with the rest of the party.

"We're back, boys," he said, "and you've stuck right to the end. No man could ask finer comrades on the trail," he put his hand on the boy's shoulder; "men, every one of you, and the boy as good a helper as any one could wish to have."

THE END

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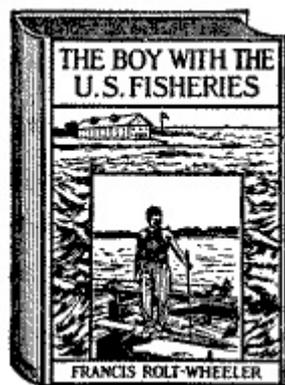
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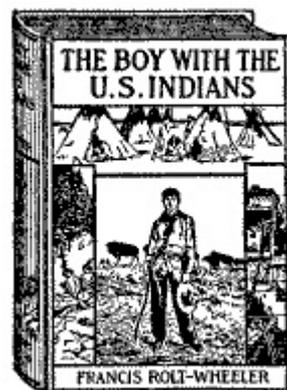
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