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Author: Francis Rolt-Wheeler

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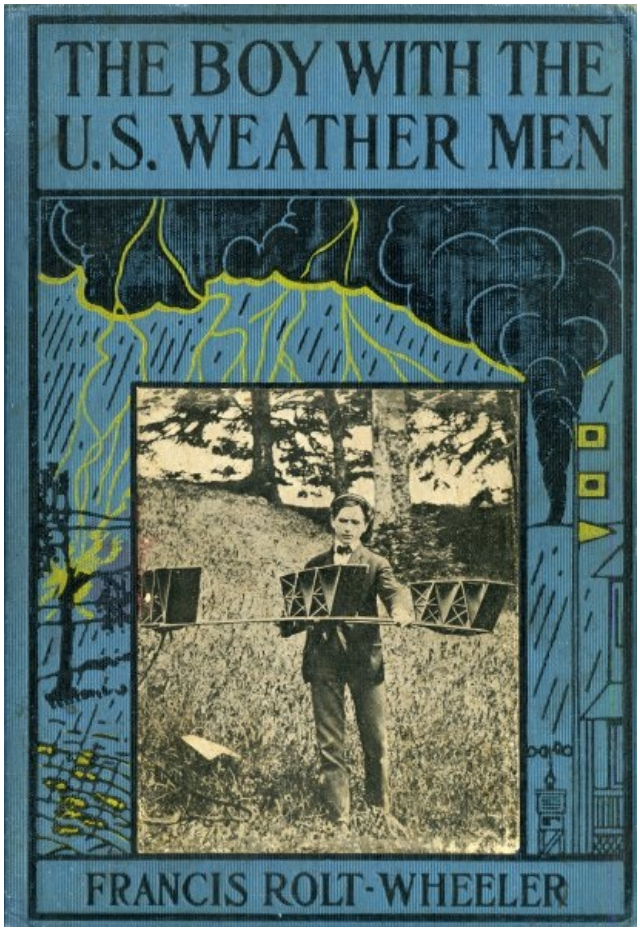

U. S. SERVICE SERIES.

THE BOY WITH THE U. S. WEATHER MEN

BY FRANCIS ROLT-WHEELER

With Seventy-two Illustrations from Photographs

BOSTON
LOTHROP, LEE & SHEPARD CO.

THE FUNNEL OF DEATH.
Photograph of a tornado in Kansas, taken less than a minute before it struck the point where the camera had stood.
(This is one of the best tornado photographs in the world and has not been retouched.)
Courtesy of Geo. S. Bliss, U.S. Weather Bureau, Philadelphia, Pa.

Published, September, 1917

THE BOY WITH THE U. S. WEATHER MEN

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PREFACE

The savage fury of the tempest and the burning splendor of the sun in all ages have stirred the human race to fear and wonder. All the great stories and legends of the world began as weather stories. The lightnings were the thunderbolts of Jove, the thunder was the rolling of celestial chariot-wheels, and the rains of spring were a goddess weeping for her daughter, Nature, held a captive in the icy prison of Winter.

We know a great deal more about the forces of the Weather than the ancients did, yet we know but little still. The hurricane does not come unheralded to our shores, the freezing grip of a cold wave is forecast in time to enable us to fight it, the lightning is tamed by the metal finger we thrust upward to the sky. But the tornado sweeps its funnel of death over our cities in spite of all we do, the cloudburst falls where it will, and rivers rush to flood with the melting of the snows upon the distant mountains.

There is no battle greater than the battle with the Weather, which is both our enemy and our ally. Death and disaster are the price we pay for ignorance. Great victories have been won by knowledge. Galveston's sea-wall dared and defeated the hurricane, the levees of the Mississippi have held captive many a flood, and our myriad spears of defence have snatched at the power of the lightning flash and hurled it harmlessly to the ground.

We are not slaves to the demons of the Weather, now—not as we once were. The United States Weather Bureau, day by day, draws closer and closer the chains which bind the untrammeled violence of sun and storm. High, high in the atmosphere, is a world all unexplored, where no man can dwell; where, as yet, no human-made instrument has reached. This unknown world calls for explorers, it calls for adventure, it calls for daring and patient work. It is for Man to tame the forces of the sky, and tame them he must and will. To show how much the Weather Bureau is accomplishing, to depict the marvels of its work, to portray the ruthless ferocity of the forces as yet uncontrolled and to reveal the gripping fascination of this work, in which every American boy may join, is the aim and purpose of

THE AUTHOR.

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THE BOY WITH THE U. S. WEATHER MEN

CHAPTER I

ADRIFT ON THE FLOODED RIVER

"What is it, Rex, old boy? What are you after? Somebody else in trouble, eh?"

Ross looked down through the pouring rain at his Airedale, who was pulling at his trouser leg with sharp, determined jerks. The dog looked far more like a seal than a terrier, his hair dripping water at every point, while a cascade streamed from his tail. The boy was every whit as wet. Here and there, through the slanting lines of rain, could be seen the smoky gleams of camp-fires, around which, shivering, gathered the hundreds of people who had been rendered homeless by the flooded Mississippi.

The lad turned to his father, who was bandaging a child's wrist, which had been broken during the work of rescue.

"It looks as if I ought to go, Father," he suggested, "that's if you don't mind. By the way Rex is going on, there's something up, for sure."

"Go ahead, then, son," his father agreed, "the dog's got sense enough for a dozen. Watch out for yourself, though, and don't get foolhardy," he added warningly, as the lad disappeared in the darkness; "you've got to be right careful when the Mississippi's in flood."

"I'll watch out," Ross answered reassuringly, as he started off with the dog, and, a moment later, the glow of the camp-fire was blotted out in the falling rain.

"This is your hike, Rex," announced the lad; "you lead and I'll follow."

The Airedale cocked up one ear on hearing his young master's voice, then, putting his head

knowingly on one side, as if he understood every word that had been said, he trotted to the front and splashed through the pools of mud and water, his stump of a tail wagging with evident satisfaction.

Ross was used to all kinds of weather, but a downpour such as this he had never seen before. The rain fell steadily and relentlessly, with never a pause between. The night was too dark to see clearly, as the sheets of water were swept before the wind, but their force was terrific. Several times the boy had to turn his back to the driving storm and gasp, in order to get his breath.

"Where are you going, old boy?" again queried Ross.

The terrier paused, shook himself so that the drops flew in all directions, looked up in his master's face, gave a short sharp bark and trotted on.

Ross leaned down, patted the dog, and followed. By some instinct of his own, the terrier was keeping to a submerged road, though how he managed to remain on it was beyond the lad's comprehension, for the night was as dark as a wolf's throat and the path was under water half the time.

Suddenly the dog stopped and looked back as though for guidance. Before them was a swirl of water. In the darkness it was impossible to say how deep the wash-out might be, or how wide. Ross hesitated. His father had warned him against foolhardiness, and here he was facing the crossing of a swift current of unknown depth on a pitch-black night. Should he venture?

Rex barked, a short excited "yap" of urgency.

"I'll go as far as I can wade, anyhow," said Ross in response; "maybe it isn't so deep after all. I'm not particularly anxious to have to swim."

The terrier watched his master, and as soon as the boy started to cross the wash-out in the road-bed, the dog plunged in. The current swept him down rapidly, but Rex was a powerful swimmer and the lad had little fear for him. It took all his own strength to keep him from being swept off his feet, but the break in the road was not more than six yards across, and the boy was soon safe on the other side. He whistled shrilly and a moment or two later, Rex came bounding up and jumped on his master with clumsy delight. Then, with another cock of his head, as though to make sure of himself, he took up his position in front of the lad and trotted ahead.

How it rained! The water had gone down Ross's neck and inside his shoes, so that they sloshed and gurgled with each step. Little rills of water trickled coldly down his back and legs. The wind was dropping, so that the rain drove less in slanting sheets, but it seemed to pelt down all the more heavily for that. Even in the darkness, Ross could see the plops, where the drops fell, standing up from the surface of the flooded water like so many spiny warts. It was lonely, even with Rex for company, so dark and so wet was the night, and Ross was glad when the glow of a fire in the distance told him that he was approaching an encampment, probably, he thought, that of another group of settlers who had been driven from their flooded houses and were shivering, homeless, in the night.

When he arrived near enough to take in a full view of the scene, however, he found it very different from what he expected. True, there was a large camp-fire burning, such as the one he had left, and around it were gathered a number of women and children, cold, hungry and wet. A rough, lean-to tent, made of a sheet of tarpaulin, had been stretched in order to try to keep off the worst of the downpour, but no shelter availed.

A few steps farther, on the river bank, was a scene of excitement and commotion. A large gasoline torch flared into the night, defying the efforts of the storm to extinguish it, and by the light of this torch, scores of men were working busily, almost crazily, repairing a cave-in that threatened every moment to make a new break in the levee.

"Who's that? Another man?" rang out a clear, strong voice, as Ross came near. "Good! We need men badly, right now."

"It's me, Mr. Levin," answered the boy promptly, as he recognized the voice, and hurried into the circle of light, "it's me, Ross Planford."

"Howdy, Ross," came the greeting in reply, "all your folks safe?"

"Yes, sir," the boy answered. "It was a narrow shave, though. Rex got us out just in time."

"Good dog, that," was the terse comment. "I always did like Airedales. Well, Ross, it's time you got busy. Bring me a pile of empty bags from Dave's sugar-mill, there."

"Yes, sir," answered the lad, and darted off towards the factory.

Rex followed at his heels, and when, staggering back with his load, Ross dropped one of the empty bags, the terrier picked it up and came trotting after, carrying it in his teeth.

"I dropped one, Mr. Levin," said the boy, "I'll go right back for it."

"You don't need to," replied the Weather Forecaster, "your pup retrieved it for you. See?" and he held up the missing bag.

The engineer in charge of this section of the Mississippi, whose duty it was to guard the artificial

banks or "levees" of the river, was working on the main break in the levee, with a huge gang of men. In this crisis, one of the planters, who formerly had been the local Weather Bureau official, had offered to take charge of the new threatened source of danger.

At his request, Ross busied himself for some time in bringing empty bags, which were then filled up with sand and dumped into the cave-in. Being in bags, the washing action of the water could not carry away the sand, and the gradually crumbling bank again was made firm. After a while, however, Ross again felt the dog tugging at his trouser leg and he realized that the mission on which he had started had been forgotten in the excitement of mending the crack in the levee.

"That's right, I was forgetting," said Ross aloud, and he appealed to his friend the Forecaster.

"Mr. Levin," he said, "can you spare me for a bit? I left Father's camp because we thought there was something wrong. Rex kept on tugging at my leg, as though he wanted to lead me somewhere. He's worrying again, now. Do you mind if I go ahead and see?"

"Not a bit," was the hearty answer, "a dog doesn't generally go on like that without some reason of his own. I'll send one of the roustabouts with you, if you like?"

"No, thanks, sir," the lad answered, "if I really need help I'll come back and ask for it. Right now, I just want to find out what it is that's bothering Rex."

"Off with you, then," said the other, kindly, "but go easy. Oh, and Ross!" he added, "if you're going down stream, just keep your eye on the levee, won't you? If you see any signs of trouble, get back on the double-quick. Don't try any of that story-book business about sitting down with your back to a hole in the bank. That sort of thing may be all very well in Holland but it wouldn't work with the Mississippi."

Ross grinned, remembering the story.

"All right, Mr. Levin," he answered, "if I see anything that looks like trouble, I'll come right back and report."

For a short distance down the river, Rex led the boy along the levee, then he branched away from the river bank towards a large stretch of low-lying land. This was familiar territory to Ross, for one of his best chums, a little crippled lad, lived in a house in the hollow.

"I hope Anton got out all right!" suddenly exclaimed Ross, half aloud, as the thought swept over him of the plight in which his chum might have been.

This fear became more poignant when, as Rex reached the path that led up to Anton's house, he turned up it, half trotting and half splashing his way through. Ross followed him closely, breaking into a run himself, as the dog galloped ahead.

There was a slight rise of the ground, near the wood below which lay the house, and from this shallow ridge the rain ran off in muddy gullies that were miniature torrents. This ridge reached, Ross looked down over the hollow toward the house. The entire plantation was a sheet of water, and, in the middle, still stood the house, the water half-way up its first story.

Rex set his forelegs firmly on the ground and barked fiercely, with loud, explosive barks that rang through the storm like the successive discharges from a small cannon.

Then, out of the rain, faintly through the distance, a shout was heard. It sounded like a boy's voice.

"It's Anton!" cried Ross. "He's been left behind! And that house is apt to go to pieces any minute!"

The first thought that sped across his mind, as he peered through the darkness to the dim outlines of the white house, was to hurry back to the Forecaster for help. Even as this thought came to him, however, Ross realized that such action might be of little use. Already the waters of the flood, swirling around the house, undermined it every moment, and it would take a long time to portage a boat all the way from the levee to the hollow, now in the wild sweep of the torrent.

Then Ross remembered that, a couple of years before, when a wet summer had caused a considerable quantity of water to gather in the hollow, forming a small lake, Anton and he, together with the rest of the boys, had built a rough boat. They had played the whole story of "Treasure Island" in this craft, Anton, with his crutch, taking the part of Long John Silver. The boat was a rough affair, as he remembered it, something like an ancient coracle, but it had been water-tight, at least. Perhaps it would be sea-worthy, still. At least, it was worth a trial.

Turning his back on the building that was islanded by the flood, Ross raced as fast as he could to the little block-house on the ridge that the boys had built two years before, near which he hoped to find the boat. Twice he stumbled over a root in the darkness and fell headlong into the mud and water. Still, as he could not be any wetter than he was already and as he did not hurt himself, a few falls were no great matter.

On the ridge, fast to the block-house, to which level the water had not yet reached, Ross found the boat. Moreover, to his great delight, he saw that Anton had been patching it up, so that it was now more serviceable than ever.

It was a different matter, punting this home-made boat around the waters of a pond on a calm summer's day, and striking out with it in a blinding storm across the flooding lowlands of the

Mississippi River. Again his father's warning not to be foolhardy, came to Ross's remembrance, and, together with it, the Weather Bureau man's caution. None the less, the boy knew well that his father would never bid him hold back from a piece of work that was dangerous or difficult when life was at stake.

The boat was half full of water from the pouring rain. Ross bailed it out with a cocoanut-shell to which a handle had been affixed, evidently a home-made bailer of Anton's manufacture, and, as soon as it was clear of water, dragged it to the border of the current and launched it. The craft floated crankily, it was true, but it floated, and, so far as the boy could tell, it seemed fairly water-tight.

Jumping out again, Ross swung himself into the water and shoved the boat along beside him. He saw the value of wading as far as possible, for he knew that, as long as his feet were on the bottom, he could govern his direction. To what extent he might be able to stem the current by the use of oars in a boat of that character, he did not know.

Rex, however, was convinced that the boat had been secured expressly for him, and, as soon as Ross came near enough to the shore, the dog bounded through the shallow water in long leaps, swimming the last few feet, and put his paws on the gunwale. Ross picked up the terrier and heaved him into the boat. Rex gave a snort of satisfaction, shook himself so that he sent a trundling spray of water clear in his master's face and then took his post in the bow of the boat and set himself to barking with all his might and main. It seemed almost as though he really knew that he was at the head of a rescue expedition and wanted to convey the information. When at last Rex ceased barking, which was not for some minutes, Ross gave a shout.

Instantly, at one of the upper windows, something white appeared. In the darkness the boy could not tell what it might be, but he guessed, and rightly, that it was Anton's shirt, and he heard again, though faintly, the answering call across the river.

"Keep up your nerve, Anton," he yelled, through the storm, "I'll be over there in a minute."

Faintly, again, came the answering cry,

"Hello, Ross! Is that you? I wondered who it was that was coming."

The slow progress made by shoving the boat along, however, was not at all to Rex's liking. He turned and looked at his master doubtfully, then barked again. To his disgust, in turn, the boy found that the slope of the hollow curved away from the house a great deal. He was tempted, time after time, to jump into the boat and pull straight across, but he knew that if the force of the current drifted him below the house, he could never hope to go upstream against it. His only chance was to make sure that he could reach the middle of the torrent above the house and drift right down upon it. A few yards' extra leeway would enable him to steer his cranky craft to the desired spot. So, though it seemed to him as if he were going away from Anton, and though, indeed, he was now so far away that the crippled boy's shouts no longer could be heard, Ross stuck to his intentions, and, still wading, pushed the little craft up-stream.

Rex protested vigorously. He ran back from the bow and looked into Ross's face with a reproachful and almost angry bark, as much as to say:

"You silly! Can't you tell what I brought you here for?"

The boy knew better than the dog.

"Lie down!" he ordered sharply.

Rex, understanding in a doggish way that he was in the wrong somewhere, went back to his post in the bow, where he stood dejectedly, his tail no longer at the jaunty angle than it had been before.

At last Ross felt that he had reached a point high enough up the flooded bank to justify him in the attempt to get across. He jumped into the home-made skiff, and, setting his strength to the clumsy oars, began to pull with all his might.

FUTEN, GOD OF THE WINDS.
Japanese conception of the origin of storms, which come from the bag on the demon's back.

He had not over-estimated the force of the current. As the light craft got into the swirl, the black water caught it like a feather. Ross pulled with all his might, but the banks slipped by as though he were in tow of one of the river steamboats. Never had the boy tugged at a pair of oars as he did now, and never had he so wished for a good boat and for real oars. He was only two-thirds of the distance across to the house when it came into sight, only a little distance below him.

He would not reach it!

With the energy of despair, Ross tugged on his oars, every muscle of his body tense with the strain.

Rex, divining the struggle, stood silent, not looking forward over the bow as he had been doing, but watching his master as he toiled with his oars.

Then, out from the darkness, shot the long black menace of a floating tree trunk. Straight for the boat it sped.

From the window, now close at hand, came a cry:

"Look out, Ross! Look out!"

Ross saw the danger. He knew, if he backed water, or halted long enough to let the tree go by, he would infallibly be swept past the house and all hope of rescuing Anton would be gone. He saw, too, that if the tree struck the frail boat, it would sink it as a battleship's ram sinks a fishing-boat in a fog at sea. He might win through, but if it struck—

The oars creaked with the sudden strain thrown on them.

On came the tree, but, just as it was about to strike the boat, it checked and turned half over, as the projecting stump of a broken bough caught on the ground below. For an instant, only, the tree halted and began to swing.

The halt gave a moment's respite, one more chance for an extra pull with the oars. The big log, thus poised, made a backwater eddy on the surface of the river, checking the force of the current. Ross reached back for another stroke, with every ounce of his muscle behind it.

The tree turned over sullenly and charged down the river anew. Yet that brief pause, that second of delay, that back-water ripple as the log hung in suspension, had given Ross just the advantage that was needed. The branches of the upper part of the tree swept round, one of them catching the stern of the boat and almost pulling it under. Peril had been near, but victory was nearer. The bow of the boat touched the wall of the house.

The current, swirling around the rocking walls, carried the boat to the lee of the house, and, as it

spun round, Ross leaped on to the porch, chest-deep in water, and took a quick turn with the boat's painter around the corner post of the porch.

The torrent took his feet from under him, and swept him down-stream, floating, but Ross held a firm grip on the rope and dragged himself back. There, clasping the post tightly, he got back his breath. After a moment's groping he found the railing of the porch. By standing on this and holding fast to the corner post, he was, for the moment, out of danger.

He had reached the house, but how was Anton to be rescued?

The crippled boy was on the second story and the upper window could not be reached from the boat, even if the boat could have been held in place directly under it. Fortunately, Ross knew the arrangements of his chum's house as well as he did those of his own. Stepping gingerly along the porch railing, he came close to the window of the sitting room. The glass was still in the window frame, but as the front door was swinging wide open, though partly choked with débris, Ross knew that the sitting room must be full of water. He kicked the glass out and then, with a heavier kick, broke away the middle part of the window-sash. The water did not come quite to the top of the window frame, sure evidence that there was room for air between the water and the ceiling.

Taking a long breath, but with his heart knocking against his ribs, Ross dived through the broken window. It is one thing to be able to swim and dive, it is another to plunge through a splintered window-frame into a dark house in the middle of the night, with a flood roaring on all sides.

Was the door into the hall open? On that, success depended.

The boy turned sharply to the left as he came up to the surface and took breath. His hand struck the top of the door jamb. The door was open, but the casing was only three inches above the water. Ross dived again through the door, and, under water, turned to the right. One swimming stroke brought him to the staircase and he rushed up the few steps at the top to the room above.

There, by the light of a single candle, he saw Anton, his eager eyes shining out of his pale face. The crippled boy hobbled across the room on his crutch and grasped his chum tightly by the shoulder. He was trembling like an aspen-leaf in the wind.

"Scared, Anton?" said Ross. "I'm not surprised. You've a good right to be."

"I wasn't so scared," the younger lad replied, with the characteristic desire of a boy not to be thought cowardly, "I just got to wondering, that was all."

"Wondering if any one was going to come for you?"

"Yes."

"How did you get left behind, anyhow?" queried Ross.

"Oh, it was my own fault, all right," the crippled lad replied. "It was all because of the dog. You know, Ross, Lassie had pups, last Monday."

"No, I didn't know about it," responded the older boy. "Why didn't you tell a fellow?"

"I haven't seen you since," Anton explained. "Well, when the levee broke and the water commenced to come into the house, Dad and Uncle Jack went and got the two boats we always keep on the river. Dad picked me up and carried me down on to the porch. I heard him call to Uncle Jack:

"'You go ahead and get Clara; I've got Anton safe with me.'"

"Then you were with him, weren't you?" queried Ross.

"Sure I was. Just as I was getting into the boat, though, I thought of Lassie and her puppies and I went back to get them. I called to Dad and said:

"'I'm just going to fetch Lassie, Dad, and I'll go in Uncle Jack's boat.'

"So, Dad, he called to Uncle, saying that I was to go with him. His boat was pretty well crowded up, too. Back I went to get Lassie. As soon as I'd picked up the pups, Lassie was willing enough to come along. The water was running over the floor and made it slippery. My crutch slithered on the wet wood and I tumbled down. It was pretty dark, and I had a job finding the four puppies again. When I did gather 'em up and started for the porch again, Uncle Jack was gone."

"Without you?"

"He thought I was with Dad, and I suppose Dad was sure I was with Uncle Jack."

"They ought to have found out and come back after you as soon as they got together."

"I thought of that," the crippled lad answered, "and that's what I expected would happen. I suppose, though, they didn't land at the same place, and so each bunch thinks I'm with the other and isn't doing any worrying."

"It's a mighty awkward mix-up," declared Ross. "There's no saying what might have happened to you if Rex hadn't been on the job."

"Was it Rex who brought you here?"

"It sure was," Ross replied, and he described how the terrier had pulled him by the leg and insisted on his coming over to the house in the hollow.

"Where's Rex now," queried Anton, "down in our old boat?"

"Yes, he's down there, keeping watch, good old scout," answered Ross. "He ought to be satisfied now, he certainly made fuss enough to bring me here. But, look here, Anton, how are we going to get you out? You don't swim."

"No," answered his chum mournfully, "I can't swim."

"If there was room enough down that stair," said Ross, thoughtfully, "I could take you on my back, but we'd never get through that door, and the window would be even worse."

"I'd been thinking of that," Anton answered. "I wondered how Dad would get me when he found out that I wasn't with Uncle Jack and came for me. So I made a long rope out of strips of my sheets."

"What's the good of that?"

"Well," said the younger boy, "I was wondering if I couldn't get out of the window. My arms are awful strong, you know, Ross."

"Yes," the other agreed, "you've plenty of muscle there."

"I thought if I could drop that line out of the window, Dad could grab it and hold the boat there. Then I could chuck down Lassie and the pups in a basket—I've got the basket—and slide down the rope of sheets into the boat."

Ross thought for a minute.

"I don't see why we couldn't do that now," he said. "Suppose we tied a piece of wood to the end of this rope of sheets, so that it would float, the current would curl it around the corner of the house so that I could get hold of it from the boat. If your end of the line was made fast up here, I could hand over hand the boat right under your window, the way you say. Why, I could get you out without any trouble at all! Let's see how it goes."

Suiting the action to the word, Ross tied one end of the line of sheets around the hinge of the door, passed it through the window, and, to the other end, tied a spare crutch. Then he leaned out of the window and watched it. The current snatched the crutch down and, as Ross expected, swung it around the corner of the house.

"Fine," said the lad. "We can work that all right. I'll have you out of here in two shakes, Anton. Where are the pups?"

Anton pointed to the bed, on which a basket was lying.

"Aren't they dandies?" he said.

Ross took the candle over and picked up one of the pups. Lassie growled in a low voice.

"All right, Lassie," said Ross, "you ought to know me."

He bent down and patted her.

The dog smelt his hand and whacked her tail on the floor in token of recognition, but growled again, nevertheless.

"I won't hurt your pup," declared Ross, putting the blind little creature back in the basket.

"Nicely marked, Anton," he said, "they look great. But we've got to get busy."

He went to the head of the staircase and stared down.

"It doesn't look a bit nice," he declared, "I sort of hate to go through there again."

"Why do you?" queried Anton. "You could go down the line and reach the boat that way."

"That's an idea," declared Ross thoughtfully, then he shook his head. "No," he said, "my weight would swing the crutch out clear away from the house. I'd better go down the way I came up. I can always get back, anyway."

He ran down the staircase until the water reached to his chest and then struck out. The water had risen slightly, but he got through the door without any trouble. Passing through the window he was not so lucky, for a projecting splinter of glass scraped him as he dived through, making a long but shallow cut in the upper part of his arm.

Rex welcomed him back with short joyful barks.

"I'm not a bit sure," said Ross as he patted the dog, "whether it was Anton or the pups that you wanted me to rescue, eh? Which was it?"

For answer Rex only wagged his tail and jumped up on his young master.

"Down, Rex, down," ordered Ross, "this boat's too cranky for that sort of thing. Now, where's that crutch?"

In the darkness and the pouring rain it was hard to distinguish anything, but the white gleam of the sheets showed where the crutch was floating.

"Out of reach," muttered Ross in disgust. "Just my luck! How am I going to get it?"

It was a problem. The crutch was floating on the current above twelve feet beyond the reach of the boat's painter, let out to its utmost length. By stretching out with one of the oars, Ross was about four feet short. Just four feet, but so far as success was concerned, it might as well have been four miles.

If he jumped from the boat and swam for it, there was always a chance that the current would pluck him down before he could grasp the line, and then he would not only be in danger himself, but he would have lost all chance of saving his crippled friend. As long as he stayed either with the boat or with the house, there was a chance. It would be foolhardy to lose connection with both.

Then a brilliant idea struck him. Suppose he tied the painter of the boat under his arms, loosed the boat from the post and jumped into the water. He ought to reach the floating line before the current had taken up the slack of the boat's painter. If he left loose a long enough end, with a loop knot, he could fasten the rope from the boat to the line of sheets, and the boat would be made fast. The loop knot would unfasten itself and he could easily clamber into the boat, from the stern, since it was fastened to the line coming out from Anton's window. Then he could haul up the boat, hand over hand, as agreed upon, take Anton and the puppies aboard and strike out straight for the shore.

No sooner was the idea conceived than Ross proceeded to put it into action. Slipping the line around his arms, once, he tied a loop knot in front of his chest, where it would be easy to reach, leaving about three feet of rope hanging, untied the painter and shoved off the boat. The instant that the boat felt the current it yawed around, but, at the same moment, Ross jumped out and forward with all his might. The action sent the boat down-stream all the quicker, but in a second's time, Ross had grasped the floating crutch and had taken a turn with the loose end of the rope around it.

He was not an instant too soon, for a sharp tug at his chest, followed by a sudden release of the weight, told him that the loop knot had untied itself, as he hoped it would. Holding on to the sheet line with one hand, he rapidly passed the rope once under and through. Ross had not learned his knots from the Mississippi sailors for nothing, and as the boat came to the end of its tether and jerked on the line, the boy had the satisfaction of seeing the knot tighten. With the strain off, it was easy to take another half-hitch around the line, and the knot was secure beyond peradventure. He climbed aboard, raised a cheery cry to Anton, and commenced to pull the boat hand over hand along the line of sheets. It was only a moment before the little craft was bobbing on the flood, immediately beneath the window.

"Let's have the puppies first," cried Ross.

Anton's head disappeared from the window, and reappeared in a moment.

"Catch!" he cried and held out the basket.

Ross balanced himself as best he could and caught the falling basket. It was not more than a five feet drop and the basket landed squarely in his arms. He placed it in the boat. Loud barking overhead announced that Lassie was displeased and worried over the sudden departure of her offspring.

"How am I going to get Lassie out?" queried Anton. "I'd never thought of that. She'll strangle if I let her down by the collar."

"That's easy," Ross called back. "Tie a bit of string to her collar, chuck me the end of the string, and then throw her into the water. It won't hurt her, and I can easily haul her aboard."

"All right, then," the other answered, "get the boat out of the way."

"Chuck me down the end of the string first," warned Ross, and, as he spoke, a ball of stout twine fell in the boat. "Out with her now," he continued, slackening away on the line, so that the boat was no longer directly out of the window.

There was a moment's pause and then the big dog appeared in the opening, struggling in Anton's strong, if clumsy, grasp. She clawed at the window-sill, not understanding what was happening, but Anton gave her a push, and half turning as she fell, Lassie struck the water all of a heap. The instant she was afloat, however, her natural swimming instincts asserted themselves and she started for the shore.

"Here, Lassie!" called Ross, with a whistle, and pulled gently on the string that was fastened to her collar. The dog felt the pull and turned around, swimming directly for the boat. Ross stooped down and lifted her in. The mother immediately smelt the puppies and scrambled along the bottom of the boat to the basket. She smelt her children, nosed them over, one by one, then, satisfied that everything was all right, muzzled against Rex, and lay down contentedly.

This feat accomplished, Ross pulled the boat under the window again.

"Now, Anton," he called, "it's your turn."

"All right," the younger lad replied, "I'm coming."

Ross heard him drag a chair to the window, to make it easier for him to clamber out.

Just at that instant, there came a cracking from the front of the house, the corner-post of the porch, to which the boat had been fastened less than five minutes before, fell with a crash and the front of the house crumbled. There was a moment's pause, and then the whole structure keeled over, away from the boat, and with a rending and cracking of timbers, broke from its foundation. Over and over it heeled, and it looked as though it would go to pieces. From the window overhead came a scream of terror.

Realizing that Anton could never save himself, if the house were collapsing, Ross leaped for the rope of linen that was hanging out of the window and went up it like a monkey.

The chair on which Anton had climbed, to get out of the window, had slid to the far end of the room and fallen on the sloping floor, the lower edge of which was now in the water, and the crippled lad was pinned down and unable to get out. The candle had been thrown down on the table and fire was beginning to lick some paper that had not slipped to the floor.

Ross dashed in, grabbed Anton by the arm, picked him up with the "firemen's carry" and staggered up the sloping floor to the window.

Had the boat suffered in the careening of the house?

The line, made of linen sheets, still was taut, and Ross, peering out of the window, saw to his great delight that the boat was still there with all its passengers safe, Rex, Lassie, and the puppies.

THERE, BEFORE THE FLOOD, STOOD ANTON'S HOUSE.
Overflowed lands in the Mississippi Valley, where scores of lives are lost when the rising waters break down a levee.
Courtesy of U. S. Weather Bureau.

A lurch almost threw Ross upon his face and the whole house swayed as though with a violent earthquake. The next instant, a sense of motion beneath them told the boys that the house was afloat.

"The house has gone, the house has gone! What are we going to do?" cried the crippled boy.

"That's all right, Anton," the older lad said consolingly, "things aren't so bad. See, it's beginning to get daylight."

"But," said the younger boy, "the house is floating down to Pirate's Cave, that gully where the big rocks are. If we run up against those, the house'll be smashed to bits, sure."

Ross thought for a moment and saw that his chum was right.

"Guess we'll have to take to the boat after all, Anton," he said, "it's a good thing the house got on a level keel again, when she came afloat."

Action was needed and that immediately. Ross climbed half-way through the window.

"I've got to get that boat up here in a hurry," he said, "the current's swift enough, when you're in that small boat, but this house doesn't float down so fast. It's a mile, anyway, to the gully."

So saying, he swung himself out of the window, went down the linen rope and dropped into the water. Hand over hand, again, up the rope came the boat until once more it was under the window. Meanwhile, by heroic exertions, Anton had swung himself up on the window-sill. As the boat came beneath him, the crippled lad swung out on the rope and proceeded to climb down into the boat.

He was not a moment too soon. While Ross had been bringing the boat to place, the speed of the

current had increased and the house, like a clumsy Noah's Ark, began to sweep swiftly towards the gully of which Anton had spoken.

"Quick, Anton," said Ross, as the smaller lad hesitated, "we've got to be quick."

He cut the boat loose.

In spite of his blunt words, it was with the greatest gentleness that Ross handed the lad to a seat in the rough craft where they had played pirates during the preceding summer, and settled down to his oars.

Lassie, finding her master safe in the boat, came and laid her head on his knee, while the shore went slipping by. Here and there a barn still stood, the tops of the trees showed above the flood, but all the ground was hidden and the torrent was running like a mill-race. Little by little, Ross edged the boat towards the shore, not trying to stem the current but rowing diagonally across it. Only a few hundred yards separated the house from the gorge which the boys knew as Pirates Cave. By this time the boat had reached the higher portion of the hollow, where the current slackened. A few strong strokes of the oars and the boat grounded, safely.

At that instant the slight lightening of the rain-filled skies showed that, behind the clouds, the sun had risen. The boys turned to look at the house which had been Anton's refuge, and which so nearly had been his tomb. As they looked, the structure struck against the uppermost of the rocks with a crash and collapsed as though made of matchwood, while, a second after, into the medley of boards and timbers some uprooted trees came crashing.

"You wouldn't have stood much chance there, Anton," said Ross.

The crippled lad put his hand on the older boy's shoulder, with as close an approach to a gesture of affection as boy nature would permit.

"I guess I'd have been a goner," he answered, "but for you."

CHAPTER II

THE HOME OF THE RAIN

The gray morning broke over the desolate scene, and Anton, hollow-eyed and exhausted, looked at the muddy waters rushing savagely over the place where his home had stood. By the tops of the trees, only, was he able to trace the outline of the fields he had known all his boyhood.

"Do you suppose it'll ever dry up, Ross?" he asked.

"Of course it will, Anton," the older lad said, reassuringly, "you'll see. In a week or two all this water'll run off and you'll forget that the old place ever looked like this."

The crippled lad shook his head, as though in doubt.

"My books have gone," he said mournfully.

The tones were quiet, but a tragedy lay beneath the words, and no one knew better than Ross how largely his chum's life lay in the world revealed in his tiny library. The flood would pass away and the fertility of summer would hide every trace of the disaster, but for Anton's loss there was no such swift remedy. His books were his closest friends, and now, at one stroke, he was bereft of all of them.

"Come," said Ross, to change the current of his chum's thoughts, "we'll have to make a start. Where do you suppose your folks are?"

The younger lad turned to his friend with the quick responsiveness and willing resignation often found among those who have suffered a great deal or who are handicapped in Life's race.

"I haven't the least idea," he said, "they might have gone over to the other shore."

"Yes," agreed Ross, thoughtfully, "that's likely. They'd certainly have more chance of finding help and grub over there. And, talking of grub, Anton, aren't you hungry?"

"Starving," admitted the younger lad.

"Then I tell you what, we'd better go and hunt up Levin."

"The chap who used to be with the Weather Bureau, you mean?" Anton asked.

"Yes."

"Don't you think that I ought to try to find Father first?" queried the younger lad, hesitatingly. "He might be worrying."

"It's because of your folks that I think we ought to go first to the camp," explained Ross. "We couldn't possibly row right across the flood to the other shore. We've had trouble enough getting as far as this. Besides, Anton, even if we did get over, we wouldn't know where to look for your

people. There's a chance that Levin may have heard from them, and if he hasn't, he might send some one with a message. We couldn't do much searching, anyway."

In truth, the boys were utterly exhausted. The only member of the party who seemed in high spirits was Rex. He frisked about and jumped on the two boys, his tail sticking straight up in the air, as though he were convinced that it was solely through his exertions that Lassie and the puppies had been rescued.

Ross slung the basket, with its living freight, across his shoulders and started off. Lassie watched this elevation of her children with manifest uneasiness, but as her master seemed satisfied, there was nothing for her to do but to follow behind, which she did with her nose as close to the basket as possible.

Nerve-frazzled and tired out, Anton pegged away behind. The heavy downpour of rain, which had not ceased for a day and a night, and which had followed upon the heavy rains of the week before, had made the ground as soft as a bog. The crippled lad's crutch sank in so deeply at every step that it was only with great pain that he could keep up at all. Still, he struggled along bravely.

Ross, turning to see how his chum was faring, caught the boy's tense and haggard look, and understood.

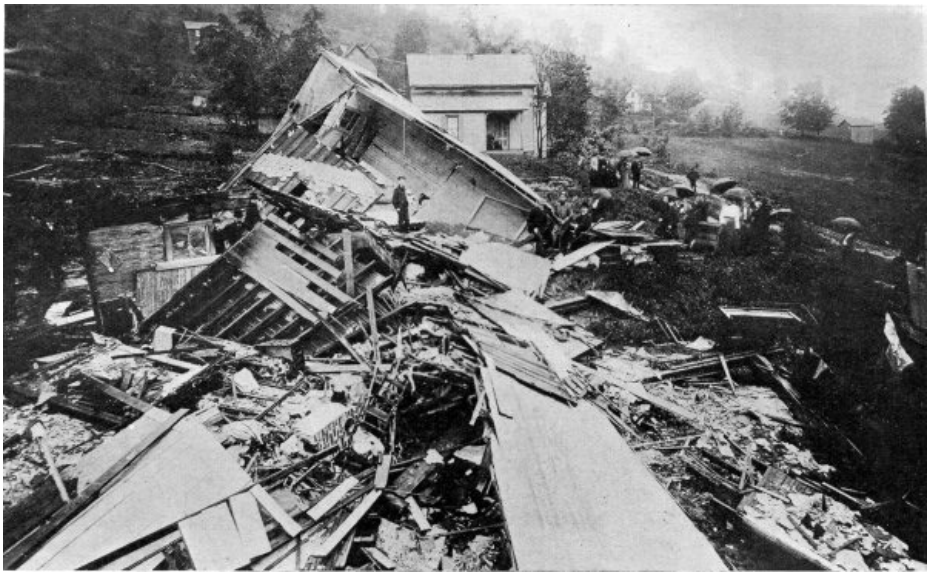
"Look here, Anton," he said, at once, "we'll never get anywhere this way. You get into the boat and I'll tow you."

"But you can't, you're just about all in," protested the younger boy. "You can't tow the boat with me in it, all the way."

"Got to!" declared Ross abruptly. "It's a sure thing that you're not able to walk there with the ground in this sodden condition. Anyway, I won't have to carry the puppies."

Thankful but still protesting, Anton got into the boat and the journey began anew.

It was a weary way. Ross staggered forward, half-blind with sleep, wading knee-deep, sometimes waist-deep, in the water. The rain had stopped, but the sky was heavy and the clouds hung low. Twice Anton had to jerk on the tow-rope to jolt Ross awake, for, unnoticing, he was heading for deep water. Even near the shore the torrent was full of floating debris. The bodies of horses and cattle drifting down the stream told of many impoverished farms and the flotsam was eloquent of wrecked and demolished houses and indicative of suffering.



THE EDGE OF A TORNADO'S WHIRL.
Note the house in the background unharmed, and the house next to it spun around like a top.
Courtesy of U. S. Weather Bureau.

When, after an hour's toil, rescuer and rescued reached the drier land that sloped up to the levee, it was hard to tell which was the more exhausted. To the last, however, Ross refused to let his chum bear the burden of the puppies, and he lurched up the road to the place where he had left the gang at work on the cave-in, not so many hours before. It seemed weeks ago.

The Weather Man was still at work. He had been up all night, also, but he greeted the lad cheerily as he came in sight.

"Hello, Boss!" he called, then, as the boy's exhausted state became more evident, "what have you been doing? Has anything happened?"

"Anton was marooned," answered Ross in the dull, listless voice of extreme fatigue.

"Marooned? You mean he was caught by the flood?"

As though in answer, Anton, toiling heavily and wearily on his crutch, came in sight.

"Yes," said Ross, in the same tone, "he was left behind."

"How was that?" the Weather Man asked sharply.

"It wasn't anybody's fault, Mr. Levin," replied Anton, who had heard the last two sentences as he came up, "Father thought I'd gone with Uncle Jack, and Uncle Jack thought I'd gone with Father."

"You're not hurt?"

"No, sir," the crippled lad answered, "not a bit. Ross is, though. He cut his arm diving through the window."

The Forecaster turned swiftly to the older boy and began examining the injury.

"Is the house still standing?" he asked.

"No, sir," the boy answered, "it's all in bits down by Jackson's Gully."

The weather expert nodded. He knew the lay of the land and had expected the water from the flooded hollow to pour down towards the entrance to the gully.

"How did you get out, then?" he asked.

Anton burst into a glowing account of his rescue in the little boat which the boys had made for their pirate adventures of two years before. Even the excitement of the story, however, was not strong enough to keep his overtaxed frame from showing signs of a breakdown and the Weather Man cut the story short.

"I'm going to breakfast later," he said curtly, "but not for a couple of hours. You two had better take a rest now. Here, Sam," he called to one of the negroes, "bring me a bucket of coffee from your camp-kettle, and fetch some corn-pone. Quick now, these boys are famished."

"Yas, suh! Yas, suh!" came the reply, and, a moment later, a bucket of coffee and some corn-bread and molasses were brought.

Despite their hunger, neither Ross nor Anton could eat more than a few mouthfuls, and the hot drink was the last straw to their sleepiness. Ross fell asleep with an unfinished piece of corn-pone in his hand, and Anton's head was nodding.

"Ain' no more weight than a babby, Mister Levin," said the laborer, as he picked up the little crippled lad and carried him to a tiny open shed near by, which was the only dry spot to be found in the neighborhood.

Very tenderly he laid the boy down on a pile of clothes that had been salvaged while the Forecaster put his overcoat over Ross and laid him beside his chum.

"There," said the Weather Man, "let them sleep a while. They'll be ready for a real breakfast in a couple of hours."

Though hungry himself, the Forecaster waited for three hours before awakening the lads. Anton, by nature a light sleeper, awoke easily and was refreshed, but the awakening of Ross was a real task. He had been on a severe strain for twenty-seven hours and Nature demanded sleep. At last, however, he was roused and after he had plunged his head in a pail of cold water, he felt as full of ginger as ever and ready to start on rescue work all over again.

"I'm just going to breakfast," the Forecaster announced. "Do you want to go along?"

"Do I? I should say I did! But I'm afraid, sir, that Anton and I will eat up everything in sight."

"You don't need to worry about that," the Forecaster replied, "my men have been hauling supplies all night. Why, Ross, there are over two thousand people homeless this morning, right around this district. They've all got to eat breakfast, too, so you see even your best efforts won't seriously decrease the supply."

"I'm not so sure about that, sir," Ross said laughing, "right now I feel as though I could eat all you've gathered for the entire two thousand."

"Come and try, then," the Weather Man said, smiling. Then, turning to Anton, he continued, "Likely enough, some of your people will be at the big tent that's been put up. If they're not there, I'll send out a couple of the boys on horseback to cover both sides of the flooded area and pass the word that you're safe." He turned to the older boy. "I've already sent word to your father, Ross."

The boys thanked him and started down the levee. Owing to the continuous work of the night, the cave-in had gradually been filled up, averting a break at this point. The river, turbid and swollen, was swirling by, not more than three feet below the top of the levee.

"Is the water going down yet, Mr. Levin?" asked Ross. "It looks as though the rain were over."

"Yes," answered the Forecaster, "the rain is over, but the water's not going down yet. It's rising. I'm fairly sure that there won't be any more rain for a few days, fortunately, but I heard from Greenville this morning that the river was still rising. We can stand another nine or ten inches, but a foot would be serious. Of course, the break that flooded out Jackson's Hollow, where your place was, Anton, is relieving the pressure a little. We've been lucky here. I haven't heard of any

loss of life so far. It's a nasty flood, but when the rainfall last week was reported as being so heavy, I knew we couldn't escape trouble."

"Is it just the rain that makes floods?" Anton asked.

"Just rain," was the laconic answer.

"Why is it," asked the younger boy, "that there's more rain one year than another?"

"If I could tell you that," the old Weather Forecaster replied, "I'd be the cleverest meteorologist in the world."

"But doesn't anybody know why it rains?"

"Certainly, we know why it rains."

"Why, Mr. Levin?"

The Forecaster pushed back his hat from his forehead and looked quizzically at the white-faced lad.

"You really want to know why rain comes? Very well, Anton, I'll try to tell you. Stop me, though, if you don't quite understand.

"The Earth goes whirling about in space, revolving around the Sun, as you know, and it has, like a sort of skin around it, an envelope of air. This air is kept from flying off by the force of gravity. You know what that is?"

"Yes, sir," the cripple answered, "it's what makes a stone fall to the ground."

"Exactly. Now the air is made up of little particles or molecules, like the stone, only, of course, not so heavy. They're heavy enough, though. How much weight of air do you suppose you're carrying, Anton?"

The boy looked puzzled.

"I don't quite see what you mean, sir," he answered.

"Suppose you had a pea on your head, it wouldn't be heavy to carry, would it?"

"Why, no," answered the lad, laughing.

"Supposing you had a basket of peas, the basket being only about as big round as your head, but six feet high, that would make quite a load, wouldn't it?"

"I don't believe I could carry it," was the answer.

"And if the basket were sixty feet high, as high as a barn?"

"I'd be squashed under it."

"And if it were six miles high!"

"Why," answered Anton, "a basket six miles high, even if you filled it up with cotton fluff, would weigh tons and tons!"

"Well, my boy," said the Weather Forecaster, "you're carrying on the top of your head a column of air, not only six, but sixty miles high, yes, and more than that! You don't notice it, of course, because you're used to it, and your body is made to accommodate itself to that weight by your tissues being full of air at the same pressure. Just the same, not counting the weight which presses on your whole body, amounting to about seventeen tons, you're carrying on your head, at this minute, a weight of over six hundred pounds."

"Six hundred pounds! As much as if I were carrying three heavy men sitting on my head!"

"Every bit of it, and more, under certain conditions of the atmosphere. This depends mainly on the circulation of the winds, especially those great movements a thousand miles in diameter known as 'lows' and 'highs' or cyclones and anti-cyclones. In the United States, an anti-cyclone generally means fair weather, and in an anti-cyclone the barometric column rises. That's why a barometer helps to foretell weather some time in advance; it responds to the vast movements of the atmosphere rather than to local conditions.

"Of course, Anton, at sixty miles up, the air is so thin that it has hardly any weight. Indeed, we wouldn't know there was any air at that height but for the trail that shooting stars leave. A meteor glows because of friction, and in a vacuum there is no friction. Therefore there must be air at the vast heights where shooting stars are first seen."

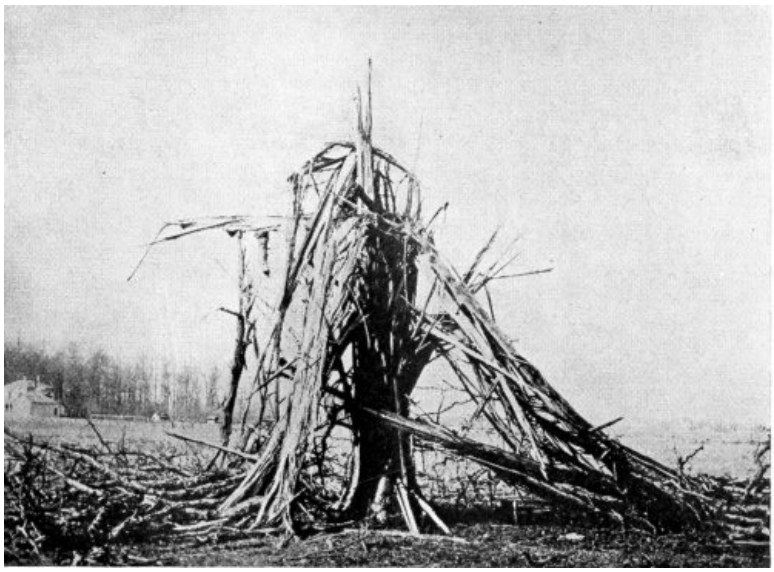
"Could an aeroplane get up there?"

The Forecaster shook his head.

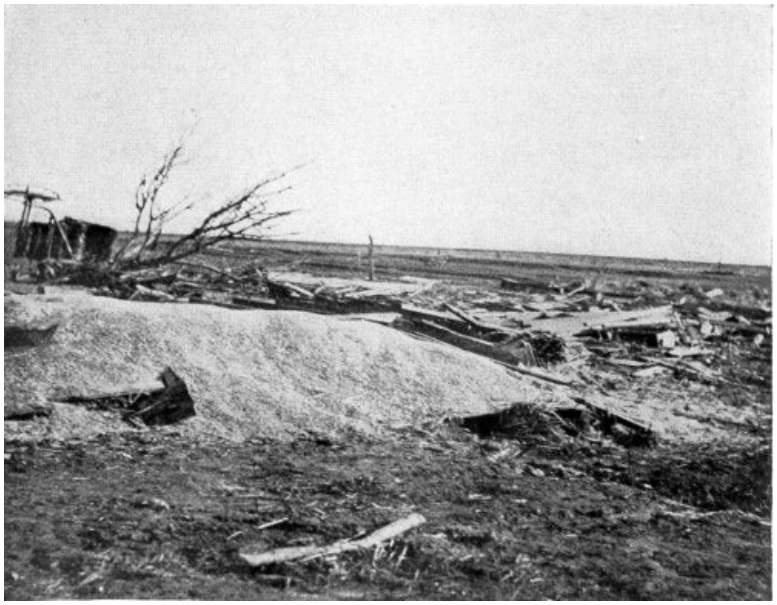
"Never," he answered. "Even six miles up, the air would be too thin to sustain the weight of an aeroplane unless the machine were flying at terrific velocity, and besides, at that height, there wouldn't be enough air for an aviator to breathe. At that, Anton, you can see for yourself that if the air is saturated with water vapor—and the cloud-bearing atmosphere is eight or ten miles

thick—there is room for a lot of water."

"It's evaporation that puts water into the air, isn't it, sir?" asked Ross.



In the Path of the Lightning.
Courtesy of U.S. Weather Bureau.



In the Path of the Tornado.
A farm-house, with farm buildings in a copse of trees stood here; the buggy, after a flight through the air, was dropped, little injured.
Courtesy of T. B. Jennings, U. S. Weather Bureau, Topeka, Kans.

"Exactly. The sun is shining on some part of the earth all the time. There's never a second, day or night, that water is not being evaporated from the seas, from lakes, from rivers and from the earth itself. All the water that is taken up must fall somewhere, and all the rain that falls means that the atmosphere must fill itself with water vapor again. It's a continuous performance, and the water which is being evaporated into the air falls to the earth, sooner or later, as rain, hail, or snow."

"If it's all so regular," said Anton thoughtfully, "I don't see why we don't get the same amount of rain every day, or at least every season."

"It isn't regular at all," the Weather Forecaster explained. "If climatic conditions were regular, we could forecast the weather several years in advance, instead of only a few days. There are a thousand complicating factors. Land and sea are irregularly divided, and as there is more evaporation from the sea than the land, every little curve in a coast line means a disturbance of regularity. Then, Anton, remember, while the earth is almost a globe it is not perfectly round, so that every variation from the regular curve disturbs the air currents. Moreover, the motions of the earth are very complicated. Sometimes it is nearer the sun than at other times. It wobbles slightly on its axis. It is inclined to the plane of the ecliptic, causing the seasons, and that brings a new set of factors into the problem. A mountain range or a desert will modify the atmosphere, even the difference between a forest and a prairie is noticeable."

"Suppose you could figure all those things out, couldn't you foretell the weather, then?"

The Forecaster shook his head.

"Suppose you had a thousand marbles of different colors," he said, "and you dropped them from the top of a house to the hard ground below, a rough and rocky piece of ground, could you ever figure out what kind of a pattern they would make? You might measure the size of the marbles and compute how many times they would strike against each other in falling, meantime figuring the angles of direction that each collision would produce. You might measure the resistance of the ground and the elasticity of the marbles and estimate the manner in which they would bounce after striking the ground and the distance to which they would roll. After you had done all that, you might have the right to expect that you would know the pattern that the marbles would make as they lay scattered on the ground. But you would be wrong, for if you dropped those marbles a thousand, yes, a million times, the pattern would be different each time. After tens of billions of experiments you might be able to find the proportion of patterns, but the result would never be of practical use.

"It's the same way with the weather. We know well enough how to do the things that would enable us to prophesy a long time in advance what the weather is going to be, but the problem approaches impossibility because there are too many factors that enter into the calculation. We're learning all the time, but it's a big piece of work and needs big men to do it. That's why, Anton, I can't tell you why this particular district had more rain this year than it has had for several seasons past."

Anton, pegging away on his crutch beside the Forecaster, looked up at him with an added eagerness in his eyes.

"And yet all those things are going on, right where I can see them!" he exclaimed.

"Yes," the Weather Man answered. "Some men can explore distant countries, and we envy them; some men can explore the greatest and the smallest things in the world with marvellous scientific instruments and we envy them, too; but every day and all day, and every night and all night, we are surrounded by the World of the Weather, less explored, less known than even the most remote corner of the earth. Why, Anton, if you could simply follow all the various causes that brought about this flood that made you homeless, you would have a story of adventure that would make the most daring explorer green with envy."

"But you do predict floods and rains, Mr. Levin," Ross put in. "Father told me, a week ago, that warnings for this flood had been sent out by the Weather Bureau."

"Yes, indeed," the Weather Man answered. "I should say that weather warnings issued by the Bureau save half a billion dollars to the country every year and prevent the loss of hundreds of lives. All those are short-range predictions. Very few of them cover much more than a week in advance, except, perhaps, a West Indian Hurricane which has been reported from the Antilles, or a flood on the Mississippi which is caused by heavy rains in the upper reaches of the streams flowing into it."

"Well, that's prophesying, isn't it?"

"Yes, and no," was the reply. "It's predicting, and it's due to observation. If a storm is moving eastward, with a heavy rainfall, and we've had telegraphic dispatches from all the towns in the west through which it has passed, it's not hard to figure the speed at which the storm is traveling, and it's a sure prediction to tell a city to the eastward of that storm that rain can be expected at about a certain date. Or, if there's a high flood wave at St. Louis, and we know the speed of the Mississippi current, we can notify Greenville, Vicksburg, and New Orleans at what time the trouble is likely to come to them. If no more rain is falling at Greenville and the river is going down there, we can notify Vicksburg that the flood danger is passing away. That's the observational end of the work, and in that line, the Weather Bureau of the United States is the best in the world."

The weather expert was proceeding to explain in detail the manner of collecting these observations, when suddenly Anton clutched him by the arm.

"What's that, Mr. Levin?" he cried.

The Forecaster looked ahead, then glanced down at the boy with a smile.

"What does it look like?" he asked.

"Why," said Anton, "it looks like a circus tent; you know, the one that was here the week before last."

"It is the circus tent," the Forecaster replied. "When I found that there were a couple of thousand people to be fed and looked after, the only shelter I could think of, that was big enough, was the circus tent. So, late last night, I sent a wagon up there, asking for the loan of the tent for a day or two. And what do you suppose the circus folk did?"

"Sent it?"

"They sent it, with two of their wagons, a lot of food, their cooking kit, and the two cooks who travel with the circus. What's more, Anton, you remember those two clowns in the show who were so funny?"

"You bet I do!" exclaimed the lad, his eyes shining.

"They volunteered to come down and help as waiters. They're doing it, too, and it's a right good thing, for every one around in the place is roaring with laughter half the time. Folks work a lot better when they're cheerful."

A perfect gale of merriment, which greeted the boys as they neared the tent, showed the truth of the Forecaster's statement. He had greatly understated the work of the circus. Nearly all the performers were there, busily helping the distressed.

"They're a right kindly folk, the circus people, as a rule," remarked the Forecaster.

"Are they all here?" queried Anton. "Goliath, the strong man, the Flying Squirrel Brothers, Androcles, the lion tamer, Princess Tiny and the rest?"

"Yes, most of them," the Forecaster answered. "Goliath is in charge of one of the gangs I've got at work on the river front, and the darkies are so proud of being under him that they're working like fury. The Flying Squirrel Brothers—cracker-jack mechanics, both of them—have been fixing up some tackle and machinery that we needed, but I think Androcles stayed back with his lions. I suppose he thought the lions wouldn't do us any good. But if you're not too hungry to wait just for a second—"

He paused.

"What?" queried Anton excitedly.

"Yes, there they are!" the Forecaster answered, gazing along the levee.

Both boys followed his glance.

Vast, bulky shadows stood outlined against the distant Arkansas shore and the clearing sky. Unreal they seemed, until it was evident that they were moving.

There, shuffling along with that heavy rolling gait which is unlike that of any other animal in the world, came two colossal elephants.

Anton shrieked with delight.

"Elephants! Real elephants!" he cried. "Oh, Mr. Levin, I haven't ever seen an elephant quite close."

He started off up the levee, but the Forecaster called him back.

"Have your breakfast first, Anton," he said; "you've got all day to look at the elephants. They're the best workers I've got. I'd like to have a gang of them at work on the levee all the time."

This sentiment was not shared by Rex. At the first sight of the huge creatures, Lassie had given a low growl. Rex stood silent, with a stillness that Ross knew to be ominous, and just as the Forecaster finished speaking, with an angry growl, he started off to do battle against the elephants. It was a sight to see him, with his hair bristling, rushing forward to dispute the passage of these huge brutes who dared to approach the vicinity of Lassie and the puppies. Only the sharp commands of Ross availed to bring him back, and throughout breakfast he lay well in advance of the tent, watching, and growling loudly every time the elephants passed, dragging the flat sleds loaded with sand bags to the cave-in a few hundred yards beyond.

"I've been wondering," began Anton, using the expression most often on his lips, "why there are so many floods on the Mississippi. Why is it? Lots of rivers I know don't have these awful floods every year."

"I've wondered, too," said Ross.

The Weather Man looked at the two boys, then took a cigar out of his pocket.

"I can't stay away from the levee very long," he said, "but I need a cigar after breakfast, anyway, and I'll tell you why the Mississippi is one of the worst flood rivers in the world and why the safeguarding of the Mississippi is the biggest piece of work to be done in the United States. It's a bigger piece of work than the Panama Canal, and a more difficult piece of work. It means millions of dollars every year to the people of the United States."

"Why is it such a hard job?"

"The Mississippi River," the Forecaster began, "is two and a half thousand miles in length; the longest river in the world."

"Longer than the Amazon?" asked Anton.

"Yes, a great deal. Besides, it is navigable for nearly two thousand miles, clear from St. Paul, Minnesota, to the Gulf. It drains two-fifths of the area of the United States. To put it another way, all the rain and snow that falls between New York State and Montana sooner or later makes its way into the Mississippi River, except for the rain that is used up by plants and animals or that is evaporated before it reaches the river or that drains by underground seepage to the ocean. So you see what a vast amount of water it must carry. Now, boys," he continued, "what kind of banks has the river around here, rock or earth?"

"Mud!" answered Ross, tersely.

"Right," the Forecaster agreed, "and it is mud nearly all the way along. But do you know what mud is?"

FACING A CLIMB ON SHOW-SHOES.

TWENTY-FIVE FOOT DRIFT A MILE LONG.

FOREST RANGER IN IDAHO.

OBSERVER AMONG THE QUAKING ASPENS.

SNOW SURVEY WORK.

Courtesy of U. S. Weather Bureau and of J. Cecil Alter.

This was rather a poser, but finally Anton said slowly,

"It's a mixture of earth and water, isn't it?"

The Forecaster looked shrewdly at the boy.

"You've hit it just right," he said, "mud is earth or soil that has been washed down by the river. That's what makes the bottom of the river so irregular and why it's always shifting. You can see for yourselves, boys, that if the bottom of the Mississippi is just made of light mud, light enough to be carried down as muddy water for hundreds of miles, any little change in the current of the

river will stir up that mud again and scoop out a hole. If it happens to be near a bank, the bank will be eaten away and, naturally, will cave right in."

"About how much mud does the Mississippi carry down, Mr. Levin?" Anton asked.

"In flood time, as much as a thousand tons a minute will be carried past here."

Ross whistled.

"A thousand tons a minute!" he exclaimed. "Why, I should think that would fill up the river in no time."

"It would," the Weather Man answered, "if the river stood still. In flood time, however, the water is flowing rapidly and takes the mud clear down to the delta. That's why there is always so much new land being made at the mouth of the river. You could buy a piece of land under water now, Ross, if you wanted, and be quite sure that in twenty years' time there would be land there for a farm."

"But a thousand tons a minute!" the boy repeated, "that seems huge!"

"It is pretty big," the Forecaster agreed, "but I'll show you where it comes from. You know, boys, generally the land slopes down in the direction of the river, doesn't it?"

"Yes," assented the two boys, "it's supposed to. But it doesn't here. The lie of the land is away from the river."

"That's just exactly the point," the Forecaster declared. "The banks of the Mississippi range in height from about twenty to forty feet above extreme low water. As the river, in times of flood, rises as high as forty to fifty feet above low water, unless there were levees, the river would overflow its banks every spring or flood time."

"It does, quite often, even yet," commented Ross, looking on the flooded scene around him.

"Well," said the Weather Man, "the present levee system only dates back to the end of the Civil War, although there were levees built during the first settlement of New Orleans, two centuries ago. Remember, though, that the Mississippi has been flowing down its present bed for several hundred thousand years, with a flood every spring, so that the overflow has had its effect. Of course, before the land was broken up by farming, there wasn't as much earth carried down into the river to make mud as there is now.

"When the Mississippi River, with its heavy sediment, overflows the banks into the swamps, it's easy to see that the current will be slower in the flooded area than in the main bed of the river."

"Of course," agreed Ross, "but what has that got to do with it?"

"A great deal," the Forecaster replied succinctly. "The faster a river flows, the more sediment it can carry without allowing it to drop to the bottom; the slower it flows, the more readily is the sediment dropped. If you put some mud in a glass of water and keep stirring it with a spoon, the mud will never sink to the bottom. Even if you let it stand perfectly still, it will take several days before the finest particles sink to the bottom of the glass and the water becomes clear."

"Yes," agreed Anton, "I've often wondered why."

"Well," the Weather Man continued, "if you look closely at the mud in the bottom of the glass, you'll see that the bigger particles are at the bottom and then those a little smaller and so on up, until your top layer is made of a mud composed of particles so fine that you'd have to get a microscope to see them."

"I don't quite see why," said Ross. "I know bigger things are heavier, but why should a big bit of earth sink more quickly than a small bit, when they're both made of just exactly the same stuff?"

The Weather Man looked at him.

"Some of these days," he said, "remind me to talk to you about sunlight and dust, and I'll tell you a heap of things you don't know. Right now, get this idea in your head. The larger a piece of matter is, the smaller is the surface in proportion to the bulk. A feather of swan's down will float in a high wind, but if you roll that feather into a ball, it will fall. Why? You haven't made it any heavier. You've only reduced the amount of surface which was borne up by the air. It's the same way with mud, the bigger pieces sink first because they have less surface in proportion to their weight."

"Yes," answered Ross, "I can see that now."

"Very good, then," the Forecaster continued, "when the Mississippi overflowed its banks and the water got out of the current of the main stream, so that it flowed more gently, the sediment began to fall, the larger pieces first and those that were finer until it was only at the most distant point from the river that the finest mud settled. This has gone on, year after year, for thousands of years.

"Therefore, you see, the lands nearest the river are higher than those farther away. In two big basins, the St. Francis and the Yazoo basins, the slope and the drainage is away from the river, instead of towards it."

"In that case, then," said Anton thoughtfully, "the Mississippi runs in a groove on the top of a hill."

"That's it exactly," the Forecaster said, "and some of the most fertile fields lie in the lowlands made of the fine mud at the bottom of this hill. It's just like that hollow where your house was, Anton. The flood hasn't done much damage south of here because all the waters poured down into that fine plantation land where your place was located."

"What I don't see," said Ross, "is why the Government doesn't build a really high levee all the way along the river. I don't mean just a few feet higher, but a regular wall 'way higher than the river ever goes. I mean a regular stone wall, twice as high as any levee that we've got now. I should think that would make the river behave."

"It would and it wouldn't," replied the Weather Man. "What are you going to build that wall on? On the ground?"

"I suppose so," said Ross. "I hadn't thought much about that."

"Indeed you hadn't," his friend replied. "You've got to remember, Ross, that the Mississippi doesn't run in a straight line; it bends and twists like a snake. In the bends the current strikes on the outwardly curving bank, and, as you know, the water is always deep there. This causes a rapid caving and erosion of the bank. At the foot of each bend, the main flow crosses to the other side, where it strikes the bank which has become concave there, and eats into that bank just as, a few hundred yards higher, it has been eating into the opposite one."

"I know you've always got to pilot a boat first on one side of the river and then on the other," said Ross thoughtfully.

"You have. And, if you remember, you'll see that it is generally on the side nearest to the concave shore that the boats pass."

"Yes," agreed Ross thoughtfully, "I guess it is."

"Now, you can easily see," the Forecaster continued, "that the river might keep its own channel clean if it flowed straight down with a current of equal strength. But, as the current crosses from side to side, it slackens speed at each of these crossings. Therefore, as the current becomes slower, it drops some of the heavier particles of sand or mud, forming a bar at every bend, sometimes so high as to prevent navigation."

"That's what the dredges are for, isn't it?" asked Ross.

"Yes. The Government has twelve large dredges at work all the time, keeping the navigation channel open."

"I don't see, yet, why the stone wall idea wouldn't work," protested Ross.

"I'm just showing you," was the reply. "If you built your heavy wall on the bank, the water would strike the concave bank at one of these crossings, eat away the earth under the wall and your wall would topple in. Then the current would cross the stream, undermine the bank on the other side and your masonry would crumble there, too. So much for the wall."

"Suppose you sunk that wall, away down deep, below the level of the bottom of the river?" suggested Ross.

"That might work," the expert replied, "but it would cost more money than the United States could afford to spend. Besides, Ross, where would you build this wall? Right on the bank?"

"Of course."

"But the Mississippi is half a mile wide at some places and three miles wide at others. If the river were absolutely walled in, you'd have swift currents at one place and slow in another. Then your channel would fill up in the wide places and you'd be as badly off as before."

"Make it all the same width, then," said Ross.

"Build two-thirds of the whole two thousand miles by some underwater system, constructing the wall under water? If you had ever read of the difficulty of building one lighthouse foundation, my boy, you wouldn't talk so glibly about building huge retaining masses of masonry under water."

"Suppose it were done, that way, Mr. Levin," put in Anton, "would that settle it all?"

"You mean—suppose there was a high masonry wall, making a canal equal in width and height from St. Louis to the Gulf, would that turn the Mississippi into a permanent ship channel? Is that what you mean?"

"Yes."

"No, it wouldn't," the expert replied. "What are you going to do with all the little streams that flow into the Mississippi? Think for a minute, boys. You can see that wherever you narrow the banks, the river channel has got to be made deeper to accommodate the water, hasn't it?"

"Yes," both boys agreed, "it has."

"In other words, suppose that before you put up this huge masonry wall, the flood crest was fifty

feet at Memphis, then, after the wall was built, the flood crest would be seventy-five or a hundred."

"Suppose it were," said Ross, "the wall would hold it in."

"So you think. There are the tributaries to consider. Take the Yazoo, for example. It flows into the main river until the Mississippi reaches the fifty-foot flood level. If you raise the flood level of the Mississippi to seventy-five feet, the water in the main river will be twenty-five feet higher than the water which used to run into it at the fifty-foot level, won't it?"

Ross whistled.

"I see where you're coming to," he said; "I'd never have thought of that. Go ahead, Mr. Levin."

"With the water in the main stream twenty-five feet higher than in the tributary, due to your retaining wall, boy, instead of the water in the Yazoo River flowing into the Mississippi, all the water above the fifty-foot level in the Mississippi would flow into the Yazoo. The Yazoo couldn't hold the water, and as the stream backed up, it would overflow its banks. All the low valleys would be flooded in exactly the same way that they were before, only, instead of the floods coming directly through a break in the levee or over the banks of the Mississippi, they would come over the banks of the Yazoo. That would be true of every small river that flows into the Mississippi, and there are scores of them."

"What can be done, Mr. Levin?"

"There's only one thing to do," the Weather Man answered, "and that's to build up the levee system, year after year, steadily and without pause, making allowances for the tributaries flowing into the Mississippi and paying especial heed to the rainfall that may be expected in the basin. Wherever possible, forestry must be undertaken to keep the slopes from erosion. Reservoirs might be built with great profit, from which water could be let down during the low water periods.

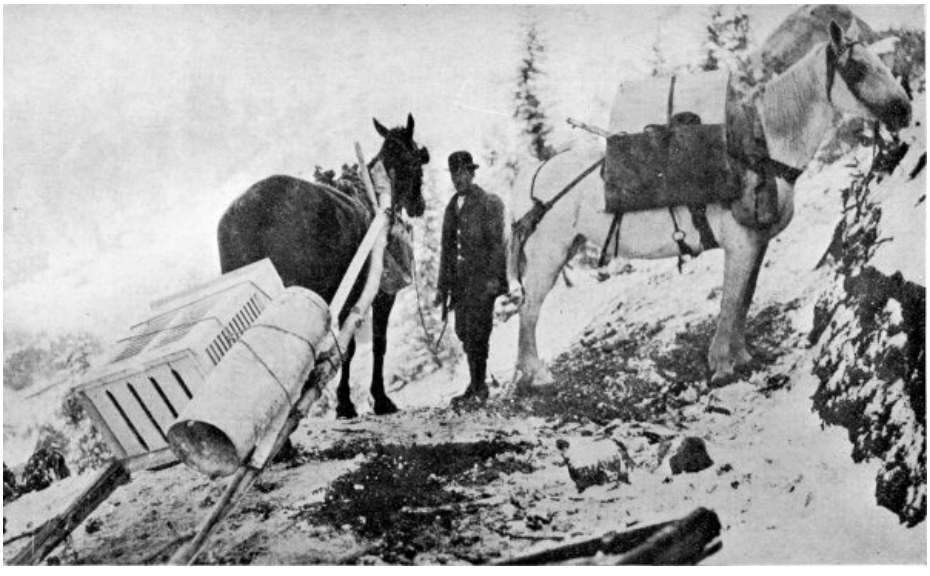
"When the river channels are accurately adjusted to the amount of rainfall in the river basin, destructive floods will be averted. We can never expect that the Mississippi will be absolutely put in harness. The basin is too huge, the amount of water that has to be carried down is too great. Permanent dredging and permanent levee construction and repair will always be necessary, and a close co-ordination between the Weather Bureau and the government and state engineers is a first need in the problem."

"Just how does the Weather Bureau come in," asked Ross, "the rainfall?"

"It isn't only the rainfall of the few days in advance," the Forecaster answered, "it's the rain that has fallen before and the rain that's going to fall. If there should be twelve inches of rainfall after a long drought throughout the Mississippi basin, it would make comparatively little difference, for all the rain that fell on the dry ground would be sucked up by it and only a very little would flow into the rivers and streams that feed the Mississippi.

"On the other hand, if there had been slight but frequent rains for weeks and weeks, those twelve inches of water would make an entirely different story. No one, except the Weather Bureau, would have kept track of the amount of rain that had fallen.

"If the ground has been steadily soaked, even by light occasional showers, twelve inches more of rain cannot soak in. Therefore, the entire amount of rain will flow directly into the stream channels and thus into the Mississippi. Flood warnings will be sent out, the height of the flood crest can be estimated, the length of the period of the danger will be known in advance and the proper preparations can be made. If further rain is threatened, that information can be sent out, also, and the entire Mississippi valley is completely prepared. That's the true preparedness, my boy, being ready for the foe that you know will come. Stupidity or cowardice are the only causes for not being willing and ready to help in time of danger."



No Peak Too Lofty for a Weather Station.
Taking recording instruments up a mountainside where there has never been a trail.

"What can a chap do?" asked Ross, aflame with eagerness.

The Forecaster looked at him thoughtfully, but before he answered, Anton piped in, with a plaintive note in his voice:

"Is there anything that I could do?"

In spite of himself, the Forecaster's glance fell on the crutch. Anton's intent gaze followed the look and he flushed. A sudden silence fell, the silence of an abiding tragedy from which all eyes are always turned, the tragedy of the disabled.

"Yes," he said with grave quietness, "there's a great deal that you can do."

The crippled lad regarded him steadily.

The steady rushing of the Mississippi in flood could be heard near by with its thousand miles of menace.

"We need work," the weather expert said, at last, "work with the heart behind it. Even now, the United States Weather Bureau has over four thousand co-operative observers, who work without pay, who work with their hearts behind their duties. Still, this is all too few."

Anton's gaze never wavered, but a question crept into his eyes.

"Yes," answered the Forecaster, "you can be one. I know your father well, and I'm sure that he will be guaranty for the instruments. The work of making and recording observations will be yours. Never late, never forgetting, never swerving from your duty, your post at the rain-gauge and the barometer will be as honorable and responsible a post as the soldier's at sentry-post or behind the gun."

The lad's eyes glowed more deeply.

"Storms, frosts, and droughts will be your enemies," the Forecaster continued, "and they never sleep and never give quarter. The lighthouse-keeper who lets his light go out and permits a ship to go unwarned to wreck upon the rocks is not more guilty than the Weather Observer who allows disaster to sweep, unwarned, upon his district. It is a trust, Anton. Can you and will you take it?"

The sun broke through the clouds, lighting up the yellow wood of the crutch and turning it into gold. It caught the boy's eye, but with a new significance. No longer would it stand between him and his future. There was something he could do for his country, as well as though he were the strongest and best-built lad in all the neighborhood. Life, with its promises of work, opened before him.

"I'll take the trust," he answered simply.

CHAPTER III

PUTTING THE SUN TO WORK

"Fo' the land's sake, Mistah Anton, what fo' yo' puttin' up that pole on the grass?"

"So that I can find the sun, Dan'l," the crippled lad answered cheerily, as he held upright the pole, while Ross began to fill in the deep hole that the two boys had spent the morning in making.

"Yo' don't need no pole to find the sun," the old darky answered; "why, yonder's the sun, right up over yo' head."

"Is it right over my head, Dan'l?" the boy asked.

The negro, an old family servant, put his hand above his eyes and squinted at the sky.

"Not right over," he corrected himself, "but mighty near it."

"How near?"

Dan'l looked at the boy with a puzzled air.

"Ah don't jest know how near," he answered.

"That's the idea, exactly," Anton rejoined, "I want to know how near."

"Is this hyar another of your contraptions to tell what the weather's goin' to be like the year after next?" the plantation hand queried, taking advantage of his position as an old family appanage. The instruments had been a point of discussion all summer, for Dan'l prided himself on being a

weather prophet, though he based most of his predictions on the behavior of the animals and birds around the farm.

"This is to tell time, not weather, Dan'l," Anton answered, "but we'll use it for weather, too."

The darky shook his head.

"Ah don't hold with none o' them glass things with silver runnin' up an' down in their insides, what you calls 'fermometers," he declared, "they're not nateral. Ah believe in signs. When, in the evenin', a rooster crows like he's done goin' to bust, ah knows sho' it's goin' to rain befo' mornin'."

He ambled up to Ross, who was busily shovelling in the earth.

"Hyar, Mist' Ross," he said, "let me do that for yo'. Yo' ought to ask old Dan'l when yo' got a job like that."

"That's all right," the older boy answered, readily yielding up the spade, however, and wiping the perspiration from his brow, "it is pretty hot, though."

"Yo' got no call to be workin' right near noon," the negro protested, "that's not fo' white folks. Fust thing yo' know, yo'll be havin' a sunstroke."

He shoveled vigorously as he talked, tamping the earth down hard.

"It's sho' goin' to be a hot summer," he said, "yo' only find the field-mouse nests where the shadder's thickest. Thar," he continued, patting down the earth level with his spade, "that's done now. Yas, suh, it's hot."

He wiped the perspiration from his forehead with the back of his hand.

"You bet the sun's hot," the boy agreed, "but Mr. Levin told me the other day that we only get a two-billionth part of the heat put out by the sun. Did you know that, Ross? The sun has heat enough to warm two billion Earths as big as this one. Even at that, Dan'l, the amount of heat we get from the sun would make thirty-seven billion tons of freezing water boil in one minute."

The negro's jaw dropped.

"Yo' not fooling?" he said.

"Not a bit."

"Ah's hot," he said. "Ah's goin' to boil, soon."

"Cheer up, Dan'l. You'll cool off tonight," suggested the older lad. "Nearly everything that takes in heat has to give it out again. The earth, the sea and the dust in the air, all gradually let out some of the heat during the night. If it wasn't for that, everything would stay at the same temperature all night long. That's why it's always colder an hour before dawn than an hour after sunset.

"See, Dan'l, the earth and the air which take in heat easily and give off heat easily, by the end of the night, have got rid of a lot of their heat. At sea, though, where the water lets go its heat less easily, it is never as cold as on land. The thermometer shows when it's hot and when it's cold."

"Ah don't hold with none o' them fermometers," the old darky repeated.

"That's because you don't understand them," the crippled lad replied. "It's dead easy, though. You see, Dan'l, when a thing is hot it gets bigger and when it's cold it gets smaller, that is, most things do."

"Ah don't see that, nohow," the negro answered. "A red hot stove is just 'zackly the same size as when the fire's out."

"No, it isn't, as a matter of fact," the lad replied, "but you can't always see the difference. Iron does get bigger as it gets hot. You've seen the steel rails on railroad tracks, haven't you, Dan'l."

"Sho'."

"Did you ever notice that there's a little crack between each rail? In winter, the crack is quite wide."

The negro thought for a moment.

"Is that the crack that makes a train bump?"

"Yes, that's it. Now, Dan'l, on a hot day in summer, you can't see any crack there at all, the rail has expanded or got bigger, and filled it up. On a frosty day in winter, there's a big crack, so big that you could drop a lead pencil between the ends of the rails. That's the difference of expansion on a steel rail between winter and summer."

"That's powehful little!"

"It's quite a good deal. I'll show you. Suppose, Dan'l, you had a small rubber ball filled with ink and there was a pipe out of the ball sticking straight up in the air, and suppose you put that little rubber ball in the crack between the rails."

"Yes?"

"Then, on a cold day, the rubber ball would have room enough. It wouldn't be squeezed and all the ink would stay in it. On a hot day, as the end of rails came together, they would squeeze the ball and the ink would squirt up. As there wouldn't be anywhere for it to go except through the tube, it would shoot up the tube, wouldn't it?"

"Sho'."

"So that you could tell, by the height of the ink in the tube, how much the rails had come closer together, or expanded. As the only thing that would make them expand would be the heat, you could measure the heat that way, couldn't you?"

"Ah reckon yo' could."

"That's what a thermometer does, Dan'l. The little bulb at the bottom contains something that's easily swelled by the heat. In a hot climate, quicksilver is used, because it doesn't boil except at a heat much greater than the air ever gets, though it freezes easily; in a cold climate, they use alcohol because it doesn't freeze except at a degree of cold much colder than the atmosphere ever gets, though it boils easily."

"Yo' fermometer's got blood in it!"

"No, the alcohol is colored, so that you can see it easily, Dan'l, that's all. The quicksilver, or the alcohol, is put into a little bulb and up from this bulb there runs a tube. That tube is awfully thin, sometimes a hundred times thinner than a hair. When a tube is as thin as that, even a tiny amount of expansion or contraction will make the quicksilver run up the tube or down. If you watch that thermometer I've got in that white shelter over there, Dan'l, you can easily tell when it's hotter and colder. It's nearly always hotter around noon."

"It's sho' mighty near noon now," Dan'l declared.

"How do you know?"

"Ah can tell that fo' sho', yas, suh!"

"How, Dan'l?"

"By mah own fermometer, Mist' Ross, an' that's mah inside. Right about five minutes befo' noon, thar's a little knock that says 'Tap, tap,' Dan'l, yo're hungry.' An' that knockin's always right, Mistah Ross. Ah sho' is hungry right at that hyar time."

"It hasn't knocked yet, Dan'l, has it?"

The darky looked thoughtful.

"Ah hasn't felt it," he answered, "but Ah's got a feelin' that Ah can expect it now 'most any minute."

"Well," the younger lad answered, watching the black shadow of the pole as it stretched along the ground almost to his feet, "we'll find out how near right your inside is."

He took a piece of steel tape from his pocket and handed it to his chum.

"How long is it, Ross?" he asked. He bent down eagerly and watched the measuring of the shadow.

"Four feet, six inches," the older lad announced.

The negro looked at the shadow a moment and then burst into a hearty laugh.

"What is it, Dan'l?"

"Why, Mistah Ross, it ain't no use for yo' to measure that! Yo' done forgot that a shadder don't stay still."

"Why not?"

"A shadder keeps movin' round. Yo' ought to have thought o' that," he added seriously.

"We thought of it, all right, Dan'l," Anton answered. "See, the line of the shadow's already on one side of the tape. Try it again, Ross!"

"Four feet, five inches and three quarters," came the reply.

"What fo' makes that shorter?" queried the negro.

"Dan'l," said the younger boy, reprovingly, "why don't you use that thick head of yours a little? When you get up in the morning, isn't your shadow longer than it is in the middle of the day?"

"Sho', it stretches away off yonder!"

"And in the evening?"

"Jest as far."

"And around noon-time?"

"It's right short."

"Then," said the crippled lad, "don't you see that if we measure where the morning shadow stops growing shorter and the afternoon shadow begins growing longer, that'll be the middle of the day?"

The darky slapped the side of his leg with a resounding smack.

"Who'd have thought o' that, now?" he said. "It sho' does look like you was right."

Ross bent down and measured the shadow.

"I think we'd better put in a peg to mark it," he said, looking up; "it doesn't seem to be changing so much. I can only make it five and five-eighths, now."

Anton stuck a sharpened peg in the ground and took out the little silver watch that had been given him on his birthday.

"It's not nearly twelve o'clock by my watch yet," he said.

"That's standard time," Ross reminded him; "don't forget that we're not right on the line of standard time here, Anton. That's New Orleans time you've got, not sun time."

"Is thar more'n one kind of time?" the darky asked. "Ain't time, jest time, all over?"

"I should say not!" declared both boys at once, "it's never the same true time at any two places in the world."

"That is," corrected Ross, "unless they happen to be due north and south."

"Yo' makin' a joke of me, Mistah Anton," declared Dan'l.

"Not a bit of it," replied Anton. "I'll show you just why. The sun rises in the east, doesn't it?"

"Sho'."

"So, if you walked a long way east, you'd see the sun quicker, wouldn't you?"

"Ah s'pose Ah would," the darky responded hesitatingly.

"And your watch would show that the sun rose earlier."

"Sho'!"

"So noon would come sooner, too. And if you walked west, it would be longer before the sun rose and noon would be later, that is, figured by your watch."

"Ah declah Ah never thought o' that!"

"So, you see, every place has a different time."

"But," the darky protested, "it's the same time when Ah goes to Vicksburg."

"Certainly," the lad answered, "and if you went away to Texas it would seem the same, but it really wouldn't be. The clocks change four times in the United States, don't they, Ross?"

"Yes, four times," the older lad agreed. "East of a line running through Buffalo, Wheeling, Asheville and Atlanta, time is called 'Eastern Time.' Everything west of that line is really an hour later, so the clock has to be put back an hour. If a train comes from the east into the station at Wheeling, at ten o'clock in the morning, and only stays in the depot five minutes, the timetable shows that it left at five minutes past nine."

"What-all happens to that yar hour?" asked Dan'l.

"It's just lost," Ross declared. "That standard of time, which is called 'Central Time,' reaches clear across to the middle of the Dakotas, and the eastern boundaries of Colorado, and New Mexico. There you lose another hour, 'Mountain Time' extending as far as the ridge of the Rockies. From there to the Pacific coast, it's called 'Pacific Time' and is another hour later.

"You see, Dan'l," he continued, "when it's noon in Washington and New York, it's eleven o'clock in Chicago, St. Louis and New Orleans; ten o'clock in Butte, Cheyenne and Denver; and nine o'clock in Spokane, San Francisco and Los Angeles."

"Who-all fixed it up that way?"

"The railways," Ross answered, "but the various states have O.K.ed it. You've got to arrange the setting of time in some definite way for the handling of railroads and telegraphs and things of that sort. It seems funny, Dan'l, but if you send a telegram here to a friend in San Francisco, he'll get it, according to his watch, nearly two hours before you sent it."

Ross stooped down as he spoke, and again measured the shadow of the pole, as it lay stretched out like a black line across the grass.

"It's just the same!" he cried. "It's noon now!"

Anton promptly set his watch right by the sun.

"There's Mr. Levin coming," he announced, "let's show him that his watch is wrong. He's always so exact."

The boys came up to him, but before they could put their question, the Weather Man spoke.

"Well, boys," he said, "what are you after? Putting up a flag-pole? It's a little short, isn't it?"

"No, Mr. Levin," Anton answered, "that isn't a flag-pole, it's a new clock, and one that's always right!"

"How have you been making it?" the Forecaster asked, immediately interested.

Anton described the principles that the boys had used and especially the means adopted to ensure that the pole should be upright.

"Why don't you fix it so that you won't have to measure the length of the shadow every day?" queried the Forecaster. "It's quite easy when you know how."

"Won't you show us?" responded Anton.

"Certainly," the old Weather Man answered, getting out of his buggy. "I see," he continued, "you've got hold of the idea that when the sun casts the shortest shadow it must be true noon, because the sun is half-way between the longest shadow and the shortest. That means, of course, that the sun is at the meridian."

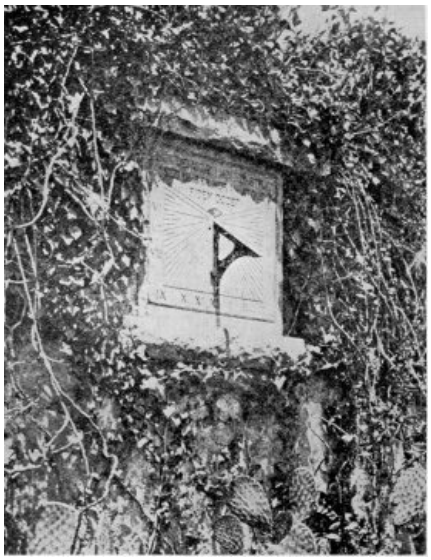
"Yes, sir."

"It would be much the same thing, wouldn't it, if you measured half the distance between the points on the horizon where the sun rose and the sun set?"

Ross thought for a moment.

"Yes," he said, "I suppose it would. But is that always the same?"

"How can it be anything else?" the Forecaster asked. "In winter the day is short and in summer it is long, but the meridian plane is always the same—that is, excepting for certain very small astronomical variations which would make no difference to you in the matter of measuring time. Let's get the meridian plane, first. Dan'l, do you suppose there's a pail of whitewash in the barn?"



WALL SUN-DIAL AT SANTA BARBARA, CAL., ON OLD SPANISH MISSION.

SUN-DIAL AT HILLSIDE, N.Y., DUPLICATE OF THAT OF SIR WALTER SCOTT AT ABBOTSFORD.

"Yas, suh," the darky replied, "Ah knows there is."

"Go ahead and get it then," the observer asked, "and let me have a piece of string."

He fastened the string to the bottom of the pole and awaited the return of Dan'l with the whitewash. In a moment the old negro came back with the pail.

"Now," said the Forecaster, "I'm going to hold this string right at the end, and, holding it tightly, walk around the pole. What kind of a figure will that make?"

"A circle," answered the two boys.

"Right. Dan'l, you take the brush and whitewash a narrow line right behind my hand as I move the string round."

Dan'l stooped down and rapidly painted in the circle, as the Forecaster moved the string.

"Next," said the Weather Man, "we'll make another circle, a little closer in."

"At any special distance, sir?" asked Anton.

"No," was the reply. "It doesn't matter. Any distance at all will do."

A second, and again a third circle was thus made.

"Tie a piece of rope around the pole," was the next direction, "as high as you can reach."

This only took a minute.

"Now, boys," the Forecaster said, "all that you have to do is to watch when the shadow of the rope crosses those three circles. Put in a peg this evening when it crosses the inside one, then the middle and then the outside. To-morrow morning, mark with pegs the place where the shadow crosses the same circles on the other side, only, of course, it will cross the outer one first."

"Then what shall we do, sir?" asked Anton.

"Have you a long straight board?" he asked in reply.

"Plenty of them," the younger lad answered.

"Good. Well then, to-morrow morning lay that board so that its edge touches the two points where the shadow of the rope on the pole crossed the outer circle and let Dan'l whitewash a straight line joining the two points. Do the same with the second and with the inside circles."

"Yes?" queried the lad eagerly, "and then?"

"You'll have three parallel lines," the Forecaster said, "the outer one longer and the next two shorter. Bisect those lines. Do you know how to do that?"

The younger lad shook his head.

"Only by measuring with a bit of string and doubling the string," he said.

The Forecaster took a pencil and an envelope out of his pocket.

"It's quite simple," he explained. "Fasten a string to the peg at one end of the line you want to divide in half. Stretch the string along the line till you come to the end of this line. Then make a circle. Do the same thing from the other end of the line. That will give you two circles crossing one another. With the board, draw a straight line joining the points where the circles cross.

"To be exact, bisect the line on the middle and on the inner circles in the same way. You'll find they all come out the same. The bisecting line, reaching from the pole, and crossing the bisected lines is called the plane of the meridian. If I were you, I'd make that line a permanent mark by pressing into the ground a row of stones, or those white clay marbles. Then the rain can destroy the other whitewash lines, without doing any harm, because you've got what you were after."

"But how is that going to show the time?" queried Ross.

"Because," said the Forecaster with a smile, "whenever the shadow of the pole lies along the line of white marbles, which marks the meridian plane, it is exactly twelve o'clock by sun time."

"Without any measuring as to length?"

"Without any measuring at all."

"That ain't no clock, Mistah Levin," the darky announced in a superior way. "Ah don't hold with no clock like that."

"Why not, Dan'l?"

"Ah gets hungry other times besides noon," he said. "Ah'd only eat once a day by that clock. No, suh, Ah wants a clock that tells every hour o' the day, not jest noon-time.

"Ah got another clock that don't never need no mending, not in summer-time," continued Dan'l. "My marigolds open at seven sharp every mornin' an' wink their eyes at me an' say 'Dan'l, yo're hungry,' and Ah sho' is. An' jest before six o'clock in the evenin', the white moon-flowers say, 'Dan'l, time fo' supper and yo' little white bed.' An' dey's right, too. Don't need no sun-clocks."

"I'm like Dan'l," put in Anton, "I'd like to be able to tell every hour, not just twelve o'clock only!"

"Well," the Forecaster answered cheerfully, "you can make your sun-clock that way if you like."

"Can we, sir?" asked Anton. "How?"

"By using your pole as the style or upright of a sun-dial. Before clocks were invented, people told the time by sun-dials, and there was a whole science of sun-dials, called gnomonics. It was quite a difficult mathematical science. Even after clocks and watches came into use, sun-dials continued to be used as time-pieces, because watches and clocks were expensive and there were few mechanics who could mend them."

"I've been wondering—" began Anton.

"Let's make a sun-dial here, Mr. Levin?" asked Ross, finishing Anton's sentence. "We can, can't we?"

"Certainly. You can make a sun-dial anywhere. If you had to do it without a watch, you might find it a little difficult, of course, but it can be done. For example, I can tell you off-hand that for this latitude here, the angle between noon and eleven o'clock, is a little over nine degrees, while it is nearly ten degrees at New York.

"Since you've got a watch, however, it's quite easy. Your meridian line marks twelve o'clock, and a line drawn at right angles to it, from the base of the pole, inclined to an angle corresponding to the latitude, will mark six o'clock, morning and evening. If you'll put in a peg on the circle that Dan'l whitewashed, exactly at the place where the shadow touches when it is one o'clock, two o'clock and so forth on your watch, the watch having been made to agree with the shadow at noon, your sun-dial will be right all the year, round. You don't need to mark anything earlier than four in the morning or later than eight in the evening, as even on the longest day, here, the sun does not rise before that time nor set after it. You don't have to get up before six o'clock to mark the hours, as the lines are the extension of the four and five lines of the afternoon."

"Let's do it!" cried Anton. "We'll make a clock with white stones, just that way! Couldn't I divide it up into five minute distances, like a regular clock, Mr. Levin?"

"Yes," the Forecaster answered, "if your circle is big enough. And if you wanted to do the thing in the way that it used to be done, you could have a little motto running all around the circle, just picked out in white stones."

"What kind of a motto, sir?"

"All kinds were used," the other answered, "I remember one that read 'Pass On'; another 'Do not linger'; but the one I like best is the old Latin one which ran 'I count only the bright hours.' I suppose you've heard the story of the American sun-dial motto?"

"No, sir," said both boys together.

"You knew that the sun-dial is one of the official emblems of the United States?"

"I never heard of it," Ross exclaimed.

"It is. It was used on some of the earliest American coins. Last century, in London, one of the courts of justice, known as the Inner Temple, gave an order to a sun-dial maker to put up a dial. He asked for a motto, and was told to come the next day for it. Next day it was not ready, nor the day after. Still the dial-maker persisted. At last, one day, in making his request, he interrupted an

important meeting, and the chairman turned to him quite impatiently and said:

"'Sirrah! Begone about your business!'

"'A very good motto,' said the dial-maker, not realizing that the command was meant personally for him, and he engraved the words on the dial. When the lawyers of the Inner Temple saw the motto, they agreed that nothing could be better, though it had never been intended.

"When our first coinage was discussed, Benjamin Franklin was on the committee and he suggested that a sun-dial should be used. As, however, the coinage would go to the people instead of the people going to the sun-dial, he suggested the old motto with a change. This motto read:

"'Mind Your Business!'"

"That's good, too," exclaimed Anton.

"Very good. So that phrase was engraved on the American coinage, and on some money that was issued by the State of New York, over a century ago. You could use whichever motto you liked best."

"I'll use the American one!" declared Anton enthusiastically. "I've a lot of those marbles. I'm going right off now to see if I haven't enough."

He shifted his crutch to a more comfortable position under his arms and pegged across the yard to the house as hard as he could go.

"I've noticed," said the Forecaster, as he looked after the limping boy, "that Anton seems a lot happier since the flood. He used to be such a mournful little fellow."

"It's this weather work you started him on," the boy answered. "It means a lot to him."

"Ross," said the Weather expert, "I've been thinking a good deal about Anton and about all the rest of you boys in this neighborhood. Issaquena county is over ninety per cent colored and there aren't very many of you white boys, but the dozen or so that are here seem to me to be mighty good American stuff."

"They're a dandy lot," Ross agreed.

"Have any of you boys thought at all about what's going to happen to Anton, when he grows up? His father hasn't money enough to send him to college, or anything like that, especially since he lost so much by the flood, and, being a cripple, Anton's not going to have much of a chance on the plantation."

"I hadn't thought of it," Ross answered, "but it does seem as if he were up against it, doesn't it?"

"Why don't you boys make it easy for him?"

"How, Mr. Levin? We would in a minute, any of us. Everybody likes Anton."

"Look here," said the Weather Man, putting his hand on Ross's shoulder, "I know from experience that when you suggest something worth doing to a bunch of American boys, they're mighty apt to go ahead with it. Now, as you said yourself, Anton seems to have a real interest in these weather observations. His father tells me he's never two minutes late in taking them. Making this sun-dial is another example of the same thing. What I'm thinking is this—why couldn't Anton be taken in hand and taught to fit himself for the Weather Bureau? I'll teach him mathematics as my share, but you boys will have to do your bit."

"What could we do?"

"Suppose—of course, without letting Anton know why you're doing it—suppose you boys got together and took up this weather plan as a sort of outdoor club. You could meet here at Anton's place. If all his chums were interested and having a natural earnestness, I'm sure he'd work like fury at it. It would give him a real chance, and, what's more, I believe you chaps would like doing it."

"Make a Weather Bureau of our own, Mr. Levin? I think it would be great!"

"I think myself that you'd get a lot of fun out of it," said the Forecaster, "but the real idea is that you'd be helping Anton, yes, helping him more even than when you rescued him from the drifting house during the flood, because you'd be giving him a start in life. It's a piece of work that's worth the doing, Ross."

"It's a bully scheme, sir," agreed the boy, waving his hand to another lad who was coming up the road. "I'm game to do all I can."

"You'll have a good deal to do," the Weather Man warned him. "I know you're practically the leader of the neighborhood and the boys follow you. I've spoken to a few of the fellows and asked them to meet me here this afternoon, but I wanted to see you first. I've just come from your house and they said you were over here. It's got to be a boys' deal, through and through."

Ross thought for a moment.

"You said, sir, we oughtn't to let Anton know. I think, perhaps, we ought to keep it dark. But I'd

like to talk to Bob Portlett about it, if you don't mind. He doesn't talk much, but the chaps put a lot of stock in what he says. Bob and I are pretty thick, you know."

"Of course, talk things over with him. I spoke to him about it yesterday. You two go into executive session, while I go up to the house a minute."

He nodded to Bob and strode off across the yard.

"Levin been talking to you about Anton, Bob?" Ross asked, as soon as the Forecaster was out of hearing.

"Yes," answered Bob, in his abrupt way. "He said you knew all about it."

"He only sprung it on me just a few minutes ago," Ross rejoined, "but I think it's a dandy idea," and he proceeded to relate to his friend the outline of the plan. When he had finished, Bob nodded his head.

"Count me in," he said, "I'll do anything for Anton."

"What'll you do?"

"Wireless," was the brief reply.

"What's that got to do with weather?"

"A lot. I got my new big sending apparatus yesterday and I've got a transmitting license."

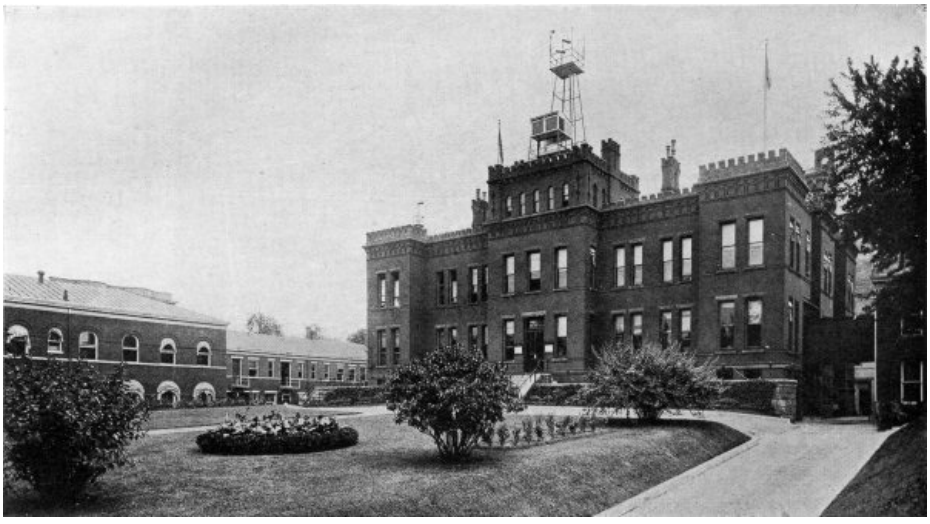
"Have you?" said Ross in surprise. "I thought they were so awfully hard to get. Don't you have to pass an examination, or something?"

"Yes. I passed it. I've still got the small apparatus I used to have, the one you know. I'll give that to Anton, teach him to work it. He can send me his observations and I'll transmit. I've a lot of amateur stations on my string. How's that?"

"Fine!" declared Ross enthusiastically, "it would keep the observations up to scratch if the chaps knew they were going to be used. Who else do you think would join in?"

One by one the two lads discussed the other boys in the neighborhood. Meanwhile, many of them had arrived and were clustering around Mr. Levin and Anton, asking innumerable questions about the new sun-dial. Dan'l was giving out information freely, and one of the puppies had taken exception to the whitewash line and was barking at it with high puppy-toned barks. Presently Ross caught the Forecaster's eye, and came over and joined the group.

"I've just been telling the fellows, Ross," said the Weather Man, speaking as though the lad knew nothing about it, "that we've a good chance in this county to give a hand to the Weather Bureau. I'm out of the work, now, of course, but my heart's in it yet, and I'd like to see Issaquena County put on the map. We haven't got an observer's station in the entire county. Weather's the most important thing in the world and we've only just begun to learn how wonderful it is.



THE FIRST LINE OF DEFENCE AGAINST THE TEMPEST.

Headquarters of the U. S. Weather Bureau, at Washington, D. C., where every wind and cloud that passes over the United States is chronicled and watched; the greatest forecast office in the world.

Courtesy of U. S. Weather Bureau.

"Every one of you boys has seen what it means when the Mississippi gets in flood, and most of you could guess what would have happened last spring if the Weather Bureau hadn't given any warnings. As it was, nobody was drowned, all the way down the river. In the Johnstown Flood, just because it was a case in which no warning could be given, over two thousand people were killed.

"Think of it, boys, if we could get together and map out the weather in every square mile of this county, we could make this district the best kept and most famous meteorological centre in the

world!

"I know, sometimes, it seems as if we were a good deal out of things, here. There's not a town of any size in the county, one day's a good deal like another, and we're apt to think of places like New York, Chicago, New Orleans and San Francisco as being the fighting centres of the nation's life.

"Yet, right here, right over our heads, the never-ending battle of the weather goes on, with its brigades of warring clouds, its wind-cavalry and its artillery of storm. The sky holds more secrets than the city does and there's a lot of adventurous work to be done. Which of you is game to do it? Who'll volunteer?"

An excited babble of answers greeted him.

"I will, Mr. Levin!" cried one.

"Sure!" said another.

"Put me down for it," proclaimed a third, voicing the general sentiment.

Ross brought the matter to a point.

"The way I feel about it," he said, "I reckon we'd all like to tackle something like that. And, I tell you, chaps, it would be bully for us to have a club-house of our own."

"A club-house!" cried one.

"Yes," said Ross, "Anton's father is ready to give us the old barn. He says we can fix it up any way we like."

"All for our own?"

"Yes, to do anything we like with. Mr. Levin has given me some bully ideas about things we can do, and Bob's thought up a scheme that's just great!" and he proceeded to explain the lad's offer of wireless.

The enthusiasm of the boys was rapidly growing. With the Forecaster behind him, with Anton's rain-gauge, with the new sun-dial staring them in the face, with Bob's plan for the wireless plant, with a club-house of their own and the admitted leadership of Ross, the whole group was swinging into line.

"Tell you what I'll do for my share, fellows," said another of the boys. "You know that printing-press of mine?"

"You mean the one you printed the pirate flags on, Fred?" queried Ross, referring to the Treasure Island period when the boat was made.

"Yes. Ever since Dad found that he had to use the shed I used to keep the press in, I haven't had much chance to get at it. I'll ship the press over here, if there'd be room for it in our club-house," the words were said with great pride. "We could print a little weekly paper. I wanted to do that last year, but Dad said that he didn't want me to print nothing but gossip, and there didn't seem anything else to write. If we really had some stuff worth reading, like weather news, I'm sure I could make it go. Enough, anyhow, to pay for paper and mailing."

"You think we ought to issue a regular weather bulletin," said Ross. "That's a good notion, Fred."

"I'll let you have some of my stories," said one.

"Or Fatty's jokes," suggested another, dodging a nudge of the elbow from his neighbor.

"A weather bulletin would be a good thing," the Forecaster said, approvingly.

"What could the rest of us do?" asked an alert youngster. "I haven't a printing-press, or a wireless apparatus or anything else."

"Nor have I," said two or three voices.

The Forecaster looked quickly at Ross. This was a crucial point. It was Anton who answered.

"You've got plenty of wind at your place, Lee, haven't you?" he asked.

The lad laughed.

"Pop says it's the windiest place in the county," he answered, "poked right up there on the top of that knoll."

"You ought to be the official wind-measurer," the crippled lad declared. "There is a way to measure wind, isn't there, Mr. Levin?"

"Certainly," the Forecaster answered, "it's a very necessary thing to do, too."

"Pete's camera!" interjected the laconic Bob.

"What's the good of that?" broke in its owner. "You can't snap-shot the wind, at least not that I've ever seen."

"Clouds!" said Bob.

"That's right," agreed Anton, "you could photograph the clouds, Pete. Suppose you took a snap-shot of the sky every day, at the same time, for a year, it would make a peach of a series."

"The Bureau at Washington would be glad of a series like that," put in the Forecaster. "So far as that's concerned, Pete, I'd buy a daily print for my own use. I couldn't pay much, of course, but enough to meet the cost of materials."

Pete brightened up.

"I'll do that, quicker'n a wink," he said. "I've snapshotted about everything else around here, but I never thought of the sky."

"You could tackle eclipses and halos and rainbows and lightning—all sorts of things," suggested Anton.

"Right-o!" answered Pete, "you can put me down as official photographer."

"I don't see," said one of the smaller lads, "where that rain-gauge is so hard to make. I'll make one and put it up at my place."

"Dad's got an old barometer," suggested another, "that he used to have when he was a steamboat skipper. I'm sure he'd let me have it. It's in the attic now, where nobody looks at it."

"Some of us might measure the amount of sunshine," said Ross. "Isn't there some way of doing that, Mr. Levin?"

"Indeed there is," the Forecaster replied. "Why, in some places, they run machinery by sunshine. There is a big solar engine at Pasadena, in California, where they pump water and irrigate an orchard just by an arrangement of mirrors. Even a small one would run quite a good-sized engine."

"Gimme that! Oh, gimme that!" burst in another of the boys, who had been passive theretofore but who was absorbed in mechanics. "I'll be tickled to have an engine run by sunshine."

The Weather Forecaster looked around with a smile at the enthusiastic group.

"It seems to me," he said, "that with an official photographer, an official wind-measurer, an official sunshine recorder, an official wireless station, a club-house and an editor with an official publication, 'The Mississippi League of the Weather' is mighty well launched on its way.

"Now, I'm going to have the fun of making the first motion. I move you, Mr. Chairman, that the League come into the house and hold its first official feast!"

CHAPTER IV

THE MASSACRE OF AN ARMY

"Where's the boss?" queried a strange voice, one afternoon.

The entire mechanical staff of the *Issaquena County Weather Herald*, consisting of Fred Lang, publisher and editor-in-chief, aged fifteen, and a general assistant with the blackest face and the whitest teeth in the county, aged seventy, named Dan'l, turned at the question.

"Why?" asked Fred.

The stranger stepped into the office of the *Herald*.

"I'd be wishful to see the foreman," he said, with a twinkle in his eye, "that's if he's not too busy."

Fred grinned in response.

"I guess I'm the foreman," he said.

"I'm lookin' for a job," the new-comer explained.

"What kind of a job?"

"Any kind of a job in a printin' shop," the Irishman replied. "I'm an old-timer. There's nothin' about printin' I don't know."

"Have you seen a copy of our paper?" asked Fred.

"I have so," was the reply, "I've got it with me, right here." He pulled from his pocket the latest number of the little four-page sheet. "'Tis an illigant publication," he went on, "but I'm thinkin' that you're in sore need of a printer."

"Does it look so bad?" queried the "foreman." "The worst of it is, I don't know how to make it any better."

"I'm not saying that it's bad, but there's a deal to be learnt about printin'," the journeyman declared. "I'm thinkin' your compositor hasn't had overmuch experience."

"He hasn't," the boy admitted. "I'm him. Dan'l helps me all he can, but since he can't read, it makes it bad."

"Give me the job," said the Irishman, "an' I'll make the paper look right."

"I can't," Fred replied. "The subscriptions hardly pay for the paper and the ink. I give Dan'l thirty cents a week for wages to run the press and it's hard to scrape up that much, because Mr. Levin says I mustn't pay out a cent that the *Herald* hasn't actually earned. What wages do you want?"

"Three dollars a day when I'm workin'," the journeyman printer replied, "an' the good green grass to sleep on and a hunk of corn-bread to eat when I'm not."

The young editor looked at the journeyman printer with a sudden eagerness.

"I've got four dollars and a half saved up," he said, "that's a day and a half's wages. Will you teach me all about printing in a day and a half? That isn't office money, that's my own, but, you see, it's for me."

"I'll teach ye for nothin'," said the Irishman, pleased at the boy's pluck, "if ye'll give me a bite to eat an' a place to sleep."

Fred shook his head.

"No," he said, "Mr. Levin won't let any of us boys take something for nothing. I'd sooner pay. It would be great if you could get out this week's number for us, and let me see how you do it. I'd learn a heap that way, and it would be just the stuff I want to know. Then the number you got out we could use for something to go by. But you'll have to do it in a day and a half, because that's all the money I've got. Can you?"

"I can that," the printer answered, "an' I'll pay for my board out of it, so that you won't be spending all your money."

"Can't do that either," said the boy, "because that would make it Anton's Dad's money, not mine. If you want to pay him, all right."

The Irishman stripped off his coat and rolled up his sleeves.

"I'll be lookin' to see what fonts o' type ye have in the shop," he declared, and examined the forms which were lying on the rough table.

"Did anny one ever show you annything about printin'?" he asked presently.

"No," said the boy, "I got this printing-press from a chap whose brother used to run it. The fellow who owned it was going to show me how it worked, but he went away and hasn't come back."

"Watch me a while," the journeyman responded and began to unlock the forms that had stood since the issue of the week before. It was a revelation to the boy to see how the trained fingers of the printer sorted, classified, and arranged the type. Talking steadily, in his Irish fashion, the journeyman explained how the type should be set up, showed that they had been using twice as much ink as necessary, warned them against pinching the type too closely, explaining that this "put the letters off their feet," and, by altering the arrangement of the sheet, improved its appearance a thousandfold. These routine matters were quickly adjusted, and then the printer asked for the copy which was to fill the first page.

"It's just got here," the young editor answered. "I haven't looked over it yet, but I guess it's all right. I had a wireless yesterday that one of our chaps was sending in a corking description of a sunset, or rather a sort of description of all the sunsets in the last month. Here it is."

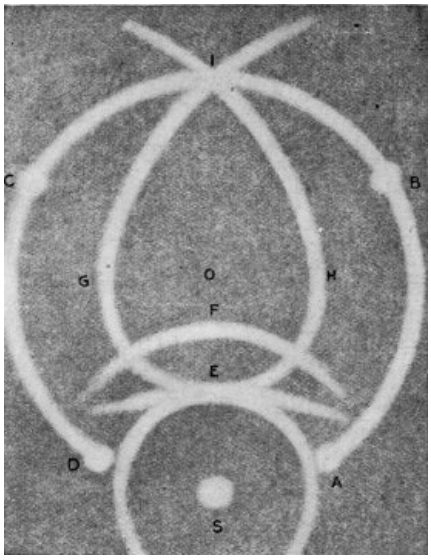
He handed the pages of boyish handwriting to the journeyman, who looked over them hastily.

"'Tis fine stuff, entirely," he said in surprise. "I'd be wishful to take some copies of the paper for myself. Listen to this now!" And, turning the sheets, the enthusiastic Irishman read aloud:

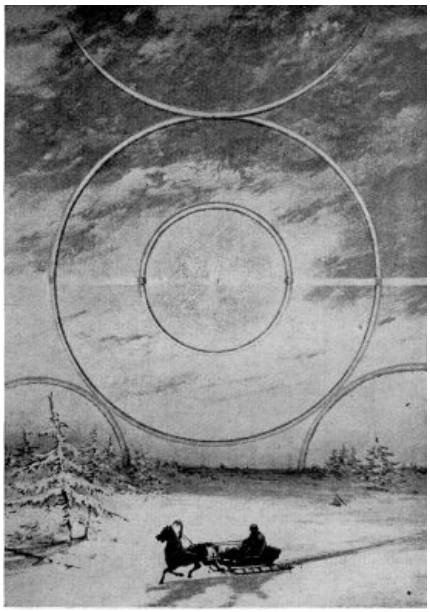
"'Sunsets all look different, but when you write down what you see, one right after the other, they seem to be quite alike, that is, when the sky is clear. When the sun begins to set, and there are not many clouds, the lowest part of the sky is more different from the rest of it than in daytime. In the west—at the side of the setting sun—the sky looks white, changing to yellow. In the north and south, it is a dull yellow, which gets yellower. In the east, it is a dirty yellow, which changes slowly into a dull purple. All these yellows are duller at the horizon than a little way above. The purple in the east looks gray at the sky-line but shades into blue, higher up.'

"'Tis an illigant style the boy has," declared the journeyman, and continued:

"'Just as soon as the sun begins to drop below the horizon, an ash-colored plate (the shadow of the earth) begins to creep up the eastern sky, covering part of the purple bit and making it look like a purple rainbow. Soon the shadow covers all the purple light in the east.



SOLAR HALO SEEN IN THE UNITED STATES.
This halo was seen over a wide area, and was especially bright in Virginia.
Courtesy of Scientific American.



SOLAR HALO SEEN IN RUSSIA.
(By permission from Camille Flammarion's "Meteorologie.")

"'In the west, where the sun is setting, the colors are all different. The whitish light spreads quite a long way up into the blue, but when the sun comes close to the horizon, this turns to yellow, lighter higher up and darker lower down. It is sometimes reddish at the horizon line, and the clouds are turned to pink.

"'After the sun has really gone down, the yellow gets darker, changing into orange, sometimes, while the white spot spreads sideways and its upper edge marks off the brighter from the darker bits of the sky.

"'In the darker part of the sky, at about quarter way up, a purple glow suddenly appears. It grows bigger quickly, making a circle, the lower edge of which looks as though it slipped behind the yellow strip. This purple spot in the west comes just as the purple rainbow in the east is dying out, and as the western purple spot grows it gets brighter, so that there is a time, after the sun sets, when it seems brighter than it did before.'"

"That's queer," interrupted Fred.

The printer thought for a moment.

"It's right, bedad," he said, "I've noticed it meself."

He continued reading:

"'Sometimes there are dark blue and greenish stripes running down to the sun and these stripes shoot a long way up into the sky.

"'If there are any clouds, they seem to be generally light yellow to begin with, changing to pink and rose, then red and dark orange. I couldn't find any system in the color of the clouds, perhaps because they are at different heights.

"'A few times I've seen a sort of second faint purple arch or bow in the east, but by that time it's

dark. In the west, though, the second arch is quite clear. As the first western purple arch sinks to the horizon, following the sun, a green stretch, ever so green, shows up, and above it is a second arch of bright light, with a purple arch above that. When this last one sinks, it is quite dark.'"

Mr. Levin, as was his habit on Saturday afternoon, had come over to the League's club-house, and he had entered during the reading, followed by his usual bevy of boys; Rex, Lassie, and four roly-poly puppies, now able to run around on unsteady legs, bringing up the rear.

"That's a mighty accurate description of sunset colors," the Forecaster commented; "whoever did that, deserves a lot of credit. Hello! Have you enlarged your staff, Fred?" he continued, as he noted the printer and realized, at a glance, that the little shed had already assumed a more business-like look.

The editor-in-chief explained the bargain he had made and the Weather Man nodded his head approvingly.

"That's the best way I know to spend your savings," he said, "using them to learn something. I'm glad you're going to have this issue properly printed, too, because that sunset article is about the best you've had, so far. If I don't miss my guess, a good many people will keep that number as a sort of reference for the colors of sunset. Who wrote it?"

"I did, sir," said one of the boys who had come in with him.

"Good work," the Forecaster commented. "Do you happen to know, though, Bert, what makes the colors of sunset? Why doesn't it just gradually get dark as the sun goes down?"

"I don't know," the boy replied. "I tried to explain it the other day and I found I hadn't the least idea why, myself. I asked Father, but he didn't know either."

"Yet it's quite simple," the Weather Man answered, "and if you boys are going to be real meteorologists, you ought to know the reasons for things. First of all, why is the sky blue?"

There was a gasp of astonishment, followed by silence.

"Sure, 'tis the air that's blue," hazarded the printer.

"That doesn't help much," the Forecaster said, "though perhaps it does, a little. Why is the air blue?"

The Irishman shook his head.

"Why is annything blue?" he asked.

"That's just what I'm going to tell you," the Weather Man answered, "and you want to listen carefully, boys, because the colors of the sunset depend a great deal on the weather. You can foretell weather from the sunset."

"Yo' sho' can," interrupted Dan'l. "Don't yo' remember Mammy's old rhyme:

> "Evenin' red an' mornin' gray
> Certain signs of a beautiful day;
> Evenin' gray an' mornin' red,
> Sends a nigger wet to bed."

"All those old rhymes are fakes, though, Dan'l," declared Anton, with the importance of his newly acquired weather knowledge.

"Easy there, easy there!" warned the Forecaster. "Not so fast. A good many of those old rhymes are mighty good weather forecasts. That one is, for example."

"You mean, sir, that a red sunset and a gray sunrise really tell that the weather is going to be fine?"

"Yes, to a great extent, they do."

"Why, Mr. Levin?"

"Because they show the state of the atmosphere, boys. Rain can't fall unless there is dust. Every little drop of rain has a grain of dust in the middle. The colors of the sunset, too, are due partly to dust. Not only that, but colors of the sunset vary as the particles of dust which reflect the rays of light, are enveloped by water vapor.

"A piece of dust, without an envelope of water, is smaller than one with a little wetness around it. When more water vapor gathers around the piece of dust, the drop becomes bigger. When the sunset is red, it is a sign that it is shining on very small bits of dust, or that the condensation of water vapor into rain has not advanced very far. If, however, the sunset sky is gray, that means that the upper air is saturated, that it has all the water it can hold, and, of course, rain is likely to come soon."

"I should think, then," said Anton, "that gray in the morning would be a bad sign, too."

"It's not, though," the Forecaster replied; "the proverb is right there, as well. A gray sky in the morning means that the air is filled with water drops which are large enough to reflect light of

every color. While this is the same as the gray of evening, the processes that led to the forming of these drops is quite different. In the day the dust is heated and the forming of the droplets in the afternoon is due to cooling. In the night, the condensation is caused by loss of heat through radiation. Radiation shows that the air above must be dry. Therefore a gray morning means a dry air above the water drops, and this means a fine day, for the droplets will soon be evaporated by the rising sun. The red morning sky declares that the dust particles have been protected from radiation by a blanket of overlying moisture, the air, therefore, is saturated to great heights and rain is probable. So you see, Anton, Mammy's rhyme is right."

"What fo' yo' talk to me against signs," declared Dan'l, putting out his chest and strutting; "Ah done told yo' them signs am pow'ful good."

"But the sunset colors, sir?" the author of the article asked. "You said they were due to dust. Just how, sir?"

"Yes, to dust, plain ordinary dust, but dust of the lightest kind," was the reply. "If you could go up in the air a hundred miles, the sky above you in the middle of the day would be jet black and the sun would shine down on you like a great bright-blue ball, without any white glare around it at all."

"Then it's a blue sun that makes a blue sky!" cried Fred.

"Don't go so fast," the Forecaster warned him. "I want you to think of the sky, first. It's a dead black, a hundred miles up. Now, at a hundred miles up, the air is so thin that there's little or no dust, but as you gradually come down and the air becomes denser, it begins to be able to buoy up some dust. Boys," he said, breaking off suddenly, "why does a stick float in water when it falls in air?"

"Because water is denser than air?" guessed Ross.

"Exactly. And why does a bar of iron sink through water and not through earth?"

"Because the particles of earth won't move aside as easily as the particles of water, I suppose."

"Not quite, but something that way. So, you see, as the air gets gradually denser it becomes gradually more able to support particles of dust, light ones at first, then heavier and heavier, until near the earth big pieces of dust can be carried in the air. You know how big some of them are when you happen to get a grain in your eye! Viscosity has a lot to do with it, too.

"The light of the sun is a bluish-white, like some of the blue stars. White, as you remember from the rainbow, is just a mixture of all sorts of colors and the different colors are created by waves of light, some being shorter and others longer. A long wave, like the red, will pass around a tiny piece of dust, but a short wave, like the blue, will be stopped by it, and scattered, sometimes polarized, as it is called, or turned into one plane."

"I don't think I quite see that," said Anton.

"It's a little complicated," the Weather Man answered, "but maybe I can give you an idea of it. Suppose you were on a big steamboat in a choppy sea. As the steamer's length would extend over several of these waves, none of them would be big enough to make the vessel heave. If you were on that same choppy sea in a small canoe, you would be tossed in every direction. Now, if you think of the long red wave of light as a steamer and the blue as a canoe, you can see that in a ripple of small particles of dust the blue is going to be more affected than the red. In other words, the blue will be scattered. It will be diffused all over the sky and the light that comes through will be less blue."

"Then I should think the sun would look red," said Anton.

"It does," the Forecaster explained, "when there's a fog, which simply means, when there's more obstruction in the air. Sunlight is never white, as you know, it's yellow-white and the golden effect is due to dust. It's the same way at sunset. Then the rays of the sun which reach you pass through a larger amount of air, because you're looking at them from an angle, so they have to strike more grains of dust, and more of the blue rays are scattered. Then, too, when the sun, at sunset is, to you, shining obliquely on the atmosphere, it is passing through several layers of air and these bend the rays differently."

"I still don't see," said the author of the sunset-color article, "why there should be so much pink, or rose-color, and why the clouds should generally be pink."

"There's not much pink in a clear sky," the Forecaster answered, "and as for the pink clouds, you've never seen them in the west when the sun was still above the horizon, have you?"

"No—no," said the other, "I don't think so. The pink generally comes after the sun had disappeared."

"Scientifically, of course," the Weather Man said, "the sun has gone below the horizon at least two minutes before you see it disappear. You're looking at a sun that isn't there at all. That's due to refraction. The reason of the pink glow is that when you see it, the earth and the air for several thousand feet above you are in the shadow of the edge of the earth. The sun, therefore, is not shining on the thicker dust of the lower part of the air, but the finer dust of the upper part, the particles of which are small and more uniform in shape.

"The glow is of a rose-color because the particles are of the size to diffuse the rays of this wave-length. That's why rose colors appear in the east, before the west, and why the color lasts in the sky, which may be reflected on dust twelve miles high, after it has disappeared from the upper clouds, which are not more than eight miles high."

"'Tis the illigant hand ye are at explainin'," put in the Irishman, "but I c'n remember, when I was learnin' me trade, about thirty-four years ago, the sunsets were much finer than annything I've seen since. We don't have such sunsets now as when I was a boy."

"They were sho' brighter," agreed Dan'l. "Ah can remember when the skies used to look like they was all burning up. Ah thought the end of the world was a-comin', sho'!"

"Thirty-four years," said the Forecaster thoughtfully; "that would be in 1883, wouldn't it? Why, of course, Mike," he continued; "that was during the period of the famous Krakatoa sunsets."

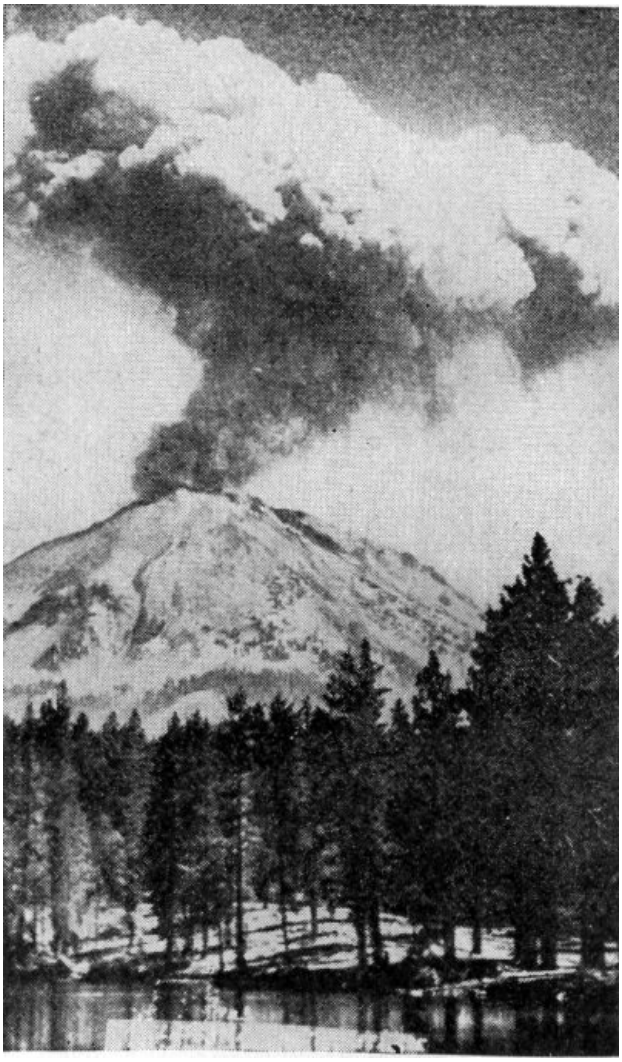
"An' what's a Kraker-something sunset?" the printer asked.

"Krakatoa," the Weather Man explained, "was a volcano, near Java. In August, 1883, one of the most violent eruptions in the history of the world occurred. Half the island was blown up in the air, and, where a mountain had stood, the ocean rolled a thousand feet deep.

"The vibrations in the air were so terrific as to break windows and overturn frame houses over a hundred miles away, and the pressure wave, like some huge blast of wind, traveled round the world three times before it died down. The huge sea-waves caused by the eruption and the engulfing of the island, swept across the oceans, destroying the coasts for hundreds of leagues around. Over thirty thousand people were drowned.

"Pumice and ashes fell over the sea so thickly that within three miles of the island you could walk on them, and even five hundred miles away, the ashes formed a scum on the surface of the sea. The finer dust and the icy particles from the condensed vapor reached extreme heights in the air. These dust particles spread all round the world, completing the circuit in fifteen days.

"The sunsets were extraordinarily red, because, in the very thin air of great heights, there was an unusual amount of dust which had been forced there by the great volcanic outburst. It took three years for this dust gradually to settle into the lower air, and this made the sunsets that Pat speaks of. The great eruption of Mont Pelé in 1902 created unusually beautiful sunsets in America for a couple of months afterward, but, of course, this was not to be compared to the Krakatoa eruption.



THE DUST THAT MAKES RED SUNSETS.
The volcanic eruption of Lassen Peak, Cal., on October 6, 1915, taken at intervals, the first three photos five minutes apart, the fourth, ten minutes later, showing the beginning of the second cloud.
Copyright by Chester Mullen. Courtesy of U. S. Weather Bureau.

"It's curious, though, boys," he said, "that Bert, here, should have been writing this article on sunsets, because it happens that I've got something here quite important to show you."

Walking to the table, he took a large home-made portfolio from under his arm and spread it out. He untied it, threw open the cover and stepped back to let the boys look. They crowded round.

"Oh—oh!" said one. "Isn't that bully!"

The Forecaster turned over a second picture.

This was greeted with cries of delight, and one of the lads added:

"I saw a sunset exactly like that only a week ago!"

The Forecaster bent down and looked at a pencilled note underneath the vivid chalk drawing.

"It is dated just a week ago," he said.

"I didn't know you drew with chalks!" said Ross.

For answer, the Forecaster smiled and turned to another one. The first few had been a little crude, but it was evident that they improved as the series went on. All of them, in a curious way, possessed the faculty of giving a real impression of the sunset.

"So you like them," the Weather Man said, when the whole series had been examined.

"They're dandies," declared Ross, and Fred added:

"I wish we could use them as colored plates in the *Review*."

"Who do you suppose drew them?" the Weather Man asked.

"Didn't you?" queried several of the boys together.

The Forecaster shook his head.

"One of the boys?" asked Ross.

Again the Forecaster made a negative gesture.

"A boy drew them," he said, "but not a member of the Mississippi League of the Weather."

"Who was it, Mr. Levin?" pleaded Anton.

"Cæsar," he answered, "down on McDowell's place."

"Cæsar!" exclaimed Fred; "it couldn't be. Why, he's—" he checked himself just in time, remembering that Dan'l was close by.

"Yes, he's colored," the Forecaster agreed. "But don't you think he can draw?"

"He surely can."

It was on the point of Anton's tongue to suggest that the colored artist should be admitted to the membership of the club, but, so far, its membership had been confined to the white boys, largely in deference to the feelings of the older people of the neighborhood, many of whom remembered the difficulties that followed the reconstruction period after the Civil War.

Anton looked a little troubled.

"Do you think we ought to get mixed up in a thing like this?" he asked.

The Forecaster glanced at him.

"You mean because Cæsar is a negro?"

"Yes, sir," the crippled lad replied.

"I don't want to persuade you one way or the other," the Weather Man replied, "but I can tell you how I feel about it. I don't see that it matters very much what point of view a fellow has on the color question, we're all agreed that the darkies should be given every chance. You certainly can't harm yourself by helping any one, no matter who it is that you help."

"Sure," Ross agreed.

"And even if the person you help is never going to be able to do you any good, why, that's all the more reason for helping, isn't it?"

"Yes," admitted Anton.

"All right, then. Supposing some of the older people here do feel that it's necessary to draw the color line closely; well, I don't see that it wouldn't be a good thing for us to strike out a little. The color line is there, and it's going to stay there. But the most unreconstructed man in the district—even Colonel Grattan, for example—will do everything possible to better the condition of the negroes. I think it's the absolute duty of every American boy to help every other American boy when he gets the chance, whether his skin is white or black."

"Yes," said the laconic Bob.

Anton brightened up, for he was anxious to help Cæsar.

"What do you suppose we can do?" he asked.

"I'd rather put it up to you boys," said the Forecaster. "This is your affair, after all."

Anton turned to Ross.

"Haven't you some scheme?" he asked.

Ross shook his head.

"I haven't thought one out. How about it, Bob?"

"Deacon Paul," was the abrupt reply.

"Yes," said Ross, "old Paul will do pretty nearly anything for me, because Dad was so good to his father when he was a slave. But I don't quite see what he can do?"

"I do be thinkin'," said the Irishman, "if I might be so bold as to make a suggestion, that there's no reason why you boys shouldn't use a colored lad's work. He's only a contributor, annyway. When a paper takes a story or a picture from a man, it doesn't ask who his parents were. Why don't ye make some color plates and give them as premiums for subscriptions?"

The Weather Forecaster laughed aloud.

"That's a good business idea, Pat," he said. "Some of the colored planters and farmers are fairly progressive here, and a premium of a colored lad's work might be a good scheme."

"But I can't make colored plates!" protested Fred.

"No," said Pat, "you can't, an' that's a fact. I was forgettin' that this wasn't a regular shop."

"How could we get them made?" asked Anton. "Do you suppose the Weather Bureau in Washington would make them for us and let us have a few copies?"

"No," said the Forecaster decidedly, "I know the Bureau wouldn't. They've a hard enough job doing their work on their present appropriations, as it is, and if they were going to spend money on sunset pictures, Anton, such would be done by some big artist, in consultation with trained meteorologists."

"I've been wondering," began Anton, and paused.

"Go ahead," urged Ross.

"Couldn't we interest some one else to do them, just to help the thing along?"

"One of the big negro colleges has a lithographing plant," the Forecaster said thoughtfully; "they might be interested in it, if the matter were put before them the right way. I don't suppose they'd give any money, but they might make plates for you at cost and you could sell them here at enough to cover the expense. Bob has the right idea.

"Talk it over with Deacon Paul, the colored minister; he's closely in touch with all the progressive work among the negroes. I think you'll find it can be arranged, because there's a right fine spirit among the negroes. They're trying hard to improve themselves.

"I believe you could interest them, too, by showing that the study of the weather, even in sunsets, is a patriotic duty. The negroes are mighty loyal."

"Mr. Levin!" exclaimed one of the boys, "what has a sunset got to do with patriotism?"

"They do look pretty far apart, don't they?" replied the Weather expert, with a smile. "Yet one of the great tragedies of military history, one which led to the death of hundreds of thousands of men and changed the map of the world, was due to a failure to study the colors of a sunset."

"What was that, Mr. Levin? Won't you tell us the story?" pleaded Anton.

"Very well," the Forecaster agreed; "maybe it'll show you how important to the world everything is that is connected with the weather.

"I was telling you about Krakatoa and its eruption and how the outburst had caused red sunsets that lasted for three years. Now, if you think for a moment, you'll see that any one who observed a period of unusually red sunsets and knew the cause of them would know that there had been a big volcanic eruption somewhere."

"Of course."

"Now, boys," said the Forecaster, "suppose that the upper air were unusually full of dust, what effect do you suppose that would have on the temperature?"

For a moment no one spoke, then Anton piped up:

"I've been wondering," he said, "if the dust wouldn't shut out some of the sunlight and make the earth colder."

The Weather Forecaster gave the boy a shrewd look.

"We're going to make a real weather man out of you, Anton," he said. "As a matter of fact, it does, though, of course, not to such a very noticeable extent. Indeed, it's only quite recently that we've been working out the relations between volcanic eruptions and weather. They're striking, though, and while it may be a little too early to say that the one causes the other, volcanic action has a big influence.

"The Krakatoa eruption, as I said, produced a dust cloud in the upper parts of the air, which not only created red sunsets, but which kept so permanent a haze over the sky that the sun was surrounded by a reddish brown circle, known as 'Bishop's ring,' during most of that time. This circle showed the existence of a dust cloud, through which the sunlight had to pass. As a result, the amount of sunlight was diminished. When the sunlight is less, the crops are poorer, for it needs the entire force of the sun to ripen them, and the three years following the eruption of Krakatoa are known to history as 'The Poverty Years.' The still more famous 'Year without a Summer,' which was the year 1816, followed the eruption of Tombora, the autumn before."

"That seems to cinch it, Mr. Levin," said Ross.

"It isn't sure," was the reply, "but it seems that way. Famines have a tremendous effect on the world's history. The great French Revolution, one of the greatest events in modern history, was brought to a head by a famine. This was the 'Three Year Freeze' of 1784-1786."

"Did that follow a volcanic eruption, sir?" asked Anton.

"It followed the greatest eruption in the history of the world, that of Asama, in Japan, in the year 1783. In that eruption, fifty-six thousand people were killed and the entire atmosphere of the earth was shaken. Like Krakatoa, you see, boys, it took three years for the dust to settle down."

"But what has that got to do with the army, sir?" Fred asked.

"I was just coming to that," the Forecaster replied. "If Napoleon had known as much about the weather as we do now, boys, the world's history might have been very different. There had been some marvellous sunsets during the years of 1810 and 1811 and the spring of 1812, but none of

the scientists of that time thought of observing them or finding any significance in them, nor did any of them imagine that such could have any effect on the weather. Before Napoleon started on his march for Russia, which was begun in June, he asked the French meteorologists at what time the Russian winter usually began. They told him that if he could begin his return by the middle of November, his army could get safely out of Russia before the winter set in.

"But, boys, the three years before that campaign had been three years of eruptions. St. George, in the West Indies, erupted in 1810; Etna, the great volcano of Sicily, had an eruption in 1811; and La Soufrière, which broke loose again in your lifetime, boys, erupted in 1812. As a result, the upper air was full of dust, and the middle air was even more filled, for while these eruptions were not as powerful as Asama and Krakatoa, there had been a continual replenishment of the stores of volcanic dust.

"So Napoleon and his army started off. The great march into Russia began with an army of four hundred and fifty thousand men, in torrid summer heat. The crops were still green, for the spring had been late and the summer most unseasonable. As a result, there was not enough food for the horses and terrible epidemics of disease broke out among them. Napoleon was always especially strong in cavalry, over eighty thousand of his troops being mounted. When, to this, is added the twenty thousand horses needed for officers and for the artillery, it is easy to see that the lack of forage seriously handicapped the army. It is by no means easy to feed a hundred thousand horses. Before the army had advanced more than ten days' march, one-fourth of the horses had died.

"The Russians, thoroughly realizing that their strongest ally was Distance, retreated, without giving battle. Napoleon's army marched on. The Cossacks, with their well fed horses, constantly circled round the French army and cut to pieces the small detachments in the van and in the rear-guard. The French cavalry, with their horses dead, dying or out of condition, could not pursue. Meanwhile the army, under the burning heat of the short summer which had known no spring, marched on.

"Into that huge wilderness, over the marshes and plains, the army marched. Always before it lay a land bare and dumb. The vast Russian army could never be found. In endless succession the French crossed plains on which the grass grew, thin and bare, splendid for the grazing of cattle, but utterly insufficient for a hundred thousand horses, now reduced to seventy thousand. Ahead of the soldiers, every day, the sun rose red upon an empty land, every night it set, red, behind them, upon a land equally bare and empty. Day after day they marched through this land without food, unmolested by the Russians, who knew well that lack of forage and interminable marching was defeating the great Napoleon better than they could upon the battlefield, and without the sacrifice of a single Russian soldier. Weather, boys, always weather, is the greatest ally or the greatest enemy in the entire history of war.

"At last the army saw in the distance a long black line. Every effort of Napoleon to persuade the Russians to attack him had failed, the Russian army steadily withdrew. But when the long black line of Smolensk appeared, hope was restored to the French army. At last they would meet the Russians on equal terms and decide the campaign against guns and bayonets instead of against leagues and starvation! On Napoleon marched and at last found himself before the town of Smolensk. The French army, now only four hundred thousand strong, was yet an unwieldy force to handle. It took two days for the various groups to form into positions and then they charged the town.

"The soldiers fighting them had fled. Everybody had fled. The city was utterly deserted, sad and silent as a grave-yard. There was nothing there to eat. The Russians had destroyed everything. There was not a handful of oats, not a loaf of bread. The French victory had gained for them only an empty city and an empty land. It was now the end of August, and Moscow was a long way away.

"The march continued. Before them, the sun rose red through the volcanic dust every morning and set red every night. Had there been a meteorologist present able to warn Napoleon, even then, the army could have retreated safely. But the army went on and on, into the land that the Russians themselves had swept bare and left empty. Villages and towns were passed, each deserted, as Smolensk had been. What the people could not carry away they had burned. The fields were scorching and black. Smoke filled the air. For three weeks more, well into September, the French army toiled forward, steadily growing hungrier and leaner, losing horses and men all along the line of march.

"At last the Russians made a stand. The desperate conditions of the march had divided the French army into scattered portions, and when, quite suddenly, the Russian troops confronted them, only a hundred and twenty-eight thousand men were available, the others straggling behind. The Russians had a hundred thousand men, but the French superiority was not enough for them to secure a final victory. The great battle of Borodino began before sunrise, and the setting sun, red as always, sank too early to see its end. When night fell on the scene, thirty-eight thousand Russians had fallen and only twenty-five thousand French, but it acted almost as a defeat upon the French, accustomed as they were to sweeping victories.

"The red sun next morning rose on the French army, eager to continue the battle. But in the night the Russians had fallen back again, and, before the French, the road to Moscow lay open. Open, indeed, but burned black and desolate as before. Seven more days of marching, with hungry stomachs and famished horses and then, Moscow! The goal of the French! The army

beheld the city it had come so far to conquer. The red sun of the seventh day found the spires of the Kremlin in sight. Again the French were sure of victory.

"Moscow was as clean swept as the smallest village on the road. Everything had been carried off or destroyed. Moscow lies far to the north and the days began to grow perilously short. Napoleon sought to make terms with the Russians, but met with nothing but delays. The Russians were waiting for the approach of their great ally, the winter.

"In all Moscow there was no food and forage. All the people had gone. Napoleon did not dare to bring his whole army into the city. There was nothing to eat. They camped at various distances outside, tightening their belts for hunger. Meantime the Russians, constantly retreating and moving the provisions back with them, were steadily growing stronger in position and men.

"The rapidly shortening days meant long cold nights. The soldiers in Moscow made camp-fires of the costly pieces of furniture that remained in the palaces, but those who were encamped on the plains outside had no fire at all in the long hours of darkness. Many of them, too, were from the south of France, unaccustomed to the cold, and, besides, were equipped for a summer campaign, not garbed in the heavy clothing of the Russian troops. In that country which had been abandoned for purposes of war, there was not even wood enough to light the fires for cooking. Ever the days grew shorter and the red sunrises and the red sunsets—which would have meant so much had any one understood—continued.

"Then into the city came Fire! In the middle of the night, at a dozen different points, Moscow was set aflame by the Russians. A great wave of fire started from all quarters at the same time, swept over the city, for the Russians had waited for the moment when the wind was high and the night was cold. Houses and palaces flared upward in the conflagration, then sank to smoking ashes, for almost the entire city was built of wood.

"All in a jumble—infantry, cavalry and artillery—the French got away, the flames howling so closely after them that the backs of their necks were singed. Suddenly they found themselves in the midst of a tremendous rush of water and ice. On one side, to windward, the Russians had started the fire, on the other, where there was a possible escape from its fury, they had turned the river into the streets. The French were caught between the two. Some of the horses, fairly maddened, turned backward and plunged with their riders into the flames. For an instant, horse and man would flare up like tow and then there would be a black twisting thing that dwindled to nothing in the blaze. Out from the burning city, in wild and utter retreat, flew the French Grand Army, out to a land without food, without forage, without inhabitants, and the nearest help a thousand miles away.

An Army Destroyed by Weather.

Napoleon deserting his troops during the retreat from Moscow, when the emperor defied the winter, and left a quarter of a million men dead on the snows of Russia.

"Then came the snow. No longer was the red sunrise before them, but behind them. The victorious march was a defeat. Black-gray clouds came over the sky and obscured the sun. At first the snow was to the ankles, then to the calves, and then to the knees. The wind was bitterly cold and the men ill-clad. It froze the French to their marrow. Every few minutes a soldier dropped from starvation, cold and exhaustion. The Russians did not appear. There was no need. They had a new ally—the wolves! No one could stop to pick up an exhausted soldier; it was all that any man could do to keep up himself. Half the officers were on foot. The cannons were abandoned. When a horse died, the regiment ate him and staggered on.

"The Cossacks now began to add their terrors to those of the wolves. If a small detachment straggled out of the blinding snow, unseen until that time would come a rush of the furious and valiant horsemen of the steppes, and the detachment, hungry and exhausted, would be cut to pieces. They fought with heroic courage, but no man can fight the Weather.

"Smolensk was reached on the return march, with the wreck of the French army, now only fifty thousand strong. The skeletons of four hundred thousand men lay on the Russian plains. Near a place called Krasnoi, the Russian army suddenly appeared and a battle was fought. Napoleon commanded with his old-time mastery and succeeded in breaking through the Russian lines, but he had to leave Marshal Ney with six thousand men behind him. Ney performed wonders, and with his tiny force also broke through the Russian army, but when the French resumed their flight, Ney had only eight hundred men. The rear-guard alone lost five thousand at that place.

"The French Army had now reached the marshes, but the Weather was fighting for Russia. Just at this time, a sudden and unexpected thaw set in, making the marsh a morass. The Russians, well-provisioned, circled around the French army, and again came in front of them at a river called the Beresina. Waist-deep in that icy current, with masses of floating ice being carried down by the sudden thaw, with a huge Russian army on the opposite bank, the French soldiers fought for their homeward way. Winter was before, winter behind, the Russians on the barrier. Yet the French fought on and crossed the Beresina with marvellous courage, the Russian strategy, meanwhile, sacrificing comparatively few men. The Beresina was crossed, but when the Russians were finally swept aside and the French passed through, less than nine thousand men answered the roll call. Forty thousand had been lost between Smolensk and the Beresina.

"The thaw was followed by another terrible period of cold. The retreat of the army became a fearful rout. Napoleon, himself, fell a victim to the panic, and deserting his troops to Murat, spurred for France, reaching Paris after a ride of three hundred and twelve hours. The routed and disorganized French Army straggled back to Germany, to Austria and to France. When Christmas Day that year came down over Europe, less than five thousand men were alive of the four hundred and fifty thousand who had started six months before to carry the eagles of Napoleon over Russia. It was the most splendid campaign and the most spectacular rout in history, and the foe who fought the battles that defeated the Great Emperor was—The Weather."

CHAPTER V

THE RUNAWAY KITE

The sunset pictures made a better showing as lithographs than even their young creator could have hoped, and the *Issaquena County Weather Review* became a source of personal pride to every one in the neighborhood. The farmers and planters vied with each other in giving information of weather happenings and the little publication was never short of "copy."

"Dan'l," said Fred to his chief assistant, one day, "I'm going to print an article on 'Weather Superstitions.'"

"Yas, suh," said the darky, wondering what was coming.

"And you're going to write it."

"Ah write it? Sho', now, you'se jokin', Mistah Fred. Ah can't even write my own name."

"I know that. You don't need to write, Dan'l. You're going to collect every rhyme and proverb and saying about the weather you can hunt up in the neighborhood. Get Mammy Crockett to tell you all she knows. Then you must repeat it to me. I'll write it down word for word, and it'll be your article."

"If yo' wrote it down, it wouldn't be mine," objected Dan'l.

"Oh, yes, it would," the editor-in-chief assured him, "some of the greatest authors in the world dictate their books."

So Dan'l went all around the neighborhood, announcing that he was a "sho' enough autho' now," and so full of delight that there was no holding him in at all. He proved a good collector of superstitions, moreover, and when at last the article came out in the *Review*, it was so complete and so original that it was reprinted in one of the big Folk-Lore Magazines.

The visit of the journeyman printer had been of great value. Fred had been shown just how the work should be done and his pride was involved in keeping the paper up to the standard. Moreover, the Irishman had secured a large box of discarded type from a printing firm in Vicksburg, and had forwarded this to the boys. Fred returned the courtesy by mailing Mike a copy of the *Review* regularly, and Mike occasionally sent a package of the printing trade magazines that he found lying around the shop. Fred picked up many hints from these and thus secured quite a good start in his knowledge of the printing trade.

The "official photographer" had been equally successful. One day, while up on the levee trying to take a satisfactory picture of an elusive "mackerel sky," which was changing from moment to moment, he met a stranger. This stranger was sitting on a log that projected into the river, holding a rod and line, and landing fish with an accustomed skill.

"What in blazes are you trying to photograph?" he said after a while, as he watched the lad focussing his camera earthwards on what looked like a piece of black glass, which projected from

the stand.

"Clouds, sir," answered Ralph.

"When I try to photograph clouds I look at the sky, not on the ground," the stranger remarked. "What's that contrivance you've got on your camera stand, anyway?"

"It's just a broken piece of looking glass," said the boy, "but I painted it on the back with black enamel."

"What for?"

"So that I could get at the clouds easier, sir," the boy replied. "I read how to do that in a book I've got."

"I don't see why black glass should make any difference," said the fisherman, getting up from the log and coming over to where the boy was standing.

"It does, sir. If you look on the glass," said Ralph, "you'll see. The clouds are ever so much sharper."

The stranger looked in. Even the fleecy white clouds, scarcely visible in the blue sky overhead, stood out a clear white against the blackness of the mirror. The blue sky was not reflected in the glass.

"That's queer," said the stranger, "the blue hardly shows at all. I wonder why?"

"It said in the book," Ralph explained, "that the blue didn't show up so much because it was partly polarized. I couldn't quite understand what that meant. As far as I could make out, the blue color of the sky is due to waves that are scattered sideways instead of coming straight down like the white light does."

"I suppose it is polarized," said the fisherman, "but it hadn't ever occurred to me that the sky wouldn't be reflected in a black mirror. You're right, though. The clouds do stand out well! You ought to be able to get some good pictures from your mirror."

"I have got a lot, sir," said Ralph. "I've made three cloud photographs every day, rain or shine, for over two months now."

"Every day?"

"Yes, sir, before breakfast, after dinner, and just before I begin my evening chores."

"What's the idea of that?"

Finding a ready listener, Ralph plunged into the story of the Mississippi Weather League and of his crippled friend, Anton.

"It's a mighty useful piece of work," the fisherman commented, when the lad had finished, "and I'm especially interested in these cloud photographs of yours. I need some. Have you any prints of them?"

"Yes, sir," was the reply, "heaps."

"If they're really any good, I might be able to use a few," the fisherman continued. "I'm writing a series of articles for an outdoor magazine and I want some Mississippi River pictures pretty badly. Mine haven't come out particularly well."

"I'll show you all I've got," eagerly replied Ralph, and, a little later, he took the stranger home with him.

There he displayed, not only his cloud photographs, but also all the snap-shots he had made with his camera during the three years he had owned it. The magazine writer was highly delighted, for many of the pictures were exactly what he needed, and when he went away he took with him thirty photographs, for which he paid Ralph, as he said, the "regular price" of three dollars apiece.

"That's what they'd have to pay if they bought them from any of the news photo houses," he remarked, "and you might as well get the same."

To Ralph this ninety dollars was a fortune. He offered to turn the entire sum over to the League, or at least that part of it which had been paid for the cloud photographs. Ross vetoed this offer, on the ground that the League itself had not earned the money. Instead, Ralph put away some of the cash and with the rest he bought a new lens for his camera. With this lens he was able to take cloud pictures even better than his former ones.

A few weeks later, at the next Monthly Feast of the League, Ralph came proudly forward with a collection of over one hundred cloud photographs.

"I don't see, fellows," he said, "why we all couldn't have a shot at observing the clouds. I was talking to Anton the other day, and he didn't seem to know anything about the names of the clouds at all. I dug 'em up from a book I've got at home. I was thinking that it would be rather jolly if each member of the League had a set of cloud photographs for himself, with the right names of the clouds and all that sort of thing on the back. It isn't much trouble to make prints."

"I'd like to have a set, Ralph," said Ross promptly. "I hate to feel like a dub and not know about the clouds. It's like not knowing any of the stars."

"There certainly ought to be a set in the office of the *Review*," declared its editor-in-chief.

"I've been wondering," began Anton, "whether Mr. Levin wouldn't pick out the best ones and tell us exactly what they are. I had an awful job trying to get Ralph to bring his pictures to-day; he said he wanted to wait until he had perfect ones."

"You'll wait a long time, my boy," the Forecaster put in, "if you wait until you have a perfect set. I don't know of such a set anywhere in the world. Clayden, in England, has got some fine examples —"

"It's his book I've got," interrupted Ralph.

"There are a few good pictures in that," the weather expert said. "Loisel, in France, has some good examples and our own Weather Bureau has done quite a little cloud work. But those I've seen of yours, Ralph, are quite good. If you like, I'll go over them for you and pick out the ones that are the most characteristic. Your plan to give a set to each of the boys is quite worth while. Let's see the pictures, Ralph."

The "official photographer" pulled out, from a bulging inside pocket, a large bundle of photographic prints and spread them on the table. The collection included both the pictures Ralph had taken with his new lens and some of the old ones intensified in the way that his visitor had showed him. They made a striking contrast, in their vivid black and white, to the cloud pictures, printed in a pale blue, issued by the Weather Bureau.

"I think Ralph's pictures are away ahead of the Weather Bureau ones," declared Fred.

The Forecaster shook his head.

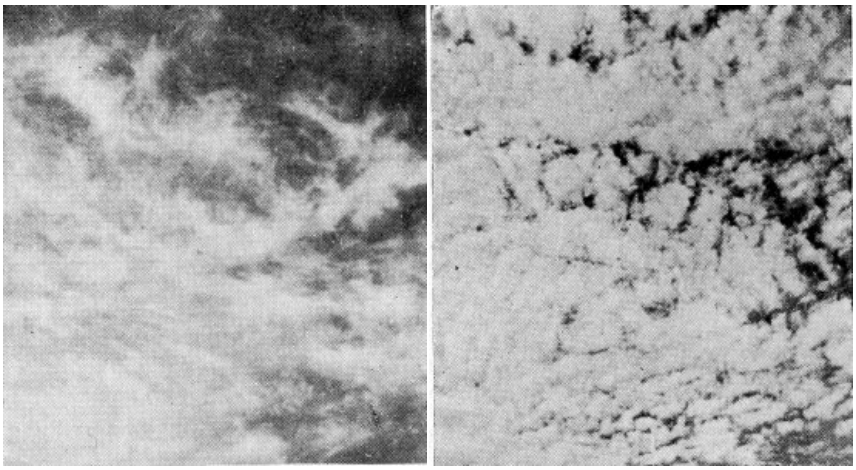
"Some of them are prettier pictures," he said, "but the Weather Bureau sheet is chosen to help observers classify the clouds. If you notice that blue sheet of cloud forms that Washington has issued, you'll notice that they are very carefully selected and that you really can tell the various types of cloud from them. At the same time, clouds are hard to classify, because, at any given time, you're looking at a stretch of sky—counting the separate layers of cloud—several hundred square miles in extent, and, generally, there are many different types of cloud in the sky at the same time."

"How many kinds of clouds does the Weather Bureau name?" asked Anton.

"Ten," was the reply. "There are lots of variations in those main groups, but that's enough to begin on. The general idea of the classification is by the heights of clouds, the Cirrus group being the highest, from about six to ten miles, the Alto group, ranging from two to six miles, and the Cumulus and Stratus groups below that. Here," he continued, picking out a photograph that showed only a few faint specks of white, "is a true Cirrus. It is the highest of the clouds, and, as you can see from the photograph, it is delicate and fibrous. This one, that looks like the ghosts of feathers, is another form.

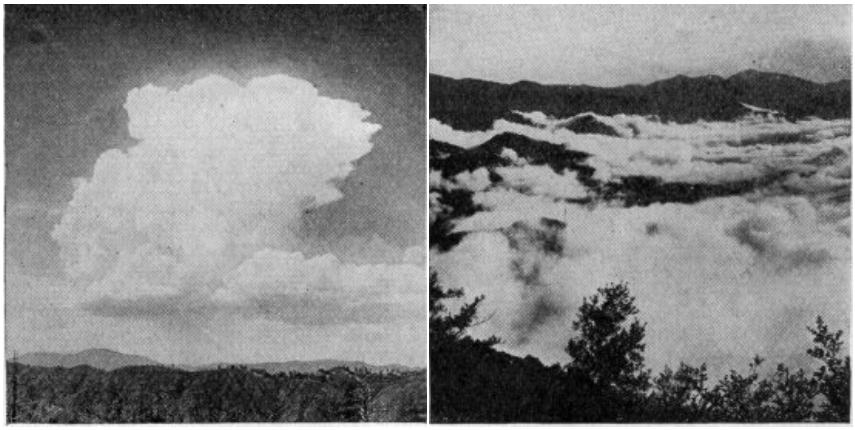
"Cirrus clouds always appear to move slowly, because they're so high up. As a matter of fact, they fly along at the rate of from one hundred to two hundred miles an hour, and generally in an easterly direction. This photo that looks as if the clouds were a whole pile of spiders' webs, all mixed up, is the second class of clouds, known as Cirro-Stratus. Did you happen to notice, Ralph, whether there was a halo round the sun when you took this?"

"Yes, sir, there was," the boy answered, "but it hasn't showed up on the plate. I've got some halo pictures at home, but I didn't think of bringing them along. I just brought my cloud stuff this time."



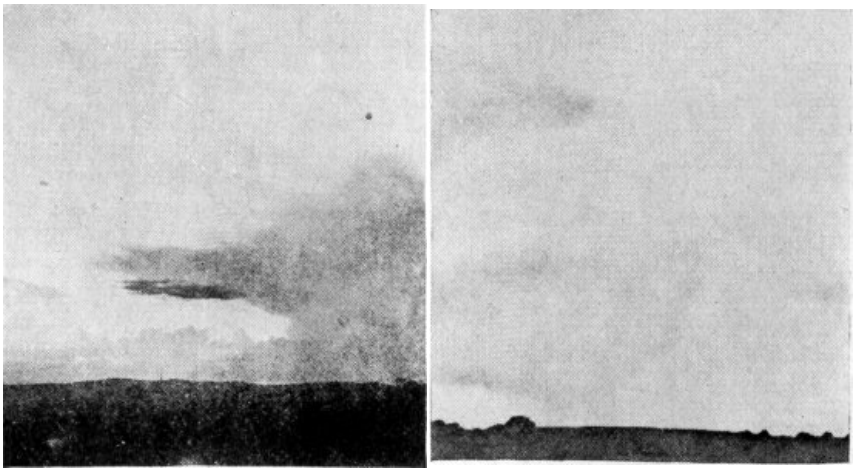
CIRRUS IMPLEXUS ALTO-STRATO-CUMULUS

TYPES OF UPPER CLOUDS.



CUMULUS STRATUS

TYPES OF LOWER CLOUDS.



CUMULO-NIMBUS NIMBUS

TYPES OF RAIN CLOUDS.

"Well," said the Forecaster, "suppose you put one of those in here as an example of cirro-stratus. There couldn't be a halo without it. All the upper clouds are made of ice crystals and it is the refraction of the sunlight through these ice crystals that forms most halos. By the way, boys, don't confuse a halo with a corona. They're quite easy to tell apart, because a halo, unless it is one of the unusual white ones, always has red as the inside color and a corona always has the red on the outside."

"How can I tell them apart on a photograph plate, sir?" asked Ralph. "That doesn't show any colors."

"By their distance from the sun," the meteorologist replied. "Halos are seldom seen except at distances of about twenty-two degrees and forty-six degrees from the sun. There are lots of others, but they are rare. You'll soon learn to catch those distances by eye. Coronas are usually much smaller.

"I think one of the most striking forms of cirro-stratus is the polar 'band,' which stretches from one side of the sky to the other, like a wide white road."

"Ah knows that one, Mistah Levin," put in Dan'l. "Noah, he done stretch that road for the animals to get out of the Ark."

The Forecaster glanced at the aged darky.

"You certainly did manage to pick up a lot of queer superstitions in that article of yours, Dan'l. I've heard that cloud called a Noah's Ark cloud, but I never knew why."

"Yas, suh; oh, yas, suh," Dan'l repeated earnestly, "Noah, he done make that cloud, jest like the rainbow was made to convince Noah that there weren't goin' to be no more floods."

"A high cirro-stratus which looks as if some cream had been poured on the blue sky and hadn't mixed properly yet," the Forecaster continued, "is cirro-nebula. It's very hard to photograph, and even when you do get it on a plate, it doesn't look like much.

"Now the third one in the classification is very familiar. That's the well-known mackerel sky. What's the rhyme about that, Dan'l?"

Proud at being thus appealed to, the darky quoted triumphantly:

> "Mackerel scales and mares' tails,
> Make lofty ships carry low sails."

"That's correct," said the weather expert, "because those clouds foretell wind. Sometimes the cloud flakes are less solid and look like the foam in the wake of a steamer.

"Beneath them come the alto clouds, which are made up of drops of moisture instead of crystals of ice. The fourth class, called alto-stratus, is a thick sheet of gray or bluish color, sometimes thin enough to let the sun shine through. When lower and in heavy roundish masses it's called alto-cumulus, which is the fifth on the list, and when it is lower still and looks like a lot of great blue-gray footballs wedged closely together it is known as strato-cumulus."

He shuffled the prints rapidly, selecting types of clouds as he did so, and pencilling on the back the character of the cloud.

"Then comes the cumulus, the big round cloud, that looks like masses of fluffy cotton wool piled on top of each other. These are the 'woolpack clouds,' which, in summer time, throw deep shadows on the grass. It is this cloud which, when it comes between you and the sun, gives rise to the old saying that 'every cloud has its silver lining.'"

"Those aren't the thunder clouds, sir, are they?" the photographer asked.

"No," the Forecaster answered. "The thunderstorm clouds are called cumulo-nimbus. They're heavy masses of cloud rising in the forms of mountains or towers. Isn't there a rhyme about clouds and towers, Dan'l?"

"Yas, suh, there's a rhyme," the old darky replied, and he quoted:

> "When clouds resemble domes an' towers
> The earth is wet with frequent showers."

"That, boys," the weather expert said, "is another true proverb, because the description applies to thunderstorm clouds, when the rain is likely to fall in frequent showers."

"It doesn't look like a regular rainy sky, though, Mr. Levin," said Anton. "I thought rainy skies were usually heavy and gray."

"They are," the Forecaster answered, "and the Weather Bureau gives all the rain clouds the general name of Nimbus, which simply means a thick layer of dark clouds, without shape and with ragged edges, through which rain or snow falls steadily. Sometimes, when there is a powerful wind in the cloud layer, the lower edges of the clouds are broken apart, or loose clouds are seen traveling fast under the overlying gray. Sailors call this scud."

"Mr. Levin, suh," broke in Dan'l, "Ah knows a rhyme for scud, too," and he quoted:

> "Scud above and scud below
> Shows there's goin' to be a blow."

"Well," said the Forecaster, hesitating, "that's not quite as good as some of the others, because you don't see scud until the wind has already come. As a whole, though, it's right, because it implies that the atmospheric currents are powerful, and if the rain disappears, a wind is likely to follow. I noticed you missed the rhyme about the rain before the wind, in your article, Dan'l," he continued.

"Yas, suh!" the darky answered, "Ah don't know that one."

"It runs like this," the Forecaster answered:

> "When the rain comes before the wind,
> Be sure to take your topsails in,
> When the wind comes before the rain,
> You can put them on again."

"That's a good one, too, because high winds and steady rain seldom go together.

"The last type of clouds, which is Number Ten in the Weather Bureau Classification, is called Stratus. It really looks like a lifted fog, which sometimes it is. Indeed, there is no essential difference between clouds and fogs, anyway, except that fogs are formed at the surface and clouds above it."

"All clouds are fogs, sir?" said Anton, in a surprised voice.

"Yes, my boy. Clouds are visible water vapor. Their visibility depends largely on condensation, just as rain depends largely on the dew-point."

"What's the dew-point, sir?"

"The dew-point," the Forecaster explained, "is the temperature at which the air becomes so full of vapor that it can't hold any more without letting it down as rain or snow. It's never the same any two days in succession, because the air can hold more water vapor when it is warm than when it is cold."

"Is that why muggy days are so uncomfortable?" asked Ross.

"Yes. When the air is full of water vapor, it hasn't the same readiness to absorb it. When you

perspire on a dry, hot, windy day, the air absorbs it right away, but on a day that's humid or muggy, the air can't hold any more, so it doesn't evaporate and the perspiration trickles down your back and into your eyes. A moist climate feels hotter in the summer and colder in the winter than a dry one, although, in reality, it isn't as hot or as cold. Every moist climate is a cloudy climate, and Ireland—which is called the Green or Emerald Isle because there's so much rain that none of the vegetation ever dries up—has some of the most beautiful clouds in the world."

"Is there any place in the United States without clouds?" asked Ralph.

"There's no place in the world that's absolutely cloudless," was the answer, "but clouds in some deserts are few and far between. There's one well known hotel, in the Southwest, that advertises 'free board every day that the sun doesn't shine.' It's a safe offer, too, for last year they only lost two days on it. There are some clouds there, but not such as to obscure the sun.

"In a cloudless country, boys, there are great extremes of temperature, as much as forty to fifty degrees between noon and midnight. You'll get sunstroke in the early part of the afternoon and shiver under blankets in the evening. That's because there are no protecting layers of clouds to equalize the radiation. The air, especially high up, is very cold. Don't forget that the upper clouds are all made of ice crystals."

"I've been wondering," said Anton, "how you can find out that it's so cold high up in the air if no one can live up there?"

"Balloonists have often passed through clouds of ice crystals and snow," the Forecaster answered, "though, of course, they've not been as high as the upper clouds. Many observations have been made by releasing small sounding balloons with an instrument attached, letting them go as high as they could, until they burst and fell to the ground. But much of our upper-air exploring has also been done with kites."

"Kites? Like Franklin's?"

"Not quite," said the Forecaster; "our weather kites aren't built like that. They look more like a box. I'm expecting one here, every day."

"Here?"

"Yes, boys," the Forecaster answered, "right here. There's a young chap I know who used to work with William A. Eddy, of New Jersey, the father of scientific kite-flying in this country. I wrote to young Osborne, and sent him a copy of the *Issaquena County Weather Review*, the one with the sunset articles and pictures in it."

"Osborne, sir!" ejaculated the editor-in-chief, "I got his subscription just a week ago."

"Did you?" said the Forecaster, interested. "That's nice of him! He wrote to me that he was constantly improving his kite models and that he had a couple of old ones which he now seldom flew. He sent me their records, too, so I know they must be good kites. He wanted to know if the Mississippi League of the Weather wouldn't do some kite-flying and send him records of the observations."

"Would we?" cried the enthusiastic Monroe. "I should say we would!"

"It means quite a bit of trouble," the weather expert warned them; "scientific kite-flying needs machinery."

"Why, sir?" asked Ross. "Can't we do it by hand?"

"No," was the reply, "you can't. How would you reel the kite home? It's a very different thing sending up a Japanese paper kite on a string a few hundred feet in the air, and making an ascent of a couple of miles with a weather kite. For one thing, the weather kite is flown with wire and an especially strong kind of wire at that."

"Where will we get the wire?"

"I've advanced the money for it," the Forecaster answered, "and for the shipment of the kites. I thought, perhaps, after a while, we might hold a kite contest and charge an admission fee, because, as you know, I think the League should be on a self-supporting basis. I'll render you a bill, then, and you can pay me."

"Thanks ever so much, sir," said Ross. "That's fine. We'll do it. But who's to have charge of the kite-flying?"

"That's your affair," the Forecaster answered. "I've nothing to do with the inner workings of the League."

"I've been wondering," said Anton, "if Tom oughtn't to do it. He's our wind expert."

Tom flushed with pleasure at the suggestion.

"I haven't done much on the wind stuff," he admitted; "there didn't seem anything to do but to take measurements and things."

"I seem to remember reading them weekly in the *Review*," the Forecaster remarked.

"Oh, I've done it all regularly enough, but it didn't seem to be of much use," the boy said.

"You'll find that it will be of a great deal of use in the League's kite work," the weather expert rejoined.

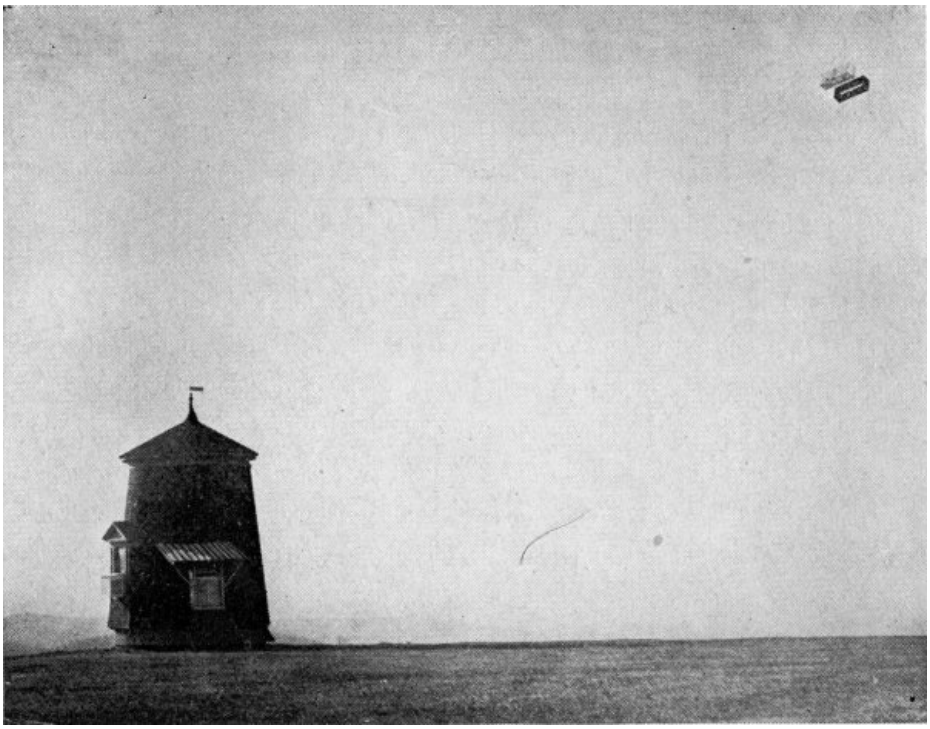
"I think Anton's right," put in Ross. "Hands up those who think Tom ought to do it."

Every hand shot up in the air.

Tom shuffled his feet on the ground and squirmed uneasily.

"All right," he said, "I'll try. You'll tell us what to do, Mr. Levin."

The next few weeks were busy ones for the Mississippi League of the Weather. The building of the kite reel, more than anything else, gave the boys a sense of the power of the new force that they were going to handle. The *Weather Review* announced the expected arrival of the two kites, and the interest of the neighborhood was aroused.



KITE-FLYING—THE NEW WAY.
Courtesy of U. S. Weather Bureau.

KITE-FLYING—THE OLD WAY.
Benjamin Franklin performing his famous experiment, whereby he proved that a flash of lightning was an electric discharge.

Not since the days of the Civil War had anything given the farmers of the district as much to talk about as did the weekly issues of the *Issaquena County Weather Review*, and the people of the county took the keenest interest in all the doings of the League. Fred had been anxious to make

the paper bigger and more important, as soon as it became flourishing, but he was held back in this by the conservative and laconic Bob. The wireless expert showed him that as long as the paper was kept small and easy to get out, it could be kept good. As a result, everything had to be condensed, and every bit of the little sheet was interesting. Twice the *Review* was quoted in important meteorological journals and various weather periodicals were sent as exchanges to the office. It meant a lot of work for the editor-in-chief, but Fred's father, realizing that the post was an excellent training for his son, released him from all his Saturday chores.

At last the word came that the kites had actually arrived. A farm wagon was sent in to fetch the wooden cases, and that wagon, when it drove into town, had every member of the League on board, all excited and chattering like so many magpies. Rex and Lassie, the pair of four-legged members of the League, also came along to give dignity to the occasion.

Permission had been secured from Tom's father to use part of the pasture as a kite-flying station, and, bright and early the next Saturday, the League gathered at the wind-measurer's home to see the cases unpacked. Mr. Levin also came, to give advice and suggestions.

"What's the direction of the wind, Tom?" he asked.

The boy glanced up at his home-made weather-vane, which had been adjusted so that it was right to the fraction of a degree.

"South-southeast, sir," he said.

"Is it steady or veering?" the weather expert continued. He was anxious that Tom should feel the importance of his wind observations. "What was it this morning?"

"I'll see, sir," said Tom, and hurried into the house for his book on wind observations, which he had kept faithfully, though, in all the five months of the League's work, there had been no opportunity to make use of them.

"It was south—a quarter—east this morning," he answered quite importantly.

"And what is the present velocity?" came the next query.

Tom ran up the short ladder to the dial of his Robinson anemometer or wind-measurer. This consisted of four cup-shaped pieces of metal fastened to four arms at right angles to each other, and set horizontally in a socket. The force of the wind on the open cup-shaped sides was so much stronger than on the convex or rounded sides that the anemometer whirled around quite rapidly.

"Say," said one of the boys as he watched Tom, "I didn't know he had all this down so pat! It's great!"

"Fourteen miles an hour, sir," said Tom, as he ran down the ladder, "by the anemometer dial."

"Well," the Forecaster replied, "fourteen miles an hour is a good enough breeze for kite-flying. How about it, boys? Shall we try a flight to-day?"

"Oh, let's!" the boys exclaimed.

"Very well," said the Forecaster, "we'll put the kites together. Have any of you ever seen a weather kite?" he queried.

"I've seen a picture of one, sir," said Fred. "I saw it in one of the Weather Bureau booklets. It looked like a box with the ends knocked out. Are these like that?"

"Yes," the weather expert replied, "all over the world the Hargrave or box kite is used. There's a little difference in the methods of bracing the frames, but the principle of them all is the same."

"Are they the best kites for lifting, sir?" asked Anton. "I saw a picture, once, of a man being carried along the ground by a kite, but it didn't look like this. It was like a lot of little triangles all piled one on top of the other."

"That's a different kind," the Forecaster answered, "it's called a tetrahedral kite, and was invented by Dr. Alexander Graham Bell. They will lift a man quite easily. Owing to the form of construction, they're much heavier and harder to handle and they won't go up as high. The box kites fly higher and more easily. They'll go up even in the lightest wind, and that's quite important, boys, because you must remember that sometimes there's quite a strong wind in the upper layers of the air when there's only a zephyr below. As you see, boys, this kite consists simply of four long sticks arranged in a square, with one third of the length at either end covered with a specially treated and tightly stretched muslin."

He was working rapidly as he talked, and, before long the kite was assembled, the wire attached and wound on the reel and all was ready for launching.

"Will that wire hold it, sir?" asked Ross, as he noted the extremely fine line that the Forecaster was using.

"Certainly, it's piano wire. It's only a thirty-second part of an inch in diameter, but it will stand a pull of nearly three hundred pounds. That's more than you could pull. More even than Monroe could pull, and he's the strongest of you."

"Couldn't I hold one of those small kites, sir?" asked Monroe.

"Yes," the Forecaster said, "you could with a well-made hand reel, and if the wind wasn't too strong. But your arms would soon give out. Of course, the pull of a kite depends on the amount of square feet of sail area. Anton," he added, turning to the crippled lad, "you're the mathematician of the League, measure that kite and tell us how many square feet of sail area it has."

Anton took a foot rule from his pocket and measured the kite rapidly.

"A trifle over thirty-six feet, sir," he said. "I can give you the fractions, if you like."

"No, that's near enough," said the Forecaster. "Thirty-six feet of sail area in a fourteen mile wind will lift nearly twenty pounds of wire and, probably, will have a pull of about sixty pounds. I don't think you'd care to stand a sixty-pound drag very long, Monroe. We'll let our new reel do the work."

"About how high could we make this kite go, sir?" asked Tom. "Does that depend on the wind?"

"No," the Forecaster answered, "it depends on the sail area of the kite and the weight of the wire. Ten square feet of sail area will lift three pounds or, a thousand feet of wire. There are over five thousand feet to a mile, and a kite usually ascends at about an angle of forty-five degrees. So, if you allow for sag and so forth, you'd have to put out eight or nine thousand feet of wire to reach a mile, wouldn't you?"

"Yes," said Tom, "I guess that's how it would go."

"It's an awful lot of line," commented Fred.

"Therefore," said the Forecaster, "if ten square feet will lift a thousand feet of wire, for eight thousand feet, you'd need eighty square feet of sail area."

"Then even the two of these together aren't big enough to go up a mile!" cried Tom.

"A mile is pretty high, my boy," said the Forecaster; "you've never seen a kite go up a quarter as far."

"What's the highest flight that ever was made?" queried Tom.

"America holds the World's Record," was the answer. "The United States Weather Bureau sent up a string of kites at Mount Weather, in Virginia, that ascended higher than four miles and a quarter, 21,385 feet above the reel, to be exact."

"How many kites did they use?" Tom asked.

"Eight," the Forecaster answered, "with a lifting surface of five hundred and forty-four square feet of sail area. There wouldn't have been much chance for you, Monroe, if you'd tried to hold that bunch in your hand. The kites would have picked you off the ground and whisked away with you like a piece of rag tied to the tail of a Japanese kite. There," he concluded as he stepped back, "I think we're ready now. Tom, how's the wind?"

The official wind-measurer ran up the ladder to his dial, calculated rapidly and answered:

"Freshening, sir. It's about seventeen miles an hour, now."

"That's all right," the weather expert declared. "Tom, you start her off."

"What do I do, sir?" asked the boy.

"Just toss the kite in the air," the Forecaster answered.

"Don't I have to run with it?"

"Not a step, except when the wind is very light. Off with you!"

Tom carried the kite about a hundred feet, the line paying out as he went, and waited the word. The boys clustered around the reel excitedly. Monroe went along with Tom. Rex also wanted to follow, but as Ross was afraid that he might jump at the kite and tear it with his teeth, though in play, he called the terrier back.

"Ross," then said the Forecaster, "you take the time of the flight, and Anton, I think you'd better watch the reel and see that the line doesn't foul."

The excitement of the boys grew intense. The box kite looked so unlike any of the kites that they had flown that some wondered whether it would go up in the air. Fred, in his capacity as editor, having seen a picture of a box-kite up in the air, was quite arrogant in his assurances that it would really fly.

"Are you ready?" the Forecaster said, watching the whirling anemometer. "Throw!"

At the word, Tom gave the kite a light toss in the air, against the direction of the wind, as indicated.

The kite swayed from side to side, but having four surfaces to the wind, did not swoop and dive like the flat kites. Only half a dozen times did it dart from side to side, then the current of the wind caught it at the right angle and it began to climb up into the air.

Tom waved his cap at it with an excited cheer, in which all the boys joined.

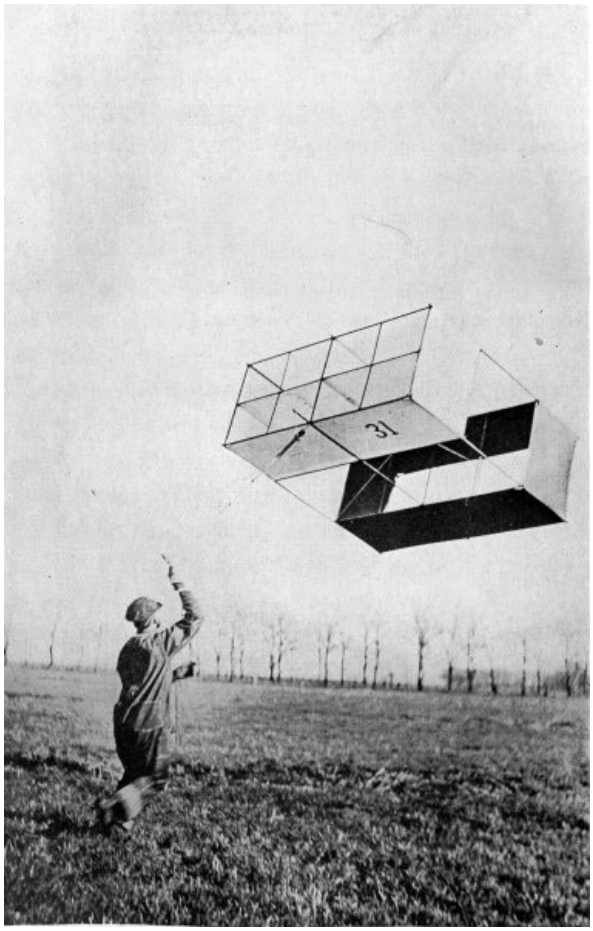
The first kite-flight of the League was on!

Smaller and smaller grew the kite, climbing until it was almost out of sight. The rattle of the reel, as the wire ran out, was music in the boys' ears. When the half-mile mark on the wire was passed, the Forecaster said:

"I think that's enough for a first flight, boys. Better pull her in."

Some of the boys begged that the kite might be allowed to go up a little higher, but the home-made reel was a trifle rickety and would need strengthening. Winding the reel by hand took quite a long time, but the kite came to the ground, safely, unharmed.

From that time on, kite-flying became a passion with the boys. The official measurements of the Weather Bureau kites were secured, together with diagrams showing exactly how the kites were to be built. Before a month was over, every member had a kite, and, as kite-races were to be held, every boy had to build his kite himself, absolutely without any outside help. It was nothing less than amazing to see how these kites, all built on the same pattern by different boys, behaved differently. It seemed almost as if the characters of the boys appeared in their kites. Bob's was the slowest and most powerful, Anton's the fastest but behaved poorly in a strong wind, Monroe's was absolutely useless in a zephyr.



THE EXPLORER OF THE UPPER AIR.
Weather box kite being released at the Drexel Aerological Station, with equipment to tell altitude, pressure of atmosphere, velocity of wind, and temperature, in a continuous record.
Courtesy of U.S. Weather Bureau.

Tom, who up to that time, had felt that his share in the work of the League was extremely small, now found himself of great importance. He thought of kites in every spare minute of the day and dreamed of kites at night. His father had to forbid the mention of the word "kite" at meal-times. The lad made fliers of every shape and pattern, and his kites were usually so stable that it was upon his model that the meteorograph was fastened which registered the pressure, humidity and temperature of the air and the velocity of the wind, according to the request of the young fellow who had sent the League the two first kites. The *Issaquena County Weather Review* was compelled to run a regular weekly feature of "Kite Records" and few were the weeks without a flight.

At last came the fateful Saturday, the last Saturday in October, the day set for the kite races. Many of the boys had made new kites for the occasion and all had overhauled them. Secret practice flights had been made and the rivalry was keen. What was the wind going to be like? Would the day be fine? It was hinted that Tom had some special secret, but what it was no one knew, unless, perhaps, the Forecaster. The event had been quite widely advertised—had it not appeared in the *Review*!—and the neighborhood gathered as though to a country fair. The roped inclosure was full of people and the dimes which rattled into the dried gourd more than paid up the club's indebtedness for the wire and the shipment of the kites.

There were all kinds of races, races for speed, to see whose kite would reach a certain height the soonest; races for steadiness; races for altitude. Anton created great excitement by sending up one of the puppies in a basket attached to a parachute fastened to a kite which was released when he pulled a string. It was a big parachute and a small puppy, so that no one feared for the pup's safety.

Ross then came forward with his big kite. It could not be entered in the races, because all the kites for racing had been of standard size.

"What are those little balls?" one of the boys asked, pointing to bundles covered with paper and attached to a leading string, which were fastened at fifty-foot intervals to the leading wire.

"You'll see," said Ross, and up went the big kite. It flew steadily and well and when a couple of hundred yards above the ground, he made it fast to one of the stakes. Then, while every one watched, he gave the leading string a sharp tug, and then a succession of pulls, breaking loose each of the little bundles attached to the leading wire. And, as the people looked, first one and then another American flag burst out of its covering, the lowermost and largest bundle being a big Stars and Stripes that floated out gallantly above the kite-ground.

"Now," said Ross, turning to the Kite-Master, as the boys had begun to call Tom, "out with your secret! What is it?"

Tom turned to the Forecaster.

"Is it all right for to-day?" he asked.

The weather expert looked keenly at the sky, glanced at the weather-vane and the whirling anemometer, and nodded his head.

"I think so," he said. "The weather's a little gusty, but this is the time to try. Nothing venture, nothing have!"

At the word, Tom ran off into the house. The boys watched him, wondering what new contrivance the Kite-Master was going to produce.

He reappeared in a moment, carrying with him a new kite, a little larger than the others, but of the same usual pattern. This was not particularly exciting. He laid the kite down on the ground and ran into the house again. In a moment, he was out again with another.

"Going to fly them tandem?" asked Ross.

Tom did not answer. He laid that one on the ground and returned into the house again.

"Do you suppose he's got three?" Anton asked. This was amazing riches, three kites. All the boys knew what a tremendous amount of careful and exacting work went into the making of even one of them.

Out darted Tom and laid a third and then a fourth kite on the ground. The four great kites, each of them with the forward part white and the rear section painted black, made a noble showing in the afternoon sun. Ralph, with his ever-ready camera, stepped forward.

"Wait a minute," said Tom, "I've got another one," and he darted into the house to get it. He returned a moment later with a fifth kite, similar in every detail to the other four and then, readily enough, posed beside the kites for his picture. Overhead flew the Stars and Stripes.

"I want that for the *Review*," said Fred.

"What are you going to do, Tom?" asked Ross.

Tom hesitated a moment and then announced:

"I'm going to try for a world's record!"

The audacity of this startled the boys for a moment, and then a shout went up, while word was passed around the crowd that Issaquena County was going to try for the kite record of the world.

The first kite, which no one but Tom and the Forecaster had yet seen in flight, took the air and was off. Tom gave it four hundred feet of line and then fastened his second kite, which he let run up until eight hundred feet more of the line was out. The wind was now stronger, registering twenty-two miles an hour. The three lower kites were run in tandem, about two hundred feet of line apart. When the last of the five kites was still on the ground, the topmost one was out of sight, and the kites were carrying only a fraction of the weight of wire that their lifting surface could bear.

"I'm afraid of it, sir," said Tom, his finger on the wire that was running from the reel, "it doesn't feel right."

"Probably your lower kite is in gusts," the Forecaster answered. "Let her go up, there may be calmer wind higher. Fasten on your three small ones, now, Tom; you might as well have all the sail area that you can."

The eighth kite was started on its journey upwards. Only those with the strongest eyes now could see the second group of three, the first pair was far out of sight.

With Anton carefully measuring the angle of altitude and giving Tom the figures in a low voice, Tom, watching the registering apparatus on the reel, suddenly announced:

"Two miles up!"

The reel rattled merrily as the line was paid out, the brake keeping it at exactly a uniform pressure under Tom's skillful guiding.

"Two miles and a half!"

The crowd began to press around the reel. Nothing was visible in the air, now, nothing but a thin piece of wire leading up into the sky. Had no one known that the kites were there, high above the clouds, it would have seemed like black magic. Some of the superstitious negroes began to mutter among themselves.

"Three miles!"

The boys yelled in delight.

"Up with her, Tom!" cried Fred.

"It's the amateur world's record!" announced the Forecaster.

The words were scarcely out of his lips when there came a sudden sharp crack. The kite-wire snapped close by the reel and as it curled on itself the coils appeared to run up into the sky.

"Gone! My kites are gone!" cried Tom, and a perfect howl of disappointment went up from all the boys.

"Gone!" cried the Forecaster, "of course they're gone, but we're going after them!"

Throwing himself on the back of an old mule which a darky had ridden to the kite ground, he started full tilt after the disappearing wire, the whole membership of the League streaming at his heels.

CHAPTER VI

DEFEATING THE FROST

Out across fields and woods, the Forecaster leading on the old mule, the boys followed the direction of the kite. Bob's pocket compass held them true to their course and Tom's keen sense told of any shift of the wind. The boys ran fast, the mule ran faster, and Lassie and Rex ran faster still. Only Anton, the crippled lad, had stayed behind.

Midway up the first hill, Fatty dropped out. His intentions were good, but he was no match for the others in running. Monroe, the athlete of the group, was swinging along in light springy strides; Bob, the silent, ran heavily and mechanically; while Tom, eager for the recovery of his kites, kept to the front with the other two.

The Forecaster checked his mule and let the boys come up to him.

"It's no use trying to outrace the kites, boys," he said, "they're dropping in any case. But as they were three miles up, they were also three miles to leeward, and as they won't fall like a stone but float down gently, it'll be another mile or two at least before they strike ground. So you've a five mile run ahead of you and you'd better settle down into a jog trot, for you can never keep up this pace."

The faces of the boys fell at the thought of a five mile run, for while they were all strong and vigorous, cross-country running was not one of their regular sports.

Ross turned to the younger boys of the party, calling them by name.

"You'd better drop out," he said kindly; "you won't be able to keep it up and there's no use getting yourselves worn out and then having to walk back, half dead. Fred," he continued, turning to the editor-in-chief, "you'd better quit, too."

"Not much," answered Fred, "I've got to write this up for the *Review*."

The Forecaster smiled. He liked pluck.

"All right, my boy," he said, "come along, if you want to. Still, I think Ross is right."

Over fields and woods they ran, but it was an hour before Bob, lean, wiry and silent, pointed to the sky.

"Kite!" he said.

The weather expert pulled up the mule and drew out his field glasses.

"Yes," he said, "that's the string of kites, sure enough. But they're going up, boys, not coming down."

"Going up, sir?" exclaimed Tom. "They couldn't be! They must be coming down. All the kites were out of sight when the wire broke."

"They have come down, of course," the Forecaster replied, "but they're certainly going up now. And, what's more, they're going up fast."

"But they can't be!" the boy protested. "The wire isn't holding on to anything."

"How do you know?" the meteorologist rejoined. "Perhaps the wire has got foul of something. I remember, once, how Eddy of Bayonne had a string of nine kites get away from him. They crossed the water between New Jersey and Staten Island. The owner had to take a train and then a small boat after them. On Staten Island he took another train and then a street car, and another street car, all the time hanging out of the window, to keep track of the fugitives, which were sailing away merrily."

"Chasing a kite with a train and a street-car sounds funny," puffed Tom.

"On Staten Island," the Forecaster continued, "the wire caught in a telegraph post, and, of course, as soon as the wire held, the kites took the proper angle to the wind and shot up in the air again. Before Eddy could reach the place, the wire chafed through and broke again, but the kites had risen another mile or more. Falling diagonally, they crossed the lower end of New York Bay toward Long Island. Eddy had to take a ferry boat, next, to chase the runaways. He crossed to New York and took the elevated railroad to Brooklyn. An hour later, he caught sight of the kites again. One of the groups had reached the ground and dragged. That sent the other six up in the air again. They flew over the whole of Brooklyn and fell again, finally entangling themselves in a telephone wire. When the owner finally reached them, after a chase of thirty miles, in two States, three of the kites, still undamaged, were flying safely in the air, never having come to ground at all."

"I hope mine aren't smashed," Tom said eagerly. The story had given him hopes.

On the boys pounded. Fred was at the end of his strength. Ross, himself, was almost done out, but he felt that, as head of the League, he ought to go on. Seeing, however, that the editor-in-chief might really hurt himself unless he gave in, Ross decided to stop. He knew that Fred would give up if he did.

"I've had enough, Fred," he said at last. "Let the other three go ahead. We can't hope to beat Monroe."

The editor stopped, willingly enough. He looked a little longingly at the other three, as they ran on.

"I'd have liked to be there, so as to write it up," he announced wistfully.

"You can't be everywhere, Fred," Ross answered, and the two boys turned homewards.

Monroe, Bob, and Tom, with Monroe leading, swung on their way. Twenty minutes more passed. Tom's heart was beating like a trip-hammer and there was a drawn look about his face which showed that he was nearly done. Bob, who had not uttered a word since he first saw the kite, and who had not varied his pace by a fraction since he began, was jogging along as though he were a machine. Monroe still ran springily and with the jauntiness which betokened the practised runner.

Then, suddenly, the Forecaster pointed ahead.

"There's something caught in that tree!" he said.

In another minute the kite wire could be seen. It had hooked its coils into a bale of barbed wire, and in trying to lift this had entangled the bale in the branches.

As though he were starting for a hundred yard dash, Monroe sped ahead. Grimly, Bob tried to catch up to him, but it was like a bull-dog chasing a deer. Tom, his face in the tense grin of exhaustion, struggled bravely, but dropped behind step by step.

Monroe was within fifty feet of the tree when a sudden thought struck him. He slowed down, and as Bob caught up to him, said in a low voice:

"Tom's made a great run! Let him be the first to get there."

Bob nodded.

As the pace slowed down, Tom, his gait a little staggering, caught up with the other two and passed them. He reached the tree first and looked up.

"My kites!" he cried. "And I got the amateur record!" and he collapsed on the ground at the foot of the tree, worn out but supremely happy.

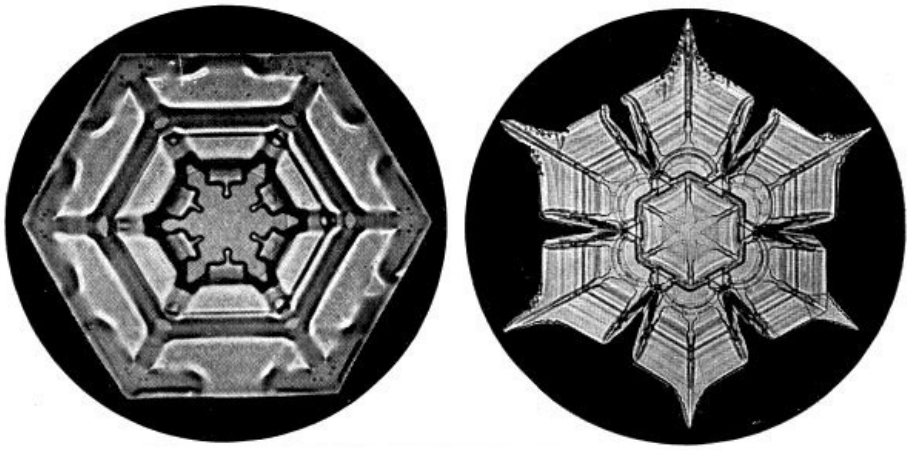
With the approach of winter, kite-flying became less popular as a sport, but two or three times a month Tom sent up one of his kites with the meteorograph, and the observations were faithfully forwarded to Osborne, whose original gift of the two kites had been the stimulus to the Mississippi League of the Weather.

The first few flakes of snow turned the attention of the boys to an entirely new line of weather

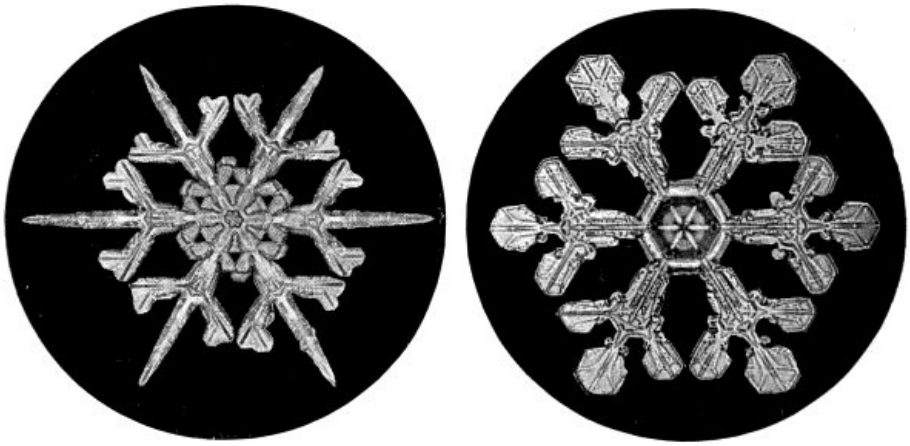
observations. Many and many a time had the boys noticed the strange shapes of snow-flakes, but without paying much attention to them. On the first Saturday after the light snow-fall, however, three different boys brought in rough drawings of star-like and feather-like snow forms that they had noticed.

"I've been wondering," said Anton, thoughtfully, "what makes snow-flakes take those shapes? Hail comes down in lumps, and rain-drops must be round, because when you see the first heavy drops of a shower they make round blobs on the ground with pointed splashes at the side."

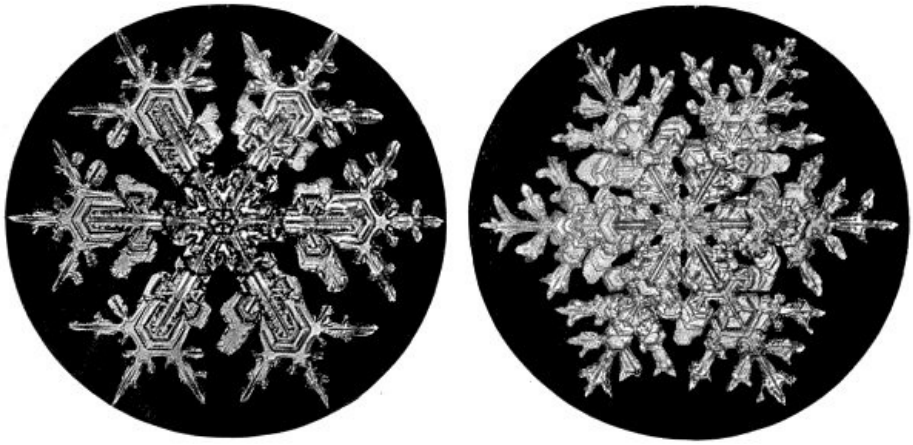
"A snow-flake," the meteorologist replied, "is a collection of icy crystals. If you could look at one under the microscope, Anton, you'd see that every little projection that goes to make up the shape of the flake, is a six-sided crystal. You've eaten barley-sugar from a string some time, haven't you?"



SNOW-FLAKES FROM THE UPPER REGIONS OF THE AIR.



SNOW-FLAKES FROM THE MIDDLE REGIONS OF THE AIR.



SNOW-FLAKES FROM THE LOWER REGIONS OF THE AIR.

Note the gradual progression from solid to feathery forms, and especially that every elaboration maintains the six-pointed crystal type.

Courtesy of J. Wilson Bentley.

"Sure!" said several of the boys, and one added, "Mother often makes it."

"How does she make it?" queried the Forecaster.

"Melts up some sugar and water and, as when it begins to cool off, she hangs a string in the middle of the pot and the sugar settles on that."

"It settles in regular shapes, doesn't it?"

"Yes."

"Well, those are crystals. When water cools into ice, boys, it does the same thing. Haven't you sometimes seen, after a cold night, a lot of needles shooting out from the sides from a puddle?"

"Yes, sir, often."

"Those are all six-sided crystals. Frost on the window pane is made in the same way. All those designs that look like lace work or trees or ferns are six-sided crystals produced by water-vapor, in the air, cooling and crystallizing on the cold glass. Ice crystals grow from each other quite readily. This is called twinning."

"But why are they always so regular?"

The Forecaster shook his head.

"You're always expecting everything to be regular, Ross," he said. "They're not regular at all. There are thousands of different forms. The United States is fortunate in having one man who's the world's expert on snow crystals, and he examines and photographs thousands every year and adds, perhaps, two or three new examples each season."

"Who's that, sir?" asked Fred.

"Wilson A. Bentley, of Jericho, Vermont," the Forecaster answered. "He's made thousands of photographs of snow crystals through a microscope. What's more, he's done it for the love of the work. Why don't you send him a copy of the *Review*, Fred? I'm sure he'd like to see it. Perhaps he might send you some prints of his snow crystals. He'd appreciate a plate of Cæsar's sunsets and Ralph's clouds, I'm sure."

"I'll send them to him right away," the editor answered.

"Why is it," queried Anton, "that when snow-flakes fall slowly and only a few of them at a time, they are big, but when there's a heavy snow-storm the flakes are small?"

"Because they are manufactured in different layers of the air," the Forecaster answered, "in the upper air, eight or ten miles up, where the faintest cirrus clouds are, they are not flakes at all, but tiny needle-like crystals, called spicules. In the depth of the Arctic winter, near the North Pole and especially on the Greenland ice-cap—one of the coldest regions of the world—the wind is full of these spicules, which one can't very well call snow.

"Snow-flakes that come from the cold regions of the air, three or four miles high, generally have a solid form. All, of course, show the six-sided form of the snow crystals. Being smaller and heavier in proportion to their surface they fall more quickly. In the layers of the atmosphere, one or two miles high, where the air is not as cold and where the content of water vapor is higher, the flakes have more opportunity to grow as they slowly sink through the air. Snow-flakes that have been formed only a short distance above the ground become large and feathery, the kind of which northern peoples say that 'the old woman of the sky is plucking her geese.'"

"I suppose, in the northern part of the country, sir," Ralph suggested, "snow has to be measured, as well as rain."

"Certainly," the Forecaster answered, "otherwise we wouldn't be able to tell the precipitation of a region at all. There is a regular instrument for it, called a shielded snow-gauge. This is like a rain-gauge, boys, only it stands ten or twenty feet above the ground, to avoid surface drifting. The snow caught is melted and expressed as so many inches of precipitation. Sometimes the depth of snow is measured by thrusting a measuring stick down to the ground.

"Of course, that's not nearly all that the Weather Bureau has to do with snow. In the northern states, especially of the Pacific Coast, snow surveys are of great importance. The Weather Bureau often sends men to determine the amount of snow that has fallen over a given area, in order to find out how much water may be expected. This is needed in flood forecasts and irrigation projects. Some of our men, boys, can tell you thrilling tales of their expeditions on snow-shoes up snow-covered slopes where there is never a trail.

"Railroads whose tracks run through the regions of heaviest snowfall build snowsheds to keep their lines from being buried in avalanches, and these sheds are built to withstand pressures calculated by the Weather Bureau. Where drifting occurs and the railroad tracks are being covered with the drifting snow, it is the combined snow and wind records of the Weather Bureau which form the basis for the work of the rotary-snow-plow.

"Even so, boys, the value of the work of the Weather Bureau in snow surveys is very small compared with the importance of frost warnings. These save the country tens of millions of dollars every year, especially in the fruit sections."

"You mean by smoking them?" queried Ross. "Father heard about that a couple of years ago and bought a lot of fire-pots for his orchard."

"How did he succeed?" asked the Forecaster.

"He didn't succeed at all," the boy answered. "There were only two bad frosts that spring, and

both times the evening before had been so warm that no one suspected that there would be frost before morning. The one night that he did start the fires, it turned warm towards midnight and we wouldn't have needed the fires any way. Old Jed Tighe, who's got the biggest fruit farm here, has made fun of Father's fire-pots ever since."

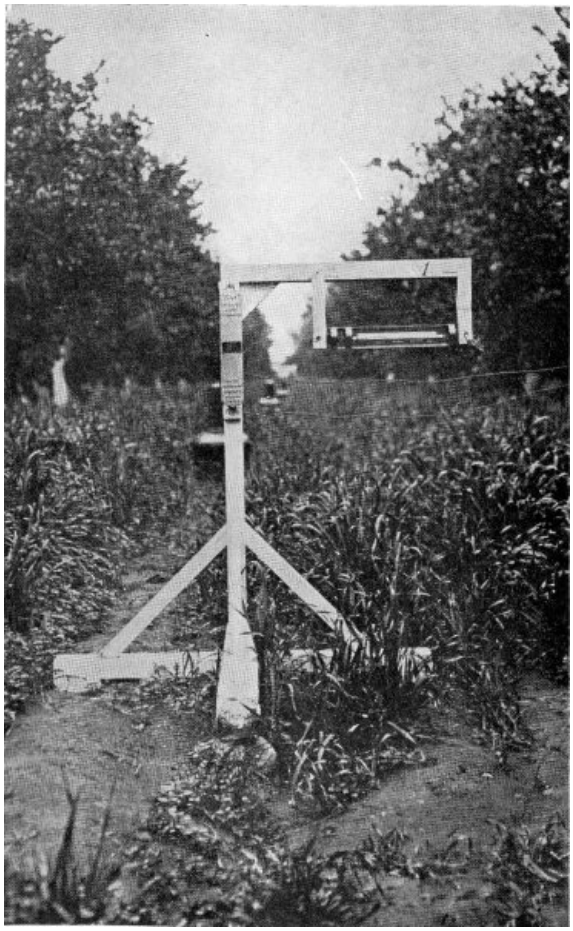
"Now, if your father had received the Weather Bureau's frost warnings in advance," the Forecaster said, "he wouldn't have wasted fuel on the night that there wasn't a frost and he wouldn't have let his crop freeze on the nights that the temperature really did drop below the danger point. For example, boys, if the League of the Weather had been in existence at that time and could have given good frost warnings, all that crop would have been saved, wouldn't it?"

"Yes, sir," said the boys, "it would."

"Of course," the Forecaster continued, "a really progressive fruit-grower ought to make himself partly independent of the Weather Bureau. He can put up frost-alarm thermometers."

"What are they, sir?" asked Anton.

"They're thermometers with an electrical attachment, something on the principle of the thermostat, which you see nowadays in big buildings. A thermostat is electrically connected with a tiny lever, and when the air of a room gets to a certain heat, the increasing temperature operates a lever and closes the steam pipe which brings the heat. When the temperature falls below a certain point, the lever is released and the steam rises again. The same principle is used as a fire alarm. When the air inside a building rises to a point hotter than it could naturally do, it operates a lever which rings an alarm bell. The frost thermometer acts exactly on the same principle. When the temperature of the air, near a fruit orchard, falls to within three or four degrees of the point at which the fruit will be harmed, the fall of the mercury breaks an electric circuit which starts an alarm bell ringing in the owner's house, perhaps a half mile away."



RINGING THE FROST ALARM.
Thermometer with electric attachment which wakes the neighborhood when the grip of a cold wave menaces ruin to a fruit crop.
Courtesy of U.S. Weather Bureau.

"I've been wondering," began Anton in his meditative way, "whether it wouldn't cost more to heat all the out-of-doors than it would be to lose some of the fruit."

"You haven't got the idea of it at all," the weather expert said briskly. "It's got nothing to do with heating the whole of out-of-doors."

"Then what are the fires for?"

"Just to heat a very small section of the air on the ground. Don't forget, boys, that a fruit tree ten feet high may have all the fruit on its lower branches, up to five or six feet, absolutely killed off, while the top branches are unharmed."

"How's that?" queried Ross in surprise. "I thought frost came down from on top, and that the higher up you went the colder it would be."

"Not at all," the weather expert answered. "Frost comes from down below. When the air is still and clear, the earth loses heat by radiation. The heat goes up and up and through the air to higher levels, the cold earth cooling the air below. Therefore, on a frosty night, in a region where frosts are rare, or at a time of year when frosts are few, a still clear night will cause a belt of cold air perhaps only a few inches in depth, perhaps ten or twenty feet in height, this belt being several degrees colder than the air overhead.

"Now, Ross, you can see that to light huge fires, with the intention of warming up all the air, would be foolish and unnecessary. All that is needful is to heat this lower cold belt of air, a few feet in depth, and only to heat it the three or four degrees necessary to bring it to the warmth of the air above."

"But suppose a wind comes up and blows the heat away?" asked Anton.

The Forecaster smiled at the question.

"If a wind comes up," he answered, "you wouldn't need to use any heat at all, because the wind would mix the warmer air overhead with the cooler air below and there couldn't be any killing frost."

"But doesn't it cost an awful lot?"

"It costs less than to lose your crop," the weather expert replied. "Usually you can figure that a frosty night will take a gallon of oil per tree, or from twenty to twenty-five cents. In a fruit growing section a grower is unlikely to have more than four or five still, freezing nights a year when his crop may be ruined by frost, so that he will spend a dollar or so per tree in protecting his orchard. As there are few fruit trees which bring in a profit of less than ten dollars during the season, and some a great deal more—according to the nature of the crop—the proportionate expense of heating is small compared with the amount of fruit saved."

"Then you think that heating an orchard will save the fruit?"

"Absolutely without any question," the weather expert answered. "And, if the fruit-grower will keep in close touch with the Weather Bureau, he will know when precautions are necessary. Of course, boys, it's especially important for this work that there are a number of co-operative observers, because frost is not a widespread general phenomenon. You could have a fearful killing frost down in the hollow where Anton's house is, or in the low ground near your house, Ross, and still Tom's place, on that little hill, would be quite safe. One of the things that the League of the Weather ought to be able to do this winter and spring is to see that frost is fought. Even when your fathers haven't got regular oil-pots, boys, a few smudges with heavy smoke, drifting over the orchards or the truck fields, if started early enough in the evening may check a freeze."

"Why, sir?" asked Ross. "Smoke isn't hot."

"No, my boy. But you remember that I told you that the cold was caused by the radiation of heat from the earth escaping into the air and through it. If there's a steady layer of smoke, like a blanket, floating across the land, the heat radiating from the earth will not have a chance to escape to the upper air. It will stay in the lower layer of the air and thus keep it from dropping to the killing temperatures of a true freeze. That's what the Indians of the pueblos used to do."

In the mild winters and early springs of Issaquena County, there seemed little reason for the boys of the League to trouble themselves with frost warnings, but, at the Forecaster's urgency, the boys kept wide awake for it. It happened, though, that the lads had talked so much about their frost protection plans that several of the farmers decided to get some oil-burning fire-pots for use that spring, in the event of a freeze. Jed Tighe, however, one of the few people of the neighborhood who had shown but a perfunctory interest in the League, laughed to scorn the idea of buying the fire-pots, as Fred had suggested in a recent issue of the *Review*. Even Jed Tighe read the little sheet every week, in spite of his alleged scornfulness.

One afternoon, when Ross was over at the club-house, where he spent so much of his spare time, Anton pointed out that the conditions were ripe for a killing frost.

"The hottest to-day was sixty-two degrees," he said, "and you remember Mr. Levin told us that one wasn't ever safe unless the maximum was sixty-four. There's not a cloud in the sky anywhere and there's practically no wind, and what there is, Tom told me over Bob's wireless, is from the northwest, and that's the worst quarter. I was just going to take the dew-point when you came in."

"Let's do it now, Anton," said Ross. "Got the cup?"

For answer the crippled lad took down from the shelf a small tin mug. It was already bright and shining, but he polished it until it looked like silver.

"I've got the jug of ice-water ready," he said.

Pouring some tap water into the cup, and filling it about one third full, he began to stir it round and round with a thermometer. The mercury in the tube quickly dropped, until it read 50°,

showing the temperature of the water.

"Now, Ross," said Anton, "pour in the ice-water slowly."

Ross picked up the pitcher and began to let the water trickle in a tiny stream into the bright tin cup. Anton went on stirring.

Steadily the mercury descended in the tube as the water in the cup grew colder and colder. Ross poured in more and more slowly. Then suddenly, quite suddenly, while both boys were watching, the brightness of the tin cup clouded over, as though with a sudden fog. Anton drew out the thermometer and looked at it.

"The dew-point's only thirty-four," he cried, "and as we've got to figure frost at three or four degrees lower, it'll be so cold that there won't be any fog to stop a freeze. Ross, it's just the night for a killing frost. What do you think we'd better do?"

The older lad hesitated.

"If you don't mind, Anton," he said, "I'll stay to supper, and we'll see what your night observations say."

By evening the threats of a frost were even more definite and the two boys consulted what had best be done.

"I can easily get Father to start his fire-pots," said Ross, "we got them all fixed up this winter. Bob's dad has got some fruit, and we can warn him by wireless, and we could get a lot of the fellows together. I don't want to make a mistake, though. If we suggest that the fire-pots ought to be started and then it doesn't freeze, we'll hurt the League a lot more than we'll help it."

"I wish we could talk it over with Mr. Levin," said Anton, "but he's down with one of his sick spells and we oughtn't to disturb him. Whatever we do, we've got to do it on our own."

"Let's get Bob here," suggested Ross, "he's got a steady head."

"And Fred," Anton added, "he's read all the Weather Bureau stuff on Frosts, I know. He's been writing his articles for the *Review* from them."

"All right," said Ross, "I'll slip over and call for Fred and you get Bob on the wireless and ask him to come over here."

An hour later, the four boys were poring over the weather maps, comparing notes and observations and trying to decide whether they ought to do anything. Fred, always ready to take up something new, was for plunging ahead, on the chance that there might be frost, but doubted whether a frost was likely. Ross, as head of the League, was a little timid and afraid to make a serious mistake. Anton was firmly convinced that a killing frost would come before morning. Bob settled it.

"Better for the League to be laughed at than chance having the crops ruined," he said.

This turned the scale, and from a discussion of the advisability of frost warning, the question turned to the best way of letting people know. It was decided that Bob should return to his wireless, get as many of his connected operators in touch as possible and get them to warn their districts. Fred, who had persuaded his father to install a 'phone, was to get in touch with the few farmers in the district who had telephones and ask them to spread the warning. Anton was to borrow his father's buggy and drive to points not reached in any other way, and Ross was to go on his pony. By this means, the county would be fairly well covered. The boys were just separating, when Bob stopped.

"Jed Tighe!" he said.

"Oh, let the old skinflint go," said Fred, "there isn't any way of reaching him, any way."

"That doesn't seem quite fair," said Ross, dubiously, "he's got more fruit than anybody else."

"It isn't fair," said Bob.

"I've been wondering," said Anton, "if we oughtn't to notify Jed Tighe somehow."

"We've got to," said Bob.

"And only get rowed at for our pains," declared Fred.

This was so likely that all the boys felt the truth of the remark and there was a moment's silence.

"Play square," said Bob.

"Jed Tighe has never done anything to help the League," said Fred. "I don't see why we should do anything to help him."

"Well," said Ross, "we can't take that stand. Any chap that needs help ought to be warned. If you saw his house on fire, Fred, you wouldn't hesitate to tell Jed Tighe, would you?"

"No," answered the editor doubtfully, "I wouldn't, but this seems different, some way. We might be making fools of ourselves and he'd have the laugh on us for ever."

"Better be laughed at for trying to help than blamed for not trying," repeated Bob.

This was unanswerable and to Ross was deputed the dubious pleasure of notifying the hard old farmer. As the boys separated, Anton looked at his watch.

"It's going to be all hours before you get home to your own place, Ross," said Anton, "it would be a shame if your fruit ran a risk by your being late. Your dad hasn't got a 'phone."

"That's easily fixed," said Ross.

He went to the door and whistled. Rex came bounding up. Ross went to the table and scribbled on a piece of paper:

"Frost to-night! Light the pots!"

This he fastened securely to the Airedale's collar.

"Home! Rex!" he said.

The terrier looked up in his master's face to make sure that it was an order, and not a game, and evidently being satisfied, started down the road at a long sweeping trot. About a hundred yards away he stopped and turned round to look. Ross was expecting this, so raised his arm and pointed. Quite satisfied, Rex swung round to the road again and galloped out of sight.

The boys separated at once, Bob to his wireless outfit, Fred to his 'phone. Anton, however, did not get in the buggy, as arranged. Instead, his father, knowing that the lad was frail, packed him off to bed and drove in the buggy himself, warning all his neighbors. Ross, on his little pony, riding like another Paul Revere, covered many miles. It was well on towards midnight when he reached Jed Tighe's house. The dogs broke out into a furious barking, and, wakened by their tumult, the old farmer with his thin scraggly beard, came to the door.

"What do you want, coming to my house at this hour of the night?" he began, not recognizing his visitor.

"It's me, Ross Planford," the boy answered. "I came to tell you that it's going to freeze tonight."

"That's a nice reason for getting a man out of his bed! Besides, it ain't so. There's never been a frost in this county later'n April 3." He snapped his fingers at the boy. "That's how much you know about it."

Ross found it hard to keep down his temper at this discourtesy.

"It's going to freeze, just the same," he retorted.

"Well, let it freeze, and you, too."

The old farmer began to close the door.

"But your fruit'll all be frosted!"

"Save it yourself, then," snapped Jed Tighe and slammed the door.

Ross dug his heels into his pony and started for home. The ride had taken him six miles out of his way and he was anxious to get home to make sure Rex had delivered his message. Still, as he rode, his pony's hoofs seemed to beat out the message:

"Save it yourself, then!"

Why should he?

Again—

Why shouldn't he?

The gallop came down to a trot and then to a walk, as Ross brooded over what he should do. As it chanced, his path lay near one of the younger members of the League, who had bought a small wireless outfit, similar to that of Anton's. Ross reined in.

As at Jed Tighe's, the hounds announced his arrival and the farmer poked his head out of the window. He recognized the boy at once.

"What's up, Ross?" he asked. "Anything wrong?"

"There's a killing freeze coming tonight, Mr. Lovell," the boy answered. "We're warning every one with fruit trees to start a smudge going. And, Mr. Lovell, can I use the wireless for a minute?"

"Of course. Much obliged for the tip, my boy, I'll get right up and attend to things. Of course, I don't know as it'll do any good, if it's a goin' to freeze; to my way o' thinkin' it's goin' to freeze and nothin'll stop it. But no one can say that Tim Lovell was too lazy to try an' save his crops."

Ross tied his pony and hurried up to his friend's room. In a minute the wireless was buzzing and presently, back came the answering buzz. Georgie sat up in bed and listened.

"I'll go with you to Jed Tighe's," he said, "that is, if Father'll let me."

"Try it," said Ross, "if he will, you can jump on the pony behind me."

Permission was readily granted, for the farmer was grateful for his own warning, and in less than ten minutes' time the two boys were galloping back along the frosty road to the old skinflint's place.

"Aren't you going to tell him about the frost?" asked George, as Ross turned his pony off on the windward side of the orchard.

"I have told him," answered Ross, and he related the story of the meeting, gathering together dry twigs and branches as he talked.

George waxed indignant.

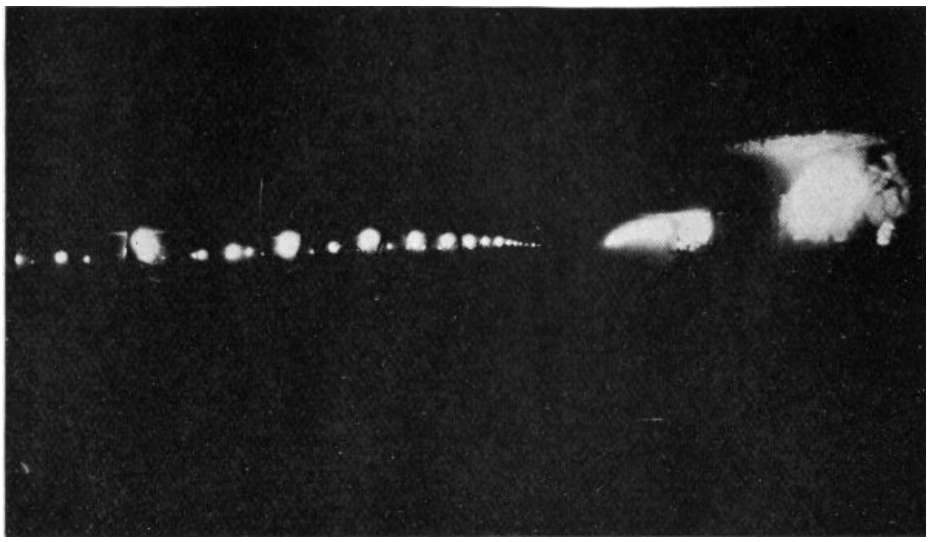
"I'd let him go to grass!" he said.

"That's what I thought at first," Ross replied, "but if you saw a chap drowning, you'd jump in and save him without waiting to find out whether he was delirious and didn't want to be saved."

"Of course," George answered, "any fellow would jump in."

"That's what we're doing, we're jumping in."

Minutes were precious and the two boys worked with all their might, gathering piles of twigs and dry sticks. There was a heap of straw and stable manure a field or two away, and Ross rolled several wheelbarrow loads of it across the fields. After two hours' work, the boys had a row of little piles of fuel, covering one quarter of the length of the orchard.



FIGHTING FROST IN AN ORCHARD—NIGHT.

FIGHTING FROST IN AN ORCHARD—DAWN.

The pall of smoke prevents evaporation and keeps the air near the ground from freezing temperatures.

"You light the first one, Georgie," said Ross, wanting to give the younger lad the honor, for he had worked pluckily and hard.

The lad went down and touched a match to the first pile. It blazed up merrily, and just as the smoke began to rise, the wheels of a buggy were heard along the road. A moment later Bob jumped out.

"Hello!" was all he said.

He cast one glance at the piles and commenced to work with a will. Presently a shout was heard and Ralph, the photographer, appeared on his wheel.

"There's a bunch more coming," he said, and he, too, set to work.

"Frost!" said Bob suddenly, as he pointed to a small glistening crystal of hoar frost on a blade of grass.

The boys cheered. Their prophecies were justified, and they plugged at the work harder than ever. Bob, who feared neither Jed Tighe's tongue, nor anything else, opened the farmer's stable, harnessed and hitched up a team, and commenced to draw the manure and straw to the edge of the orchard. It was now three o'clock and the frost was beginning to form rapidly.

"We can't save the rest of it," said Ross, as he looked longingly at the far quarter of the orchard; "we've got all we can do to keep going what we've got."

Four o'clock and five o'clock passed. The sun rose. Promptly at five-thirty, his regular hour, old Jed Tighe got up and walked to the window to see what kind of a day it was. He rubbed his eyes and looked again, astonished.

There, on his land, using his team of horses, was a group of eight boys, their forms only occasionally seen through the blanket of smoke which drifted sluggishly over and through the trees of his orchard. The ground was white with hoar frost and the lower branches of the trees in the yard had frost crystals on them. The farmer dressed hurriedly and went out.

A dead silence fell along the boys as the tall spare form of the farmer was seen approaching. Georgie and some of the younger ones shrank back. Ross stood his ground. Bob lounged forward.

Jed Tighe said never a word. He cast a shrewd glance at the fruit trees in the orchard which had been nearest to the fires and the smudges, and then, still silently, walked down the entire line of the fires until the end of it, and beyond. On the unprotected stretch, the frost lay thick. He stood thoughtfully a moment and then walked back up the line, more slowly, until he came to where Ross stood, watching him.

"So you did save it, eh?"

"Yes, Mr. Tighe," the boy said, "I did."

"And I suppose you think I told you to?"

"Yes, you did."

"I'm not any fonder of being made to look like a fool than most men are," the farmer said, "but I'm fair." He turned on his heel and started to walk away. Over his shoulder he snapped:

"Twenty-five per cent of the value of the difference between the fruit on the protected and the unprotected parts of my ground goes to the League. And I'll let my boy, Bill, join you."

CHAPTER VII

CLEARING AN INNOCENT MAN

The saving of Jed Tighe's crop did more to establish the reputation of the Mississippi League of the Weather than anything which the boys had done since the League was organized. Although Jed Tighe was stern by nature, he was thoroughly fair. He had no hesitation in placing the credit where it belonged, and the boys soon found that they had no stronger ally than the hard-spoken old farmer.

Even his friendship, however, did not prepare the boys for the farmer's sudden arrival at their club-house, on a Saturday afternoon, two weeks later. He drove up in a ramshackle old buggy, driving two of the finest horses in the county. Skinflint though he was, he loved horses. He came into the club-house and eyed the boys standing around the table.

"I'm going to ship some potatoes to Chicago," he said abruptly, without any preface. "I want to know whether they'll be safe from freezing on the way."

There was a moment's dead silence. The boys had not bargained for such a point-blank demand for help, and it took them off their feet. One looked at the other and several shuffled uncomfortably. The Forecaster watched the lads keenly, interested to see how they would face the issue. Ross spoke first.

"Well, Mr. Tighe," he said hesitatingly, "we haven't done any figuring on the weather outside this neighborhood, as yet."

This cautious attitude did not appeal to Fred, who always wanted to plunge in head first.

"Sure we can, Ross!" he declared.

The president of the League looked inquiringly at his mainstay, the silent Bob, and, in answer to

his unspoken question, the other nodded.

"We could try it, of course, if you wanted us to," agreed Ross.

"Ain't I asking you to?" said their visitor, sharply.

"But suppose we don't get it just right?" Ross queried.

"That's the chance I'm taking," the farmer replied. "But there's no doubt that you know a lot more about it than I do, and your guess is likely to be nearer than mine. Those potatoes have just got to go to Chicago some time next week, anyway."

"It's a new stunt for the League," said Ross again, hesitating, but the editor-in-chief broke in impatiently.

"We might as well tell what we know," he said. "We do know that there's a cold wave on the way."

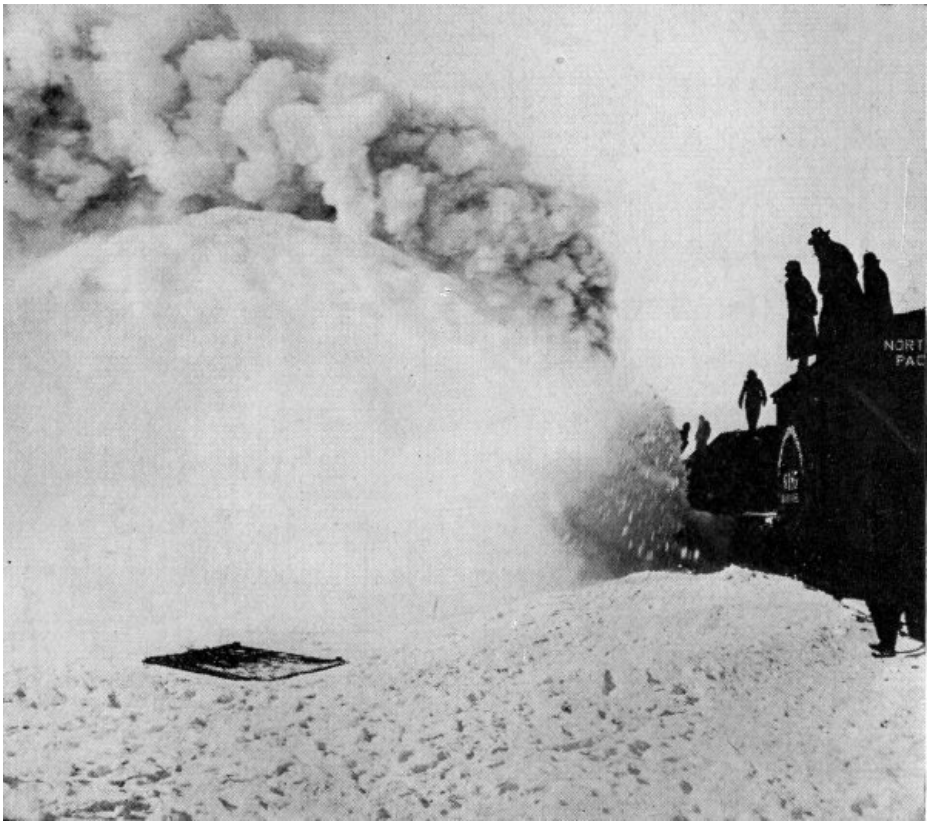
"There is? How cold?" the farmer asked, with a sudden quickening of interest.

"Cold enough to freeze potatoes, at any rate," assured Fred. "I was looking at the Weather Map only about an hour ago. Oh, it's going to be cold, all right."

"How do you know?" Jed Tighe demanded. "If I'm goin' to act on what you boys say, I'd like to know how you find out."

"I've been wondering," put in Anton thoughtfully, "if it wouldn't be a good idea to have Mr. Tighe go over the map with us. He might be interested in figuring it out, and then if we didn't hit it just right, he'd know we'd done our best, anyway."

BUCKING A SNOW DRIFT.



CLEAR THE WAY!
Even an avalanche cannot stop Man, backed with the resources of modern snow-fighting machinery.
Courtesy of Northern Pacific Railway Co.

"Well," rejoined the farmer grimly, "if I've got to hand you over some of my crop this fall, I might as well find out what sort of project I'm supporting. I really would like to see how you find out. You boys certainly made good on that frost business the other night."

From a hook over the compositor's "case," Fred reached down a sheaf of the Daily Weather Reports, and laid those for the last three days on the table in front of Anton. The Forecaster stood by to help the crippled lad and to correct him if he made any mistakes in his explanations.

"All our weather in the United States," the boy began, explanatorily, "comes from the west."

"Why?" snapped back Jed Tighe.

The Forecaster smiled. He realized that the question went to the very root of weather knowledge. The query was a poser to Anton. He stammered.

"I know it does," he said, "but just why, I—I—"

"You'll have to begin at the beginning, Anton," put in the Forecaster quietly. "If Mr. Tighe really wants to know, you can't take anything for granted. Explain to him the circulation of the atmosphere, just the way I taught it to you during the winter."

The crippled lad's face brightened. He knew, now, how to proceed.

"All changes of weather, Mr. Tighe," he said, "happen because of the winds, and all the changes of winds are due to the differences in heat at various parts of the globe, especially at the equator, where it is always hot, and at the poles, where it is cold nearly all the year round."

"You mean to say that the weather at the North Pole and at the equator has anything to do with our weather here?"

"Everything," Anton answered, nodding his head. "The heat of the sun is what causes weather changes, because winds are due to the heating of the air, and the sun is the only thing that heats the air. At the equator, where the sun shines nearly overhead all the year round, the air gets to be very hot. Hot air expands, and as it gets bigger, it displaces the cold air above it. Gravity pulls down the colder air on both sides of this belt of rising hot air, and the down-flowing cold air on both sides blows in toward the equator under the warm air, where the heat of the sun warms it again, and, in turn, it rises. This is going on all the time and is one of the chief things that starts the winds blowing."

"But winds don't always blow the same way," said the farmer; "you talk as if they did."

"Some of them do," Anton replied. "There are lots of places where the winds hardly change, at all, but always blow in the same direction. You read of sailing ships taking the 'trade winds' when coming from Europe to America. Those are all easterly winds and blow towards the American coasts all the year round."

"I don't see how they can," the other objected.

"They do, Mr. Tighe," the Forecaster interrupted, endorsing Anton's statements; "the trade winds are the downflowing currents of cold air that Anton spoke of, which come down at either side of the equatorial belt to replace the warm air which is rising. The trade winds, however, form only a narrow belt and blow only near the surface of the earth. Above them, you can see the lighter clouds blowing eastward with a westerly wind, so that, quite often, in the trade winds, you can look overhead and see two layers of clouds driving in opposite directions."

"You mean to say that there are different layers of wind?" queried the farmer.

"Sure," put in Ralph, the cloud expert, "I've got photographs that show that up clearly. You've seen clouds going at different rates, haven't you, Mr. Tighe, some fast and some slowly?"

The other nodded and turned to the Forecaster, who continued.

"There are always several layers of wind, and, except above the equatorial belt," he said, "the direction of the upper air winds is generally towards the east."

"How can you tell that?"

"By the clouds, or by kites and balloons. But we don't even need to do this, because there are a few places that rise above the lower layers of the trade winds. Thus, the Peak of Teneriffe, which is in the trade-wind belt, has a continuous easterly wind on its lower slopes and a continuous westerly wind right at the summit.

"This gives three belts of weather in the tropical and sub-tropical zones. The first of these is a light up-flowing east wind on or near the equator—it shifts a little to the north or south with the change of the seasons; a belt of heavy rains and calm, the rains being due to the warm, moist, uprising air cooling by expansion so that the moisture is condensed—this region is known to sailors as the 'doldrums' and many a sailing-vessel has been held for weeks there, without enough wind to carry her the few miles necessary to get into the next belt of winds; outside this, come the downflowing easterly currents, known as the trade winds, which form a belt between the tropics and the temperate zones. Beyond this—to the north and south of the tropical zones—come the prevailing belts of strong west winds, which stretch almost to the Poles.

"The United States is in this west-wind zone and the strength and regularity of the eastward movement of the weather is because both the winds of the surface and of the upper air blow in the same direction. Naturally, the same conditions are repeated on the other side of the equator. In the southern hemisphere the land masses are not so large and the regularity of the winds is less disturbed. There, the west winds are so strong that certain latitudes are known as the 'roaring forties.' These 'forties' correspond in latitude to the northern third of the United States. Chicago and New York are both in the 'roaring forties' of the northern hemisphere."

"The way you tell it, it sounds all right," the farmer objected, "but from my experience, winds blow from all over the place."

"Locally, perhaps, they seem to," the weather expert responded, "but if you watched them closely, you'd find that about seventy per cent of the winds come from a westerly direction."

"They do here, for a fact," put in Tom, who, as official wind-measurer of the League, had been following the explanation with the keenest attention. "I've noticed that in my kite-flying. The winds are from the southwest or from the northwest nearly all the time."

"You mean both in summer and winter?"

"Yes," answered Tom, "they're more from the northwest in winter, I think, but they're generally westerly."

"If the winds are due to the position of the equator and the poles," the old farmer said shrewdly, "I don't see why summer and winter ought to make any difference."

"That," said the Forecaster, "is due to an entirely different set of conditions. It's due to the difference in radiation. There's much greater change in temperature over the land than over the sea. Take an island like Bermuda, for example. From the hottest day in summer to the coldest day in winter there isn't a change of more than forty degrees, because Bermuda is surrounded by water and is near warm ocean currents. In Arizona, on the other hand, there's a change of as much as fifty degrees of temperature in a single day. That is because land absorbs heat quickly and lets it go equally quickly. The interior of a continent in summer time heats and expands the air in the same way that the air is heated over the equator, and, in the same manner, sets in motion another system of winds, for cold air comes rushing down from all sides and forces up the rising warm air.

"Take Asia, for example, where the continental mass is large and the plateaus high. The interior becomes so hot that the air is sent up like the draught in a big chimney, and cool winds from the sea blow toward the interior from all sides in the summer time, and away from it, to all sides, in the winter time. That's what causes the famous Indian monsoons, which blow steadily to the north-east for the six months of summer and just as steadily to the south-west for the six months of winter. The native boats, there, are built on purpose for the monsoon, so that they can only sail with a fair wind and they make one round trip a year, going south with the monsoon in winter and returning with the summer monsoon."

The old farmer scratched his head.

"There's more to this than I thought," he said; "I always supposed that winds just happened."

"No, indeed," the Forecaster answered, "every place in the world has its own system of winds, though in some parts there are so many variations that it isn't always easy to distinguish between the regular and the irregular currents. In the United States the surface winds are very irregular, for we live in one of the stormiest regions of the entire world. Still, that doesn't alter the general rule that all our weather comes from the west."

"And yet," said the farmer, in a puzzled manner, "I don't see why it comes from the west."

"I think I can explain it to you," the weather expert replied. "You know that when water is running down a hole at the bottom of a basin, if it is in motion it doesn't go down straight but with a circular movement, finally making a whirlpool?"

"Of course," the farmer said.

"So does air," the Forecaster rejoined. "There is something the same sort of a whirl at the poles. The prevailing westerly winds of the United States are due to this circumpolar whirl, though modified and altered by the changes of the seasons, the differences of heat between day and night, the radiation from the land, the irregularity of the coastline, the currents of the ocean and a thousand other factors. Each of these the Weather Man has to study when he makes a forecast, but, in the United States, his work is aided by the fact that weather always travels eastward and that the storm follows regular tracks, sharply outlined, like Indian trails across the country."

"Roads in the air?" queried Fred.

"Yes, my boy," the Forecaster answered, "regular roads in the air. There used to be an old saying: 'American weather is made at Medicine Hat.' In a sense this was true, for about sixty per cent of the storm areas—'lows' or region of low barometric pressure—come from the Canadian Northwest. The St. Lawrence Valley is the outlet for our storms. You know the saying about the St. Lawrence, don't you?"

"No, tell us, Mr. Levin," begged Fred, always eager for some weather saying which he could put into the *Review*.

"Up there," the Forecaster rejoined, "they say that when a stranger complains about the weather, a native will reply, 'Don't mind this, we'll have another sample along in about five minutes.' And, sure enough, they do. The St. Lawrence Valley is a magnet for weather changes and has, perhaps, more storms than any other valley in the world."

"You spoke of the 'roads in the air,' sir," put in Ross, "how many are there?"

"Five regular trails," the Forecaster answered. "The northernmost one begins at the Canadian Northwest, runs along the International Boundary, crosses the Lake region and disappears up the St. Lawrence Valley. The second starts at the same point in the Canadian Northwest, travels southeast to the lower Mississippi Valley—a little north of where we are now, boys—curves up to the Ohio Valley and also escapes by the St. Lawrence route.

"A third storm track strikes into the Pacific Coast a little north of San Francisco and runs east and a little south until it joins the Ohio Valley and St. Lawrence track. A fourth develops in the southwestern states and runs along Texas and the gulf states to the Florida coast, where it curves northward along the Atlantic coast, though a few storms take a sharp turn in the Mississippi Valley and go Ohiowards. The fifth storm track is that of the West Indian hurricanes, which whirl around the West Indies and enter the United States south of Cape Hatteras or from the Gulf of Mexico and pass north or northeastward. A few of these hurricanes—like the famous Galveston type—sweep westwards a long way before the northward movement sets in. This type also goes to the St. Lawrence Valley.

"These five tracks are clearly marked, but as such areas are a thousand miles across, it follows that the country for five hundred miles on either side of the lines has its weather governed by them. Knowing these tracks is of great importance in forecasting weather, because, while you cannot always tell exactly what a storm is going to do, you definitely know some of the things that it will never do."

"What sort of things, sir?" asked Fred.

"Well, my boy," the Forecaster answered, "if there's an area of low pressure in Dakota, we know that it won't strike California; if there's one in New York, we know that Maryland is safe. A storm will never go down the Mississippi, nor up the St. Lawrence, but will always travel up the Mississippi and down the St. Lawrence."

"There does seem to be something regular about it," the farmer remarked, his interest growing, as the Forecaster took his pencil and sketched out, across the map of the United States, the five great storm tracks. "That's all right for storms, maybe. But how about a cold wave? Fred, here, said that a cold wave was coming. Can you figure that out in the same way?"

MEASURING THE BLIZZARD'S RAGE.
Shielded snow gauge in the Northwest to register the amount of snow-fall.
Courtesy of U. S. Weather Bureau.

"Certainly," the weather expert answered. "As a matter of fact, it is comparatively easy. A cold wave is simply a fall of temperature caused by the cold air from the upper atmosphere sweeping downwards after a cyclone of low pressure has passed."

"A cyclone?" ejaculated Ross, in surprise. "Is there always a cyclone before a cold wave?"

"Always," the Forecaster answered, "but, unless I'm mistaken, Ross, you're using the word 'cyclone' in the wrong sense. Most people do. I suppose you think a cyclone is some kind of a whirlwind, a particularly violent storm, eh?"

"Yes, sir," said Ross, "that's what I thought."

"Well, Anton can tell you better than that," the weather expert rejoined. "Tell him what a cyclone is, Anton."

"So far as I can make out," the crippled lad answered, "a cyclone is a whirl in the air, generally from five hundred to a thousand miles across, in the middle of which the barometer is very low, and on the edge of which the barometer rises. It always has winds that blow spirally inwards, those in the United States whirling in a direction opposite to the movement of the hands of a clock.

"So you see, Ross, to the east of a 'low' or ahead of it, the winds are southeasterly, to the north they are northeasterly, to the west, or behind it, they are northwesterly, and to the south, they are southeasterly, all curving into the centre and shifting as the 'low' advances. As these 'lows' travel along the storm track at an average rate of four hundred miles a day, as mountains interfere, and as the shape of a 'low' in America isn't quite round, but looks like a sort of crooked oval, it takes close figuring to find out what the wind is going to do."

"And where does the cold wave come in?" persisted the farmer.

"That comes after the cyclone," explained Anton. "A 'low' means that the pressure of the atmosphere is less than usual, and, consequently, doesn't press the mercury up so far in the barometer. The air weighs less, that shows that it must be expanding. The winds in front blowing into a 'low' are generally warm winds. When a 'low' is traveling fast, with a 'high' or 'anti-cyclone' behind, the colder winds come rushing forward to take the place of the rising warm air and they bring colder weather with them. The freeze comes during the early clearing weather of a 'high,' before the anti-cyclonic winds—which blow in the opposite direction, the way of the hands of a clock—have had a chance to steady down."

"Then," said the farmer shrewdly, "if you get reports of wind and of barometer from points to the west and northwest, you can tell when a cold wave in on the way. Is that it?"

"Exactly," the Forecaster replied. "We cannot always tell, of course, when the weather is going to be a little colder or a little warmer, but a cold wave, serious enough to damage crops and property, can always be foretold. Remember your storm tracks again. In this county, in the State of Mississippi, we are very unlikely to get a freeze, unless there is a rapidly moving 'low' passing up towards the Ohio and St. Lawrence Valleys followed by an equally energetic 'high' plunging down from the Canadian Northwest."

"And can you always tell what the weather is like, all over the country?"

"Yes, indeed," the Forecaster answered. "There are two hundred official stations scattered all over the United States and the West Indies, each one carefully selected because its site is a key station to weather changes. Twice a day, exactly at eight o'clock in the morning and eight o'clock in the evening, the observations are taken at each station."

"And have they all got rain gauges like mine?" asked Anton.

"Yes, all of them."

"And wind-measurers, like my anemometer?" queried Tom.

"Yes," the Forecaster agreed with a smile, "and some of them have devices that make a continuous record of wind velocity."

"And barometers like mine?" put in one of the younger boys, not to be outdone.

"Various forms of barometers, and barographs, and thermographs, and sunshine recorders and all sorts of things. Some of them even have seismographs, which tell of every tiny little earthquake, that may be going on all over the world. You know, boys, there's hardly an hour of the day that there isn't a small earthquake, somewhere, and there are really quite sizeable earthquakes at least once a month. A well-equipped weather office is quite a complicated affair, and it takes well-trained men to conduct the observations and interpret them properly."

"All those observations are sent to Washington, aren't they, sir?" queried Anton. "Just as I send mine every night to Bob, for him to transmit by wireless."

"Just the same way," the Forecaster answered, "except that they're all sent in cipher, of course. Once in a while the cipher results in some queer combinations. The regular routine requires that an observer send the temperature, the barometric pressure of the atmosphere, the amount of rain or snow, the direction and force of the wind, the state of the weather, the types of clouds and the highest and lowest temperature since the last observation. I remember once, while at the Milwaukee station, we got the following message from La Crosse, Wisconsin:

"'Cross All My Ink Frozen'

"It so happened that we had Charlie Cross working at that station at that time, but the message did not apply to him, nor, for that matter, to his ink. On second consideration and reading, the message read very differently. 'Cross' was the code name of the station; 'All' meant that his barometer read 30.02 and that his morning temperature was zero; 'My' conveyed the information that his sky was clear, the wind from the south and that his minimum temperature for the night was zero; 'Ink' informed us that the wind velocity at the station was six miles an hour and that he could not add the usual height of the water in the Mississippi as the river was 'frozen.' Similar code messages are sent in twice a day from each of the two hundred stations.

"So you see, Mr. Tighe, if all these various observations combine to describe a certain weather type, if we can check up the accuracy by comparison with stations to the north, south, east and west, and if all these combine to produce a certain definite picture, our weather forecast can be made with tolerable certainty. As an absolute matter of fact, during the past six years, the exact percentage of accurate forecasts is eighty-two per cent, and of the eighteen per cent remaining, eleven were partly right. That leaves a very small proportion of mistakes in weather forecasting. Now, let us take in detail the cold wave which Fred, quite rightly, said was on its way here.

"Here is the Weather Map of the day before yesterday." He placed it on the table in front of the old farmer. "You will notice two sets of curved lines, solid lines and dotted lines. The solid lines are called 'isobars' and they follow the course of places which have the same barometric pressure. The dotted lines are called 'isotherms' and they follow the lines of places having the same temperature. These maps are never twice the same. The Weather Bureau does not possess on its books the record of any two days when the weather was duplicated over the United States."

"You mean that every day's weather map is different?"

"As different as every human face," the Forecaster replied, "and to those of us who have done much forecasting, it is as easy to see from the map when the weather is going to be peaceful or stormy as it is to tell whether a man is smiling or scowling. But let us look at these three charts closely, and you will see just why Fred was right.

"At eight o'clock in the morning, the day before yesterday, there was a well-defined 'low' with a barometer of 29.8 just east of Salt Lake City, driving warmer weather before it. Issaquena County was just recovering from the effects of a 'high,' which, as you can see on the map, was disappearing by its favorite route, the St. Lawrence Valley. What was your temperature here the day before yesterday, Anton?"

"Thirty-six degrees, sir," the crippled lad answered, rapidly consulting his week's record, which was hanging on the wall.

"Fairly cold, you see. And the wind, Tom?"

Tom pulled out a note-book from his pocket.

"North-east, sir," he said.

"Very good. Now, Mr. Tighe, you can see from the map that the barometric pressure, the isobar, running through this part of the country shows a barometric pressure of 30.30. From what Anton told you, it is easy to see that, the day before yesterday, Issaquena County was still in the grip of the tail end of a 'high,' with a high barometric pressure—five points above the low in Salt Lake City—with a cold temperature, and with a wind blowing outwards from the 'high' or anti-cyclone. Is that clear?"

"Clear as well water," the farmer declared.

"Now," said the Forecaster, "let us look at yesterday's map for eight o'clock in the morning. Here, just over the Canadian border, right at Medicine Hat—as though to make good the old proverb—is a vigorous 'high,' with a barometer of 30.50, with a temperature of 20° below zero and with the winds blowing outward from the centre. The 'low,' which the day before yesterday was central over Salt Lake City, yesterday was central over Oklahoma City. It has, therefore, traveled over five hundred miles in the day. On all sides of the 'low' there is rain, and you remember how it rained here, yesterday morning, early?"

"Indeed I do," said Jed Tighe. "I didn't get out on the land until nearly eleven o'clock."

"Now what was the temperature here yesterday morning, Anton?" the Forecaster queried.

"Forty-six degrees," answered Anton promptly, for he had been expecting the question.

"Ten degrees warmer, you see, Mr. Tighe, as the 'low' came nearer. And what was the wind, Tom?"

"South-south-east," the lad answered, his note-book in hand.

"Showing," the Forecaster explained, "that during the twenty-four hours, Issaquena County had lost the effect of the 'high,' which has disappeared from the map, and was fully in the grip of the oncoming 'low.' Now, if you look at the map, Mr. Tighe, you'll see that the isobar for this region shows a barometer pressure of 29.50, a terrific drop of four points in twenty-four hours. No wonder it rained!"

The farmer bent over the map, his eyes glued on the lines which suddenly seemed to spring into life before him.

"Down over the country comes this 'low,' at the rate of five hundred miles a day, with rain and moist winds accompanying it, and sharp on its heels, racing from the north, comes the cold 'high' which we have just seen forming at Medicine Hat. The cold wave is fully organized and is on its way."

He laid the third map on the table.

"Here is the situation at eight o'clock this morning," he said. "The 'low' or storm, has swung at right angles, following the preferred Ohio and St. Lawrence Valley Route. It left Toledo early this morning and at eight o'clock was raging over the Great Lakes, with its centre north of Buffalo. It is speeding up, you see, having traveled eight hundred miles since yesterday. The cold wave 'high' from Medicine Hat has traveled along its usual track and is now central over Kansas, with clear skies and a drop of thirty degrees in temperature. There was a severe freeze in Kansas last night, with zero temperatures, and freezing point was touched on the Mexican border."

"Whew," whistled the farmer, "and is that on its way here?"

"It is," the Forecaster answered. "Your temperature?" he continued, turning to the boy.

"Thirty-seven," Anton answered.

"Going down rapidly, you see. The wind, Tom?"

"Northwest."

"Blowing outwards from the rapidly approaching 'high.'"

"What's the barometer?" asked the farmer, who was quickly grasping the manner of reading a weather map.

"It has gone up again to 30.02. The cold wave is coming fast. Since Dodge City, Kansas, is about five hundred miles from here, and since the 'high' is traveling at about seven hundred miles a day, and as, moreover, there is generally a slight slowing up as it makes the turn, the centre of the 'high' ought to strike us here about six o'clock tomorrow morning. The cold wave, however, is in advance of the centre, so Mr. Tighe, you need to be prepared for a cold wave tonight.

"If you ship your potatoes this afternoon, as you planned to do, they would meet severe weather and might get frozen. If you ship them tomorrow, you might be safe, but you couldn't be sure,

because the 'high' is turning northwards and therefore its eastward distance is not so great. If you ship them on Monday you would be safe, but even then you could not ship them to New York, for a fast train might overtake the tail of the cold wave. On Tuesday you can safely ship them to any part of the United States."

The farmer stepped back from the table and his eye roved over the boys.

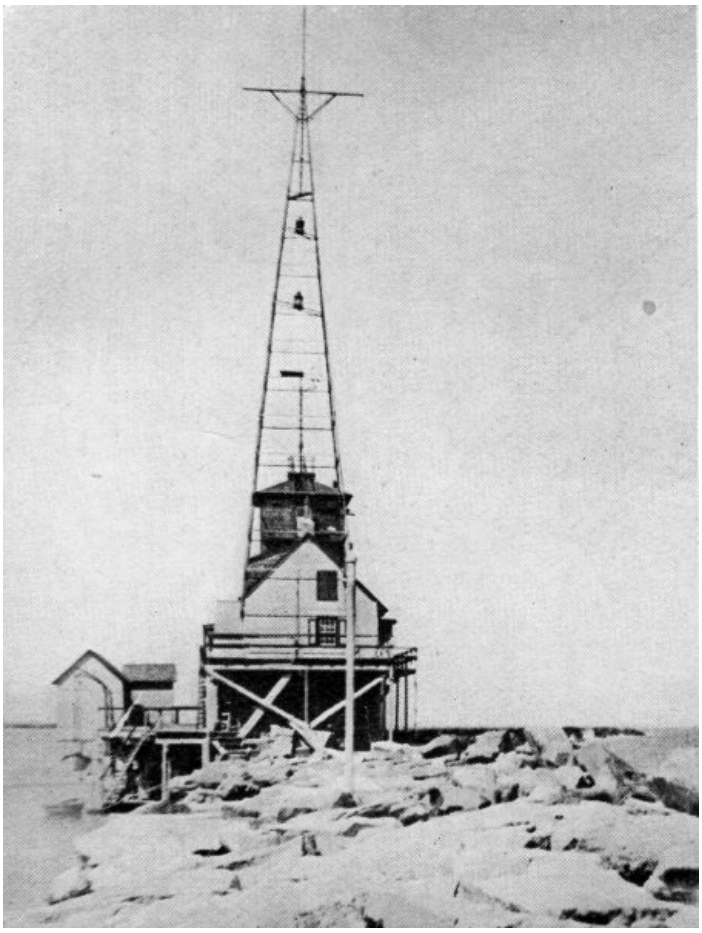
"And was that the way that you lads figured out that my fruit was likely to be frozen?" he asked.

"Yes, sir," said Anton, "that was how."

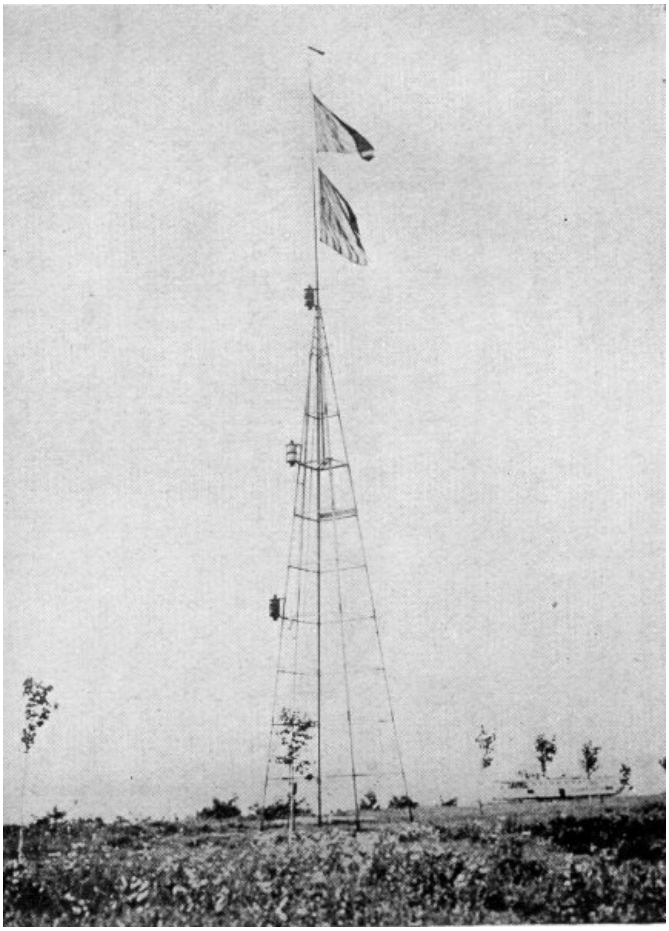
"It's a marvel," the farmer declared. "I don't see why more people don't use these Weather Maps."

"Hundreds of thousands of people do," the Forecaster replied. "You'd be surprised, Mr. Tighe, if you knew how big business firms all over the country study these changes of weather. Heating and lighting plants of great cities study conditions of cold and of darkness. Municipal systems, with exposed water mains, take precautions against frost. Large stockyards, like those of Chicago, drain their water pipes. Gasoline engines are drained. Street railway companies are supposed to turn more heat into their cars. Natural gas companies are required to put on a greater pressure. Dredging of sand and gravel is suspended. Piles of iron ore, lying on wharves, are placed in the holds of vessels to keep the ore from freezing solid.

"Take ordinary questions of trade, which we all know well. Wholesalers distribute stocks of cold-weather goods to retailers when a cold spell is forecast, and wideawake retailers make special provisions for it. Advertising managers of big department stores, who prepare their advertisements for the daily papers, the day before, study weather reports very carefully. You can go into an ad-writer's office, with the sun shining in at his window, and find that he is writing display of umbrellas and rubbers. The explanation is the Weather Map, which is lying on his desk. Everywhere you go, you'll find that the really big business organizations study the Weather Reports as closely as a stock-broker studies the Wall Street reports."



SIGNALS ON DELAWARE BREAKWATER.
Courtesy of Geo. S. Bliss, U.S. Weather Bureau, Philadelphia, Pa.



SIGNAL TOWER FOR STORM WARNINGS.
Flags used by day, lanterns by night.
Courtesy of U.S. Weather Bureau.

The farmer stared at the Forecaster.

"Why," he said, in astonishment, "I never had any idea that the Weather Forecast was so important. I just thought people read it to know whether it was going to rain, whether they should take an umbrella or not."

"Rain forecasts," the weather expert rejoined, "may be useful for one's personal comfort, but their importance is nation-wide. Until a few years ago, one-eighth of the value of the entire raisin crop was lost every year by occasional showers while the fruit was drying. The Weather Bureau established a special service to take care of this region and for five years there has not been a single non-avoidable loss. Berries are picked before rain. Vegetables which are dug before rain, stand shipment better than those dug afterwards. In the alfalfa region, rain forecasts are all-important, since the hay can be baled in the field when it is dry but not when it is wet.

"Every kind of brick, cement, and lime manufacture has got to be protected from the rain, and twenty-four hours' notice enables all such factories to protect their product. Contractors for outdoor work make their estimates and contracts on the basis of weather forecasts, railroad companies provide against washouts, and irrigation companies control their output of water according to the expected rainfall."

"This is great stuff," said Fred, under his breath to Ross. "I'm going to run this in the *Review*!"

"Snow warnings," the Forecaster went on, "are of equal value. All over the western country, where the snows are apt to be heavy, the tonnage of passenger and freight trains is made up in accordance with the expected weather, and the snow-fighting equipment is prepared. On the great Western ranches, stock is hurried from the open range either to constructed shelters or to naturally protected gullies, on notice of blizzards, northers and heavy snows. This is especially necessary on sheep ranches. Twenty-four hours' notice of a heavy snow-storm saves the country at least half a million dollars in stock loss and property damage.

"Storm warnings, perhaps, are even more important. Hundreds of lives are saved, every year, by vessels remaining in port when a storm or hurricane is expected. A recent storm on the Great Lakes was forecast as being so severe that scarcely any vessels left port. Many ships, undoubtedly, would have foundered, had they been out in the gale. Yet, aside from the Weather Map, there was no local indication that bad weather was brewing. When storm warnings are issued, fishermen take steps to protect their boats and nets and a fisherman's boat and net is his whole livelihood. Lumbermen make their booms of logs secure. Rice-planters flood their crops to prevent the breaking of the brittle straw by the wind. Wherever construction work is proceeding, and a wind of unusual force is forecast, builders and engineers make doubly secure that which is already constructed, instead of proceeding with outlying portions of the structure.

"In short, Mr. Tighe, there is scarcely a business in the country which would not be benefited by a close study of weather conditions. The difference between a careful man and a careless one is the difference between a man who thinks in advance and a man who does not think until some condition of grave difficulty is thrust upon him. Weather is, to this day, and will ever remain, one of the most potent factors in human welfare, and a man cannot plan for the weather in advance, unless he has a weather forecast."

The farmer brought his fist down on the table with a thump.

"Tell me, then," he said, "since all the big business firms in the country use the Weather Bureau so completely, why do people laugh at the Weather Man?"

"That's very simply answered," the Forecaster replied, "it's because every one is not a wide-awake business firm. Ask a commission merchant, whose business depends upon his receiving his produce in good condition, whether the Weather Bureau warnings are profitable or no? Ask a fruit merchant, who knows that a difference of twenty degrees in temperature during shipment spells either profit or disaster! Ask a shipowner on the Great Lakes or the captain of a trading schooner in the Gulf! These men will tell you that their lives and their fortunes hang on their careful understanding of the weather. But if you ask some one who merely wants to know whether or not to wear new clothes or whether it will be safe to have a picnic on a certain afternoon—then, indeed, unless the weather is of the particular pattern that they prefer, you are apt to hear that 'the Weather Man is always wrong.'

"There's another reason, too," he admitted, "and that is that local conditions may differ from regional conditions. I've shown you that there's a cold wave coming, and that over this section the temperature may drop twenty degrees. But suppose your thermometer, Mr. Tighe, is near the slope of a hill, which starts a small current of air moving, just enough to keep the air well mixed, then your thermometer may not register a fall of more than ten degrees, and you'll accuse me of being an alarmist. None the less, in a valley a quarter of a mile from your thermometer, the temperature may have dropped twenty-five degrees and for a hundred miles in every direction, the average temperature will be equally low.

"Suppose, over a section as large as the Gulf States, or New England, the Weather Bureau announces a forecast of showers. There might be stretches of fifty miles square in which never a drop of rain fell, and people in a hundred towns would take their umbrellas needlessly. Yet, in six hundred other towns in that region, there would be showers.

"Naturally, the Weather Bureau could give a much more detailed, though not necessarily a more accurate report, if, instead of having 200 stations, we had two thousand, and if the appropriations of the Bureau were multiplied by ten, so that there might be a larger force to interpret and explain the observations that have been recorded. Still, we're all proud of the Weather Bureau and its work, and if you watch it closely, Mr. Tighe, you won't find us far out. Just as a test of it, keep your potatoes in your root-house until Tuesday and watch the thermometer for the next two days."

"I'll do that," said the farmer, "and I'm much obliged." He took his hat. "Any of you boys coming my way?" he asked.

This was an unheard-of geniality on the part of Jed Tighe, but two of the boys jumped at the offer. The last words that the Forecaster heard were in the farmer's voice, as he drove off:

"About that Weather Map, now—"

Mr. Levin nodded to the two boys and strolled across the sun-dial lawn to his own buggy, well satisfied that another convert to the Weather Bureau work had been made.

About ten days after this meeting, after supper, just as Anton was going to bed, his father came in with a grave face.

"I'm afraid Dan'l's in a peck of trouble," he said.

"Why, Father?" asked the crippled lad.

"He's accused of having shot Carl Lindstrom," was the startling reply.

"But he couldn't!" declared Anton, jumping at once to the defence of the darky.

"Well," his father said, "it looks a little black for him. I don't mean, of course, that there's anything purposed, but it looks as if Dan'l had been careless with his gun. Carl was shot in the leg this evening, just as we heard. Now it appears that, about the same time, Dan'l was seen walking with his gun and his two old hounds at his heels, coming from that direction along the levee."

"Oh, I'm sure it can't be Dan'l," said Anton. "Where is he?"

"In his cabin, under arrest," his father said. "The sheriff's there. Dan'l seems quite excited about it and he said he wouldn't move until he saw you."

"Sure," said Anton, reaching out for his crutch. "I know well enough he didn't do it, though."

He hurried across the sun-dial to the negro's quarters.

It was a poignant scene that Anton faced when he reached the hut. Dan'l was sitting on the bed, in shirt and trousers, evidently having just been awakened from sleep. The sheriff, tall and rangy, showed little interest in the affair. To him it was a clear case. The man had been shot. The negro had been seen in the neighborhood with a gun. What more proof could any one want? The brother of the man who had been shot, a nervous, excitable chap, was there and wanted to lynch Dan'l immediately. One of the sheriff's men, keen and watchful, stood beside his prisoner, his hand on the negro's shoulder.

"Ah never done it, Mistah Anton," said Dan'l, as the boy came in, "Ah never done nothin'!"

"I've brought Anton, Dan'l," said the father, quietly, "but it doesn't do you any good to say anything. They'll only make use of everything you say."

"Ah've got nothin' to say," the darky declared. "Ah jes' went after some rabbit an' come home. Ah've been in my bed since a little after sundown."

"You couldn't ha' been," declared the sheriff, "'cause the injured man wa'n't shot till it was nigh dark."

"What time was the shooting?" asked Anton.

"Between a quarter and a half after eight," the sheriff replied coolly, "we know that much fo' sure, any way. And Dan'l can't show an alibi. He says he was in bed. His bed can't give evidence in court. Yo' didn't see him, Anton?"

"No," the boy answered, "I haven't been out of the house since seven o'clock except just to my rain-gauge."

"Well," said the sheriff, yawning, "that's yo' last chance, Dan'l. If Anton had seen yo', there'd have been a witness. But yo' ain't got none and Ole Lindstrom, here, declares that he seen yo' jes' afore it got dark."

"Ah've done nothin'!" the darky declared.

The sheriff kicked the darky's tattered boots across the floor, not unkindly.

"Hyar," he said, "put yo' shoes on. Carl ain't goin' to die, and the jedge won't do much to yo'."

"Ah never done nothin'," the negro protested, but he leant down as he was told, and started to put on his shoes.

One of the shoes had slid close to Anton's feet, almost knocking the crutch out of his hand, and the lad's glance fell on it. He started.

"What time did you say the shooting was done, Mr. Abner?" he asked.

"Between a quarter and a half after eight," the sheriff replied.

With a sudden excitement in his voice, Anton turned to the negro.

"How many pairs of shoes have you got?" he asked.

Dan'l caught the tension in his voice.

"Two pair, Mistah Anton," he said.

"Which did you wear this afternoon?"

"These hyar."

"And where are the others?"

"In yonder corner."

Anton limped across the room and brought out the second pair of shoes. The leather was all dry and wrinkled. They had evidently not been used for a long time.

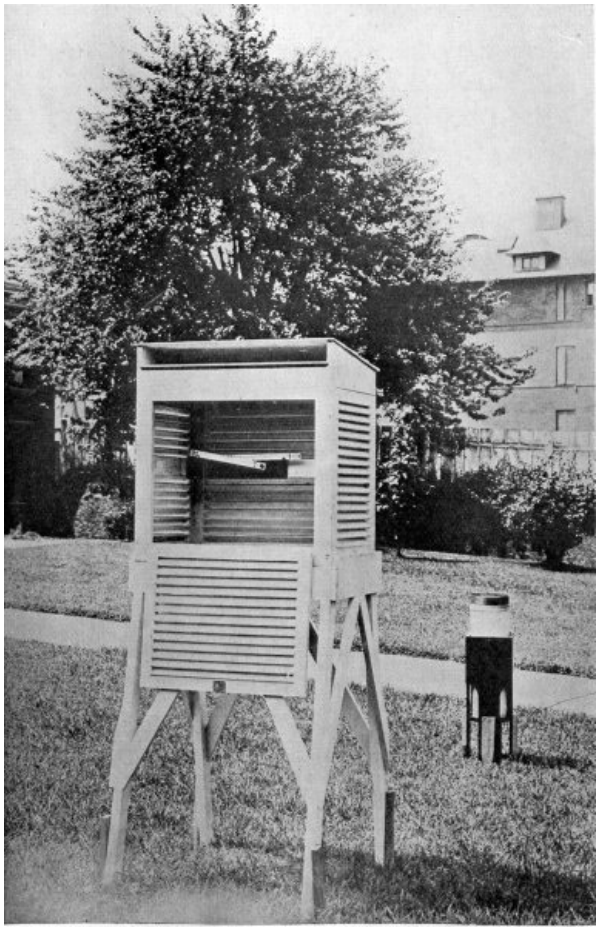
"He's right, Mr. Abner," he said, "he wore those shoes."

The sheriff, divining by the excitement in the boy's voice that there was a hidden purpose in these remarks, took up the second pair of shoes and looked at them.

"Yes, that's sho'," he answered, "he didn't wear these hyar!"

"Then he wore those," said Anton.

"Well, what if he did?"



THERMOMETERS AND RAIN-GAUGE.
Instruments in shelter, as supplied to each co-operative observer.
Courtesy of the U.S. Weather Bureau.

"Look at your shoes," said the boy.

"Well?" queried the sheriff, looking down at his boots.

"They're muddy, aren't they?" persisted the boy.

"Right muddy," the sheriff agreed.

"And Bill's shoes are muddy, too."

There was no doubt of that, either.

"Well?" said the sheriff, questioningly.

For answer Anton held out Dan'l's other shoe, the one he had been holding in his hand.

"This isn't muddy," he said. "What's more, it's got dust on it, dust in all the cracks. You can see it hasn't been cleaned for a long time, probably never since it was given him."

"Well?" repeated the sheriff, still uncomprehending.

"Lindstrom's place is more'n a mile from here," declared Anton, his heart beating hard.

"Jest a mile," said Ole Lindstrom.

"And you say the shooting was before half-past eight?"

"It sho' was," the sheriff answered, "it was jest a little after half-past eight that Carl was carried home."

"Then," declared Anton, in a quiet way that carried conviction, "Dan'l didn't do it, and I can prove it."

"Mistah Anton! Mistah Anton!" the darky cried.

"Quiet! You!" said the man who was holding the prisoner.

"What do you mean, Anton?" the boy's father asked him.

"It's quite easy," the boy declared. "If the shooting was done before half-past eight, it was done just about the time that the rain began. It would take Dan'l—if he'd done it—all of twenty minutes to walk from Lindstrom's place here. It rained heavily, if you like I can give you the amount of rain in tenths of an inch, and twenty minutes of walking in that rain would make him wet through. By the time it had rained five minutes, the ground would be muddy. But see, Mr. Abner, the soles of the shoes are quite dry. And, Dan'l's clothes are quite dry."

He picked up the gun that stood leaning in the corner.

"The gun's dry, it hasn't been cleaned and there's no rust on it. Dan'l hasn't got two sets of rough clothes and he sure hasn't got two guns. Doesn't that prove he couldn't have been out after the rain started?"

The sheriff looked a little dubious.

"Yo' sho' put up a good argument for yo' nigger," he said, "but yo' boys' foolin' about weather ain't evidence. That don't go in court, yo' know."

"You're a little wrong there, Mr. Abner," said Anton's father. "This is an official co-operative observer's station of the Weather Bureau. By a decision of the supreme court, our records have got to be accepted as evidence. There's a ruling to that effect."

"There is, eh?" said the sheriff. "First I ever knew of it. But if yo' say so, why, of course, it's so. But how can you-all tell when the rain began?"

"When rain comes down unusually hard," the boy answered, "the Weather Bureau likes to keep a record of the amount of precipitation in five minute intervals. My big record-book is in the house, but here are the notes I made," and he took a little note-book from the pocket of his shirt.

"'Rain began, 8.21,'" he read, "'first five minutes three-tenths of an inch, second five minutes four-tenths, third five minutes, three-tenths,'" he stopped and held the book open, "it began to get less, then, and I didn't need to keep the record any longer. But you can see, Mr. Abner, that it was impossible for Dan'l to have left the Lindstroms' and reached here before the rain came, and just as impossible for him to have come through the rain with dry clothes and dusty shoes."

"An' the courts have a ruling that weather records is evidence?"

"From an official station such as this, yes!" Anton's father declared. "Evidence as to weather is a factor in a great variety of cases. Civil cases are largely personal injury, damage to perishable goods by freezing or rain and loss by fire. The criminal cases are usually confined to murder trials.

"When accidents occur by reason of a street car running into somebody or something, the question arises as to whether the rails were so slippery that the car could not be stopped. This fact is, of course, important in an action for damages. A slippery rail can be caused by 'sweating' but it is generally due to recent rain. The relative humidity may be such as to prevent the drying up of the rail.

"An observer was called in a case where it was alleged that the plaintiff had been injured by being pitched through the open window of a car. It was claimed that she was trying to shut the window on account of the raw, cold weather and, as the car reached a curve, she was suddenly thrown headlong into the street. The weather record showed that it was a warm and sunny day.

"The question as to whether a sidewalk was sufficiently slippery to make it dangerous for travel frequently comes up in court. One such case, I remember, was that of a man who asked damages from a jitney driver for starting his bus before he had alighted. The driver declared that the passenger slipped and fell on the ice in the gutter, several feet away from the bus. The plaintiff declared that it was a warm day and that there was no ice. The weather record showed rain the day before, with a severe frost during the night, precisely the conditions to support the jitney-driver's story.

"Many accidents are alleged to have been due to fog. The weather expert is called upon to testify to the degree of visibility permitted by atmospheric conditions. One man who was accused of murder and who undoubtedly would have been convicted, was positively identified by the wife of the murdered man, the woman declaring that she saw him at a certain hour of the evening passing in front of the house. The Weather Records showed conclusively that, at that hour, owing to the excessive cloudiness of the atmosphere, it would have been impossible for the woman to identify the suspect, even at half the distance.

"Wind records are often very important. In April, 1902, a severe storm moved over the middle western states, and, at one place in Indiana, it developed such velocity as to start in motion an empty box car standing on a railway siding. It was carried on to the main track, the derailing switch not being turned, and ran for two miles before the wind, the grade being slightly up-hill. It finally collided with a passenger train and several persons were killed. The railroad company produced the weather records to show that a storm of such violence was outside the common run of events, seeking thereby to lessen the amounts awarded for damages.

"This direction of the wind often is called into requisition. A suit for many thousand dollars was brought by the owners of some property in Chicago, against a railroad company, the property-owners alleging that a fire which had destroyed some of the buildings had originated from sparks from a locomotive. The Weather Bureau records, however, showed that there was a brisk wind blowing directly from the property to the railroad. Of course, all damages incurred in storms of unusual severity, such as the St. Louis tornado or the Galveston Flood, would be ignored in a court of law, as they would come under the head of unavoidable happenings of 'the act of Providence,' a well-known legal phrase. In all matters connected with events in which the weather is a possible factor, the Weather Bureau observer has a place and a part, and the United States Supreme Court, as long as thirty-five years ago, ruled that weather records were

competent evidence."

"I reckon yo' is wrong, Mr. Lindstrom," said the sheriff, turning to the brother of the wounded man. "Ef the weather records goes as read, this hyar's a powerful bit of evidence. Look at them shoes!"

"I'm satisfied," the other remarked gloomily, "I reckon the boy's right. But I'd have sworn that it was him I saw. All right, Sheriff, I'll withdraw the charge."

"Let him go, Bill," said the sheriff, nodding to his assistant. "That's a mighty narrow escape fo' yo' nigger," he continued, "I thought it was yo' myself, for sho'."

For a moment Dan'l did not understand. Then it flashed over him.

"Ah's free! Ah's free!" he cried, and fell on his knees on the floor.

CHAPTER VIII

IN THE WHIRL OF A TORNADO

The success of the Weather Forecasts which had been put out in the weekly *Review* and the saving of Jed Tighe's crop had given the League a high standing among the farmers of the neighborhood, but when the story became noised abroad how Anton had saved Dan'l from unjust arrest, every darky in the neighborhood became its devoted slave.

Dan'l himself racked his brains for some way to show his appreciation, but none occurred to him. He could not be any more faithful and loyal than he had been in the past. A dozen plans occurred to him, all to be set aside as useless. He wanted to do something that really would help the League. What was there that he could do? As in all cases of difficulty, he decided to go to blind Mammy for advice. The conference in the old fortune-teller's cabin was a long one, but when Dan'l came out, he carried a huge bundle in his arms and his black face shone with triumph.

As spring advanced, kite-flying resumed its former sway among the boys and Tom's place became again a centre of attraction. Assiduous as he had been before, Dan'l had redoubled his attentions, and he was seldom found far distant from Anton's side. One Saturday, however, he did not appear at the kite-ground until well on in the afternoon, and when he did come, he was carrying something big in his arms, and stepping along as gingerly as if the burden were a baby.

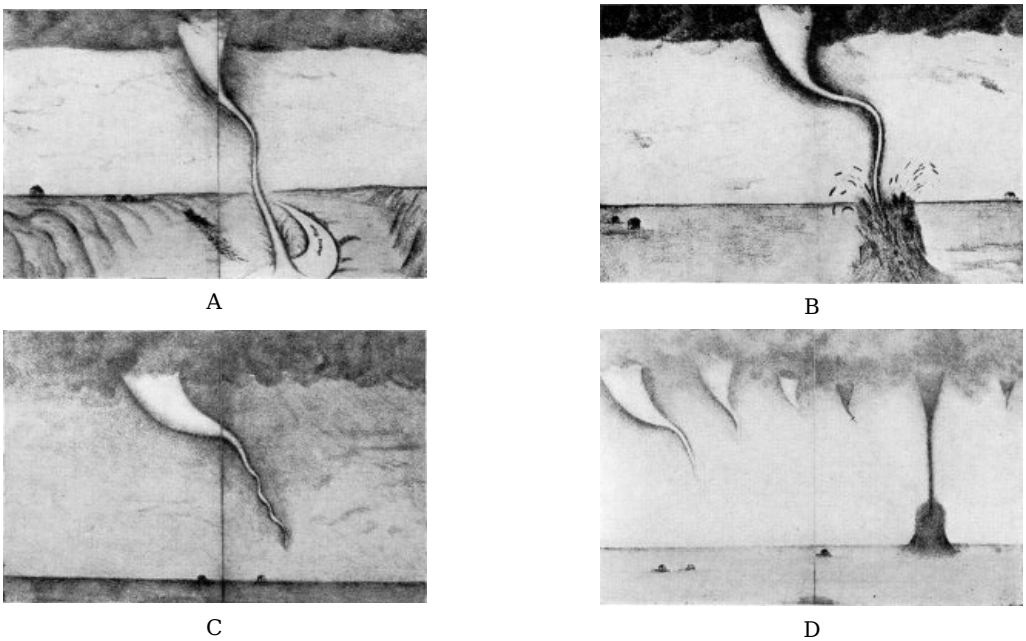
"What on earth have you got there, Dan'l?" asked Tom.

"Ah done got somethin' fo' the League," the darky answered, and, coming up to the midst of the group, which was gathered around the kite-reel, he lowered the burden gently, very gently, to the ground.

"What is it?" asked Anton.

Dan'l looked around. There was triumph in his glance. He was evidently very proud of himself.

"Ah's made a discovery," he said. "Mistah Fred, yo'-all wants to take notes of what I say, so's yo' can print it in the *Review*."



A B C D

PENCIL DRAWINGS OF TORNADO IN DAKOTA.

For many years this was an authoritative series of pictures, and shows:—(A) Tornado becoming a

waterspout;—(B) Tornado wrecking a farmhouse and barn, nothing but fragmentary timbers being thrown out;—(C) Tornado funnel rising from the ground;—(D) Successive funnel formations, with a second whirl reaching ground and sucking up a pillar of dust.

To humor the old darky, the editor-in-chief took out his pencil and note-book and waited for the story.

"Ah was down in ol' Mammy Lee's cabin the other day," he began, "becase Ah wanted to talk to Mammy about somethin'."

"Went to have your fortune told, I suppose," put in Tom.

"No, Mistah Tom, no, Ah done hold with no tellin' of fortunes, but Mammy she knows a heap an' can see more with her eyes shut than most folks with them open. It was a mighty hot day an' the sun was a shinin' hot. Ef it hadn't been that the sun was a shinin' so hot, Ah wouldn't have this story to tell yo'."

He paused for effect and the boys drew closer. Dan'l was a famous story-teller and his tales were always popular among the boys.

"Ah was standing in Mammy's cabin," he continued. "She was a sittin' in her old rockin' chair in the sun right near that little table where she keeps the big glass ball for tellin' fortunes."

"You mean her crystal?" put in the Forecaster.

"Yas, suh, Mistah Levin, her crystal. Mammy has two, the little one, what she uses all the time an' the big one, which she doesn't use no mo'. Ah was a sittin' on the other side o' the table, right by the window, an' my hand was on the table. By and by, Ah felt my hand burnin' as though some one had laid a match on it. Ah pulled away my hand but thar wa'n't nothin' thar. Ah thought it queer, but Ah didn't say nothin' and went on talkin'. By and by, leanin' forward to say some thin' mo' to Mammy, Ah put my hand on the table again, an' suddenly, the back of my hand began to burn as if de devil was standin' on it.

"Ah looked, an' Ah looked again, but thar wasn't nothin' thar but jes' a spot o' sunshine, jes' so bright. An'it sho' was burning hot. Ah took my hand away an' looked at the table. Yas, suh, it was burnin' hot. It's an ol' table and in a sort o' ring jes' exactly the same shape as the ring o' white stones that Mistah Anton put round his sun clock, thar was a burned groove in the table. No wonder my hand got hot. If Ah'd have left it there, there'd have been a hole burned right through my hand. Yas, suh.

"Ah spoke to Mammy about it, and Mammy she says to me that in summer time, when it's very hot, she has to throw a cloth over the crystal to keep it from settin' the table on fire. In winter and in cloudy weather thar ain't no heat at all. So Ah says to myself:

"'Dan'l, if a bright sun burns the table and a half-bright day scorches the table an' a dull day don't do nothin' to the table, why couldn't some kind o' record be made o' the amount o' sunshine? Mistah Anton, he likes most everythin' like that, an' Ah'm goin' to talk to him about it."

"But you never did, Dan'l," put in Anton, not giving much belief to the darky's story.

"Ah 'sperimented all by myself first," Dan'l answered. "Ah took a piece of cardboard, the shiny kind, an' I cut out a piece like the shape of the new moon an' laid it on Mammy's table. Sho's yo' born, Mist' Anton, that spot of light from the crystal jes' started to scorch that cardboard. When the sun was bright it burned it a real dark brown, when thar was a cloud over the sun, it didn't burn it at all. When the sun had a little cloud it jes' burned that cardboard a light brown. Ah'll show yo'."

He pulled from inside his shirt a piece of cardboard. It was marked with the hours of the day and, as he had said, in places it had been burned dark brown and in others a light brown. At one spot, there was about an inch where the cardboard was perfectly white, and opposite this, Dan'l had got his son to write in sprawling letters, "Cloud here."

The cardboard passed quickly from hand to hand.

"But this is great!" cried Fred. "I wonder if Mammy wouldn't keep a regular record for us!"

With a pompous air, Dan'l stretched out his hand and made a clean sweep around him. Then he reached down for the package at his feet and commenced unwrapping from around it the newspapers in which it was hidden. As, with a flourish, he pulled away the last piece of paper, there was a gasp of admiration from all the boys.

There, on the ground before them, was the huge globe of crystal, clear, shining and flawless.

"How did you get it, Dan'l?" cried the boys.

"Ah bought it," the darky replied. "Leastways, a lot of us got together an' bought it fo' a present to the League. Deacon Brown he arranged it all, when Mistah Levin said to us that the crystal would really work right."

"Mr. Levin!" cried Anton. "Then you've known all about this, and never told us!"

"It was Dan'l's secret," the Forecaster answered. "Do you suppose I'd rob him of the fun of telling you? He's right. Dan'l's worked out, all by himself, the principle of the Campbell-Stokes sunshine recorder, and I think there's a lot of credit coming to him."

Anton leaned down and tried to pick up the globe, but it was too heavy for him. Monroe raised it for examination. It was a beautiful crystal, almost two feet in diameter and without a scratch.

"What a corker!" cried Tom.

"Where will you put it, boys?" asked the Forecaster.

There was a moment's pause and then Bob said:

"Club-house."

"Yes," the Forecaster agreed, "I think that's best, because I know Dan'l really would like to see it a part of Anton's outfit. Besides, boys, Anton's going to do some work this summer on sunshine measuring and the relation of sun-spots to the weather, and he'll need a recorder just like this."

"Have sun-spots anything to do with the weather, sir?" asked Ross, in surprise.

"Yes," the Forecaster answered, "it seems quite possible that they have, though to what extent we don't quite know. There's a big field of original work, there, and we've only just found out about it. It's rather a pitiful story, boys, but the man who blazed the trail to that new knowledge, died just two months before the world knew about him."

"Who was that, sir?" asked Anton.

"Veeder," was the answer. "Dr. Major Albert Veeder, who lived and died, an almost unknown country doctor in the little town of Lyons, N. Y. Without any money of his own, he worked hard on meteorology, especially studying auroras and sun-spots. More than any man who ever lived, he tried to show to what an extent the weather of the earth is modified by changes in the sun, chiefly by intensifying the pressure of the anticyclonic areas.

"Now, boys, for the discovery.

"In January, 1916, one of the best-known American meteorologists sent to a brother scientist a postal card which called attention to a recently published article which appeared to be of a good deal of importance. By a curious coincidence, the other scientist had that very day been reading an article published twenty years before in an obscure local scientific magazine, written by Dr. Veeder.

"The two meteorologists, struck by the originality of the ideas and the evidence of the vast amount of work that lay behind them, wrote to Dr. Veeder at his home in the little New York State town. The recognition that had so long been delayed was on its way. A black-bordered letter came in reply. Dr. Veeder had died two months before!"

A sharp indrawing of the breath told of the boys' interest.

"Dr. Veeder's family at once forwarded the papers, published and unpublished, of the unknown country doctor. These revealed that, as early as twenty years before his death, he had made discoveries of vast importance to meteorology and astronomy. He wrote time and again to the Weather Bureau, begging us to give his hypothesis a trial."

"And didn't you?" asked Fred.

The Forecaster shook his head.

"We couldn't," he answered. "We had no funds for special research and Dr. Veeder's ideas were so far ahead of his time that, then, they seemed visionary. Now, twenty years later, when a great deal of similar work has been done in Europe and in this country, we see that Dr. Veeder was a real pioneer, although, of course, many of his conclusions are still doubtful. Yet, in poverty, in discouragement, in the turmoil of a busy life, he continued his work for fifteen years, then reluctantly abandoned it, despairing of support and opportunity. Yet he leaves a debt that science can never repay. Such men may be everywhere; one of you boys may be the meteorologist of the coming generation. Veeder may be dead but his work lives after him."

The Weather expert picked up the great glass crystal which Monroe had replaced upon the ground.

"We will go on with Veeder's work ourselves," he repeated, "so far as we can. Veeder showed us that sun-spots and changes in the sun are closely followed by changes on the earth, and he suggested that this is caused by some agency other than heat. From that we shall go on. Let us do some sun-study. It is symbolic, to me, that a crystal once used for the superstition of crystal-gazing, should become a tool for scientific research."

He raised the crystal to shoulder height.

"Here's to Veeder!" he shouted. "And to Dan'l!"

The cheers were given with a vim.

Interesting as the work of the League had been to the boys during its first summer, when all

were learning of the ways to read the weather, this second summer became tenfold more exciting, when every lad realized that he was part of a group striving to advance along the lines laid down by Veeder. The money which Jed Tighe handed over to the League as its fair share of having saved his fruit crop, was spent in the purchase of a telescope for studying the sun and for various other scientific instruments, and, as the Forecaster had foretold, Issaquena County began to take its place as one of the most efficiently organized meteorological regions of the United States.

The summer was passing on. The year and a half that had elapsed since the flood, a year and a half of constant association with the Forecaster, and still more, of constant association with work that was worth while, had developed the boys of the League and given them a new grip on life.

One Saturday, Ross came over early in the morning to help Anton with some of his sunshine experiment work. The crippled lad had definitely settled down to the study of meteorology and spent all his time either at his instruments or at his books. Under the Forecaster's teaching, he was becoming thoroughly proficient, and the fact that the lad was a natural-born mathematician stood him in a good stead. He was no longer merely a crippled lad, with scarcely a chance before him, he was making a place for himself in the community and there was no doubt that he would make a place for himself in life. This morning, as Anton came out of the club-house to meet his friend, Ross looked at him and thought how wisely the Forecaster had done in suggesting the formation of the League.

"Bad weather coming, isn't there, Anton?" Ross asked, as they strolled into the club-house together.

"Thunderstorms, I expect," the other answered, glancing carelessly at the Weather map. "There's a big 'low' over Illinois, with colder weather coming."

"I'm glad it's going to be cool," said Ross, mopping his forehead, "to-day is something fierce."

"Yes, it's hot," agreed Anton, and turned the subject to some of his recent work on sun-spots and the weather. He had become an absolute convert to Dr. Veeder's theories, and the dream of the boy's life was to be able to take a part in the most fascinating of all weather problems—long-range forecasting.

"It would be great, Ross," he said, "if we could tell a year in advance what kind of weather we were going to have, so that farmers would know exactly just what kind of crops to plant and when!"

"Yes," Ross agreed, but uneasily, for he was watching the sky steadily, "but do you think we'll ever be able to do it?"

"I don't think we'll ever be able to tell exactly," replied Anton, "but I'm sure the time's coming when we're going to be able to get a general idea. If we can just find out enough about the sun's influence on our weather and enough about the big changes in the sun, we ought to be able to foretell something. There's no doubt that weather does go in cycles."

"I don't see that," said Ross. "I think it's changing all the time. You always hear people say that the winters aren't nearly as cold as they used to be."

"That's all bosh," Anton declared. "Mr. Levin and I were talking over that just the other day. There hasn't been any change of weather. The winters to-day average the same that they did fifty years ago. There's some sort of an eleven-year cycle in rainfall, and there's a variation in temperature that seems to swing around about once in every thirty-seven or thirty-eight years, but the differences are so small that only Weather Bureau records can prove them. The weather isn't any hotter or any colder than it used to be, it's just about the same."

But Ross was not listening. His eyes were fixed on the horizon.

"Anton," he said, "I wish you'd come here a minute."

Struck by his companion's tone, the younger lad looked up and, grasping his crutch, limped to the door. He took a glance at the sky and whistled in a low and thoughtful way.

"Look at those clouds to the north-west," said Ross. Then, pointing to the south-west quarter, "And look at them there!"

Anton looked, his eyes dilating. In the north-west, swarthy, curling wreaths of vapor that seemed as though they rose from a monstrous burning straw-stack writhed their way upward to a great height, the upper portion seeming to tremble threateningly, as though there were a shaking fist within the swirl, hidden by clouds. The column was smoky and threatening, yet a whitish light came from beneath it suggesting phosphorescent vapors.

TRUE TORNADO FORMING IN ADVANCE OF A DUST WHIRL.
Courtesy of U.S. Weather Bureau.

TORNADO DROPPING TOWARDS GROUND.
Courtesy of T. B. Jennings, U.S. Weather Bureau, Topeka, Kans.

To the south-west were clouds of a different character, darker and more compact. They were not blacker than many clouds preceding a heavy rainstorm, but they had an uneasy motion. From these came no whitish phosphorescent light; instead, there was a greenish glitter, like a snake's eyes seen in the dark. There was something evil and sinister about them. The air was reverberant, sounds could be heard to a great distance. The farm animals were unquiet and moved restlessly. Anton wiped the perspiration from his forehead with the back of his hand. He

glanced up at the weather-vane.

"It ought to pass to the east of us," he said.

Ross also looked at the weather-vane, and then at the advancing cloud. He knew that nearly all such storms traveled to the north-east.

"It may pass us," he said, "but sometimes they swing north."

"I know it," Anton answered, and fell silent, watching the coming of the storm.

In the distance a faint moaning was heard.

The two huge cloud masses from the two quarters of the sky, as though advancing to give battle, hurled themselves toward each other, the whitish cloud of the north-west towering above the sinister black cloud of the south-west. For a moment, almost as if they paused, a strip of blue sky could be seen between them, then with a sudden rush, the two collided. So solid seemed the masses of the clouds that both boys started, expecting a clap of thunder. Yet never a flash of lightning appeared nor was there any sound.

In the whirl of the two meeting clouds there was a minute of confusion, and then, slowly, a long funnel, like a black finger, began to reach towards the earth.

Both boys saw it at the same time.

"A tornado!" cried Anton.

"Let's get to the cellar!" cried Ross, and started to run, but Anton grasped him by the shoulder.

"No," he said, "we're safe here; it'll pass to the east over the farm lands and won't hit anybody."

In a few seconds Ross saw that the crippled lad was right, and, themselves safe, the boys watched the passing of the tornado.

"It's going about thirty miles an hour," said Anton, figuring rapidly, "and it's all of fifteen miles away. There won't be much left of it by the time it passes here. We don't need to worry."

Reassured, Ross turned to his companion, and asked:

"What makes tornadoes, Anton?"

"A quick current of warm air going up in a thunderhead cloud," he said, "which takes a spinning motion from the general whirl of the cyclone to which it belongs. It has a whirling vortex, from the outside to the inside, and its speed gets higher toward the middle. The speed of the inside of a tornado has never been figured out, but it has been estimated at eight hundred miles an hour, or sixteen times as fast as a train."

"Eight hundred miles an hour!" Ross repeated. "But how did they find that out?"

"Not by any instrument," said Anton; "there isn't anything made that a tornado wouldn't level to the ground. But you can figure that from the size and weight of objects lifted and from the effects of tornadoes. Anyhow, the inside of a tornado is like a vacuum, the pressure is so low.

"I remember reading in a tornado account of a storm in New England where the funnel passed within twenty yards of a house. It was exactly as if a house filled with air were suddenly plunged into a vacuum. All the windows were blown out, the walls bulged, furniture flew out of the windows and corks were drawn from empty bottles by the air inside trying to get out to fill the vacuum in the tornado."

"That's a wonder," ejaculated Ross. "But we're not going to get anything like that this time."

As the boys were talking, the distant tornado suddenly raised itself from the ground and seemed to be drawn up in the clouds again. The danger from the funnel was over. A few minutes afterwards, there came a clap of thunder and the rain commenced to fall in torrents. It rained for less than a minute, however, then was followed by a few hailstones as large as walnuts. The hail stopped as suddenly as it had begun.

Yet, though the funnel cloud had been withdrawn again into the sky, though the rain and hail had ceased, the two boys did not move from the doorway of the club-house. The sky was pressing down heavily and in the masses of clouds that seemed to be moving in every direction, the whitish luminous cloud and the greenish black cloud could both be traced. This was no puny battle of the elements, but a veritable war.

Then, absolutely without warning, as suddenly as though some malevolent demon had picked them out for destruction, from the low-lying bank of clouds that was advancing, a long black swaying clutch thrust at them from the clouds. For a second or two the funnel swayed as though there were eyes in its tip and then snatched at the earth with a roar and crash like a thousand trains in collision.

While one could count three, the lads watched, panic-stricken, then Anton shouted:

"Run north-west, Ross! North-west!"

Like a flash the Forecaster's advice in the event of the approach of a tornado recurred to the

boy's mind, and he sprang into a full run. Ten yards, perhaps, he ran, then cast a glance over his shoulder to see if Anton were following. He saw the younger lad huddling down by the south-western corner of the club-house.

Ross colored with shame. For one second he had forgotten Anton's crippled condition.

He whirled on his heel with a speed scarcely less than that of the approaching tornado and darted back for his friend. A dozen strides took him back and he reached down for the younger lad.

As he did so, with the corner of his eye, he saw the tornado touch a neighbor's barn. The moaning suddenly swelled into a vicious and snapping roar. The point of the tornado enlarged, as it became filled with the débris of the barn, and Ross fancied he could hear the squealing of the mangled horses.

Out from the upper part of the wild whirl, high in the sky, a black spot flew. Thrown at a tangent, it fell, growing larger and more bat-like as it fluttered down, striking the earth with a crash. It was the roof of the barn.

All this had happened in the fraction of a second that had elapsed while Ross was picking up the crippled lad, and by the time that he had flung him across his shoulder, the tornado had passed over the neighbor's farm and there was nothing left of the barn but a black bare spot. Before the out-flung roof had struck the ground, Ross was running from the track of the swiftly-moving destruction, with his chum on his shoulder.

The boy knew well that in ninety seconds or less, the tornado would be upon them, and while it swayed with a malicious eagerness from one side to the other, as though seeking for its prey, there was no doubt that it was rushing straight at them.

Second by second, the moaning grew louder, with an uncanny sucking sound as though the monster were licking its lips over the destruction yet to come. The air grew more oppressive and more still.

Twenty yards from the club-house, Ross found Dan'l crouching on the ground, quivering with fright.

"Mistah Anton, Mistah Anton," he cried, "we's all goin' to be killed!"

"Run, Dan'l!" cried Ross, as he sped past. "Run north-west! Follow us!"

White with terror, the aged negro rose and started to run, but before he had gone two yards, his steps slowed down.

"Thar's Mammy," he said, aloud. "Ah can't leave Mammy, nohow. Thar's no one to look after her."

He turned back with unsteady steps, hurrying towards the negro quarters, almost facing the approaching finger that seemed to point at him as he ran.

Ross never looked back. His terror and the terrific heat of the air choked his breathing and he gasped as he ran.

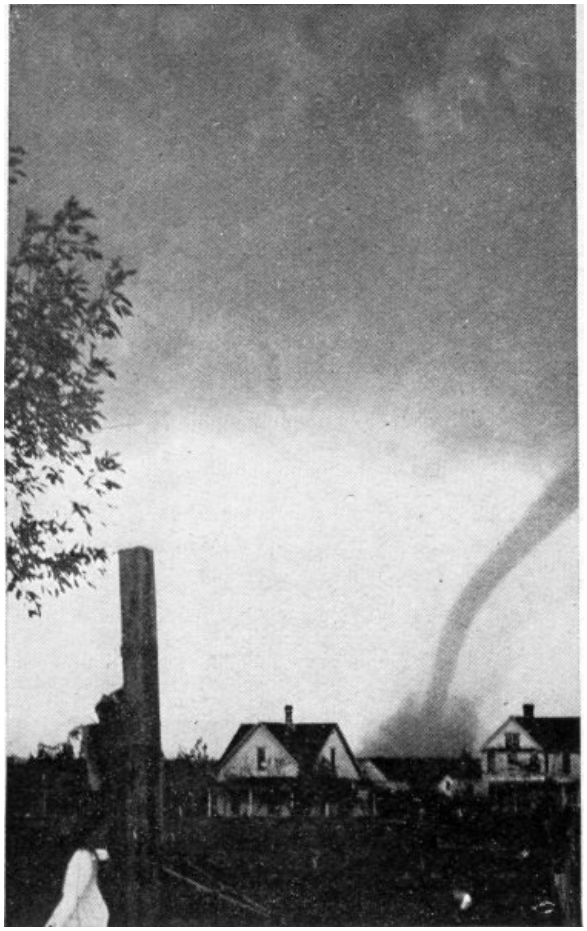
A sudden swirl of air clutched at his feet. He stumbled and almost fell. The crippled boy's crutch slipped to the ground. Anton slid to the earth and a second swirl picked Ross's feet from under him and threw him to the ground.

Then, with a roar and a confusion which stunned the senses, the Thing struck! A legion of hands tugged at them. The earth rose up in a cloud of dust around them.

Towards them the tornado swerved, then away, just a fraction out of its course, and swung back again towards them. As in a dream, Ross saw the crutch, which had slipped out of Anton's grasp, not five yards from where they lay, move restlessly, then, touched by an unseen hand, rise up. While two heart-beats lasted, the crutch stood still and perfectly upright, and then flew straight upwards into the all-devouring maw.

The black-green fury snatched at the waiting world.

With a roar like that of crashing universes, it swept by the boys and swung into the farm building. A hay-stack disappeared into the vortex like a puff of smoke. With a crash of glass, the tornado swept by the corner of the house, and with one wild last shriek was gone.



TORNADO WRECKING A FARM.
Whirl had been in action for ten minutes when photo was taken.
Courtesy of T. B. Jennings, U.S. Weather Bureau, Topeka, Kans.

TORNADO WHIRLING SIDEWISE.
The swaying motion of the funnel cloud makes the path of escape uncertain.
Courtesy of U.S. Weather Bureau.

Gasping, Ross sat up. Across the fields the cloud swept, the long black finger still touching the ground and still bringing wreck and destruction in its wake. Ross gently raised the younger boy, who was only half-conscious from the din and tumult, for the tornado had passed within a few

yards of them. They had scarcely walked a dozen yards when the scene of destruction met them full view.

Every window in the house had been shattered and the garden was strewn with broken glass. The buggy, which had been standing before the door, was nowhere to be seen, but one wheel impaled in a tree twenty yards away, told the story. The upright of the sun-dial was gone, snapped off at the ground as though it had been a reed. The club-house remained intact. The track of the tornado was not more than forty feet wide, but where it had passed, the ground was swept clean and bare.

Only one thing remained, and that, by one of the freaks of the tornado, was the pedestal and the large globe of crystal. It had not even been fastened down; it had passed through the centre of the tornado and yet it stood there as unwinking as the sun itself. Stood there all by itself, sharply gleaming against the black ground—

What was that lying on the farther side of it?

"Go back, Anton, go back!" said Ross, hoarsely.

But Anton had seen it, too.

He shook his head.

Haltingly, step by step, the two boys advanced, Anton's hand on Ross's shoulder, to the figure lying on the ground beyond the sun-dial, motionless and oh, so still.

Behind the fast-flying clouds the sun shone out, shone clear and strong on the crystal, standing on its pedestal, and the gleam, passing through, fell full on the face of the man.

"Dan'l! Dan'l!" the crippled lad cried, and dropped to the ground beside him.

He was not hurt. He would never be hurt any more.

Ross looked down at the faithful old darky, who, despite his terror and in the teeth of certain death, had turned back to try to save the aged blind woman in the negro quarters. The tornado had dealt kindly with him. His ragged clothing fluttered in the wind, but his kind old face was peaceful.

The sunlight, gleaming through the crystal, made a halo of light around the negro's head.

"Don't!" said Ross, laying his hand on Anton's shoulder. "There's mighty few of us that'll ever get the chance to die like Dan'l."

CHAPTER IX

THE TRAIL OF THE HURRICANE

"Two o'clock, Tuesday morning, August the seventeenth, Nineteen Hundred and Fifteen!

"Slowly down and across the white, faintly ruled paper wrapped about the revolving drum, I watched the long-shanked, awkward pen of the barograph in our Weather Bureau station at Galveston. In the jerky, scrawling fashion of a child writing his first copy on a slate, I saw the pen gradually draw what looked like a rough profile map—a long declining plateau, a steep and then a steeper slope, a jagged ugly valley—

"The valley of the shadow of death!"

The boys clustered closer round the speaker, the man who had seen and lived through, the Galveston hurricane.

"We knew well, the three of us in the Weather Bureau," he went on, "that descending zig-zag line meant that the hurricane, then beginning to rage over our heads, would increase in fury and in ruin, until the other wall of that strangely-drawn valley should begin to form under the halting pen. Thus we watched and waited.

"'Read the wind velocity,' my chief said to me.

"I focused a glass on the recorder, holding a lantern in my other hand.

"'Ninety miles an hour, sir,' I said.

"'It'll be a good deal more than that,' he answered. 'I only hope we don't have a repetition of 1900.'"

"That was the worst ever, wasn't it, sir?" asked Anton.

"It was the most destructive storm that the United States ever saw," the Galveston weather observer answered, "but, as a storm, it wasn't nearly as violent as the one we've just been through."

The speaker, who had his arm in a sling and who was still frail and weak from the injuries he had received during the hurricane, looked round at the boys. Being the Forecaster's nephew, he had come to his uncle's house to recuperate and the work of the League had fired his imagination.

"Tell them of the 1900 storm first," said the Forecaster.

"You tell them, Uncle," his nephew replied; "you remember that better than I do, and then I'll tell the boys my adventures in last week's storm."

"Yes," put in Fred, "you tell us, Mr. Levin."

"Very well," said the founder of the League, and he began:

"I suppose, measured by the loss of life and property, the Galveston hurricane of 1900 was the worst catastrophe that wind and water has ever brought to America. On Galveston Island alone, over six thousand people were killed, and five thousand more in the inland coast country. The ruin and loss of life was caused by a storm wave, which swept in from the Gulf in advance of the hurricane's vortex. This wave, four feet in depth, struck the already submerged island with almost irresistible force and entirely destroyed the city for ten blocks inland. Over five hundred city blocks were ravaged and two hundred blocks were laid level to the ground. Three thousand three hundred and thirty-six houses were destroyed."

"Where did it begin, sir?" asked Anton. "In the West Indies?"

"Undoubtedly," the Forecaster answered, "but, unlike last week's storm, we knew very little about it, before it came. Three days before the hurricane struck Galveston, storm warnings were hoisted, although, at that time, advices from Cuba showed that it had developed but little force. By the next afternoon it was beginning to wake up to true hurricane strength and the steamer *Louisiana* almost foundered in the middle of the Gulf.

"In Galveston, our barometer commenced falling that afternoon, and by next morning the situation began to look serious. The barometer was still falling steadily and high cirrus clouds of the mares'-tails variety, that always run in advance of the hurricane, were clearly marked.

"That afternoon over the waters of the Gulf came the long low swell, each wave one to five minutes apart, which is the sure sign of trouble. Though the wind was from the north and north-west, the swell from the south-east steadily increased and the tide began to rise. Before mid-night, the Weather Bureau had sent warnings to the newspapers to urge special precautions for the next day, as a rising tide and possible hurricane threatened disaster. At breakfast, the next morning, every one in Galveston read these warnings, none too soon, for at nine o'clock, the edge of the storm struck the city.

"The wind was steadily rising, and shifting by gusts at five minute intervals, until one o'clock in the afternoon, when it reached storm velocity. After that, it began to increase in fury. Every subscriber of the telephone company was warned personally from the Weather Bureau. Hundreds of people who could not be reached by telephone besieged the Weather Bureau, seeking advice. Dr. Cline, the chief of the station, who had been directing all precautionary measures since five o'clock in the morning, went to his home for lunch at half-past three o'clock that historic afternoon. The wind was then blowing fifty miles an hour.

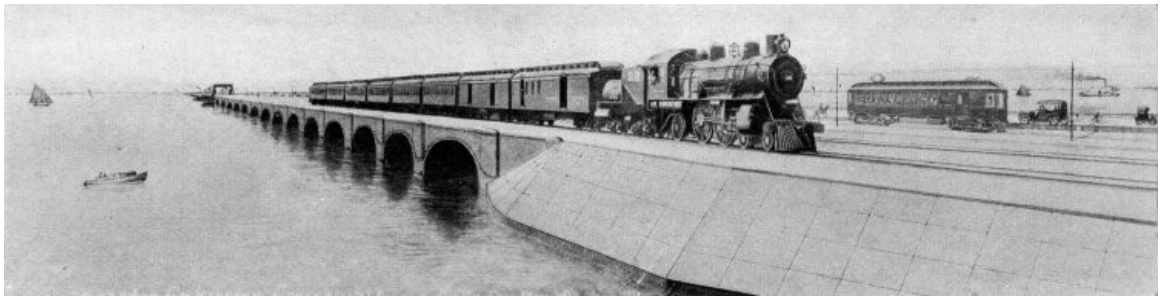
"'I reached home,' wrote Dr. Cline, 'and found the water around my residence waist-deep. At once, I went to work assisting people, who were not securely located, into my residence, which, being large and very strongly built, I thought could weather wind and tide. About 6:30 P. M., one of the other weather observers, who had been on duty since the previous midnight, reached my residence, where he found the water neck deep. He informed me that the barometer had fallen below 29.00, that no further messages could be got off to Washington, or anywhere else, as all the wires were down, and that he had advised every one whom he could see, to go to the center of the city; also, he thought that we had better make an attempt in this direction.

"'The roofs of houses and timbers, however, were flying through the streets as if they were paper, and it appeared suicidal to attempt a journey through the flying timbers. Just at this time, the anemometer in the Weather Bureau office registered one hundred miles an hour and blew away soon after. In the next hour the wind rose to a velocity of one hundred and twenty miles an hour. Many people were killed by flying timbers, about this time, while endeavoring to escape to town.

"'The water rose at a steady rate from 3 P. M., until about 7:30 P. M., when there was a sudden rise of four feet in as many seconds. (Hundreds of people, undoubtedly, were killed and drowned during those four seconds.) I was standing at my front door, which was partly open, watching the water, which was flowing with great rapidity from east to west. The water at this time was about eight inches deep in my residence, and the sudden rise of four feet brought it to my neck before I could change my position. The tide rose in the next hour nearly five feet additional, making a total tide in that locality of about twenty feet.

"'By 8 P. M. a number of houses had drifted up and lodged to the east and south-east of my residence, and these, with the force of the waves, acted as a battering ram against which it was impossible for any building to stand for any length of time. At 8:30 P. M. my residence went down, with about fifty persons who had sought it for safety, and all but eighteen were hurled into eternity. Among the lost was my wife, who never rose above the water after the wreck of the building.

"'I was nearly drowned and became unconscious, but recovered through being crushed by the timbers and found myself clinging to my youngest child, who had gone down with myself and my wife. Mr. J. L. Cline joined me five minutes later with my other two children, and together with a woman and child whom we had picked up from the raging waters, we drifted for three hours, landing three hundred yards from where we started. There were two hours that we did not see a house or any person, and from the swell we inferred that we were drifting to sea, which, in view of the north-east wind that then was blowing, was more than probable. During the last hour that we were drifting, which was with south-east and south winds, the wreckage on which we were floating knocked several residences to pieces. When we landed about 11:30 P. M. by climbing over floating debris, the water had fallen four feet. It continued falling, and on the following morning the Gulf was nearly normal.



GALVESTON CAUSEWAY BEFORE THE HURRICANE.

GALVESTON CAUSEWAY AFTER THE HURRICANE.

The Sea-Wall saved the greater part of Galveston in the hurricane of 1915, but the Causeway was exposed to the full fury of wind and water.

Courtesy of I. R. Tannehill, U. S. Weather Bureau, Galveston, Tex.

"'While we were drifting, we had to protect ourselves from flying timbers by holding planks between us and the wind, and with this protection we were frequently knocked great distances. Many persons were killed on top of the drifting debris by flying timbers, after they had successfully escaped from their wrecked homes. In order to keep on the top of the floating masses of wrecked buildings, one had to be constantly on the look-out and continually climbing from drift to drift. Hundreds of people had similar experiences.'

"Fearful as was the disaster," the Forecaster continued, "it would have been incalculably worse had it not been for the Weather Bureau warnings. Hundreds of people were saved by retiring to the upper portion of the town during the afternoon of the hurricane and no amount of foreknowledge could have told the sudden four-foot rise in the Gulf. Galveston learned her lesson, too, as was shown in the recent hurricane."

"I don't understand those hurricanes a bit," declared Fred, "they don't seem to act like tornadoes, and instead of coming from the west, like all the rest of our weather, they come up from the south-east. How is that, Mr. Levin?"

"The West Indian Hurricanes," the Forecaster replied, "are storms which are also called tropical 'cyclones' and which in the China Sea are known as 'typhoons,' and the fearful stories that one has read of the typhoon in the China seas applies equally to the hurricanes that strike our Gulf coasts.

"Like all other tropical cyclones, the West Indian Hurricanes are formed by an upward rising current of air over a moist heated area. There are five cradles of such storms. One is over the Pacific ocean south-east of Asia and gives the coast of China, the Philippine Islands and Japan the typhoon. A second and a third are in the north and the south parts of the Indian Ocean. A fourth, which is less frequent, is found east of Australia.

"The cradle of the West Indian Hurricanes is in the North Atlantic, about six to eight degrees north of the equator and from two hundred to a thousand miles east of the West Indies. These hurricanes, when first seen, are quite small but they increase in size and in motion as they come westward. Most of them, when they reach the Lesser Antilles—where Uncle Sam's new islands lie, the Virgin Islands—also increase in whirlwind character, and turn northwestward, skirting the northern edge of Porto Rico. This is the mean track. About seventy-five per cent of them pass over a regular storm trail between Bermuda and Charleston, most of these coming close to the coast and sweeping circularly away from the land at Cape Hatteras. At the latitude of New York,

the curve has taken them half way round the circle and they disappear as violent westerly gales, though beginning as easterly hurricanes.

"As you will have noticed, nearly all these storms come in the autumn. That is because the cradle of the hurricane is the doldrums, and in August and September, the Atlantic doldrums are at their furthest north. The Chinese typhoons are most frequent in the same months of the year, from the same cause."

"And this last one, sir," Tom asked, "the one that blew down my anemometer last week and which smashed up the old windmill, was it just like the hurricane of 1900?"

"I think I'll let my nephew tell you about that," was the reply; "he was in the thick of it, and the people of Galveston gave him a medal for bravery in connection with it, so he ought to be the one to speak."

"Gee, did you get a medal!" exclaimed Fred. "Do let's have a look at it."

The young weather observer shook his head.

"I haven't got it with me," he said, a little embarrassed. "But if you chaps want to hear about the Hurricane, I guess, perhaps, I can do that." He smiled. "I don't know that I've anything quite as thrilling as Dr. Cline's drift to sea, but one really astonishing thing did happen. I'll tell you about it."

"Tell us the whole thing," said Anton, "how the storm started and when you first got hold of it and what you did, and why they gave you the medals and—oh, everything!"

"All right," the young observer answered, and nursing his broken arm with his other hand, he began:

"We first heard about the hurricane on the morning of August 10th, where it had been seen between the islands of Barbados and Dominica. A little before ten o'clock that morning, storm warnings were sent to all West Indian stations. It came as a good deal of a surprise to us at Galveston because there had been none of the signs which usually go before a bad tropical disturbance. At two o'clock in the afternoon of that day, notice of the approach of a storm was sent to all Atlantic and Gulf stations of the Weather Bureau and the report was sent out by the wireless naval station at Arlington, Virginia.

"On the morning of the eleventh, the storm was south of the island of St. Croix, with a hurricane strength wind of sixty miles an hour at Porto Rico. On the twelfth, it was central off Haiti, and by the next morning was ravaging Jamaica. Hurricane warnings were sent out by the Bureau for Key West and Miami. On the fourteenth, the hurricane was central off the Isle of Pines, Cuba, and on the fifteenth, was central in the Gulf, gathering force steadily. All vessels were urged to remain in port. As a result of this warning, shipping scheduled to sail and valued at forty-five million dollars remained in harbor until after the hurricane had passed. Had they sailed, few of these ships would have lived. Hurricane warnings were ordered as far west as Brownsville, Texas. On Monday, August 16th, the storm approached the coast, and, in our office in Galveston, its menace began to make itself felt.

"Over the glassy surface of the Gulf there came a long, low swell, smooth and deep, the waves several minutes apart. Those who saw the swell remembered the disaster of fifteen years before, when eleven thousand lives were lost. True, the great sea-wall had since been built to protect the town, but would it stand? Man against the hurricane—which would win?

"In the sky, which was a weak, watery blue, appeared the ice-plumes of the cirro-stratus clouds, the true mares'-tails, flung out across the vault, their ends stretching to the centre of the storm. At the horizon, a wicked, dull glare gave threat of the typhoon's approach. All as yet was soundless, only the far-flung clouds told of the fury which was hurling them ahead of the circling hurricane below.

"Then! A low, whirring whistle of the wind. Not like the moan of an approaching tornado is this wind, but like the high-pitched note of an engine running smoothly at high speed. Characteristic and peculiar, boys, is that heralding wind, with a throbbing note in its character. That day, too, came the white squalls, lasting a minute or two each, with puffs of furious wind and a bucketful of rain, like bombs fired in advance of the hurricane by some huge æolian howitzer. Steadily the whir of the advancing wind became louder, steady, without gusts, and more and more frequent became the white squalls.

"Up, up and ever up came the sea, forced by the iron hand of the grim wind-tyrant behind. The swells came faster and the tide rose. Against the sea-wall the billows fell back, baffled, but, inch by inch, the waters of the Gulf rose against the city. Man's hereditary enemy, the Ocean, prepared itself for attack. Inch by inch the water gained, wound its sinuous way through the channel in the bay, backed into nook and cove and, long before the storm came, swirled a foot deep over land which never before in the city's history had been under water, even in the great storm of 1900.

"All day long, since midnight of the day before, three of us, up in the Weather Bureau, kept watch by our instruments, at the telegraph wire and the telephone. We had the men of Galveston to deal with, men who were not afraid of danger, men who knew well what the word 'hurricane' meant. All through that day an army was organized, an army of men that rested neither for food nor

sleep, warning those who were in the path of danger, leading the women and children to safety, carrying the old and sick upon their shoulders from regions where death was threatening.

"Our chief, at the Weather Office, summoned volunteers with motor-cycles and these men went to every corner of the city with the news of the approaching disaster. Through the streets rode these Paul Reveres, carrying the cry of the warning, and on that Sunday not one house in the entire city of Galveston was left unwarned. The city had lost six thousand lives in the hurricane of 1900. It was not to be caught napping a second time.

"At Seabrook, Texas, across the bay, Professor Stearns, a co-operative observer, personally visited every house in that section on Sunday, the fifteenth, and again on Monday. Before the hurricane, eighty-eight houses stood there; after the hurricane, there were three. Yet every one was saved, except two people, who had laughed at the weather warnings.

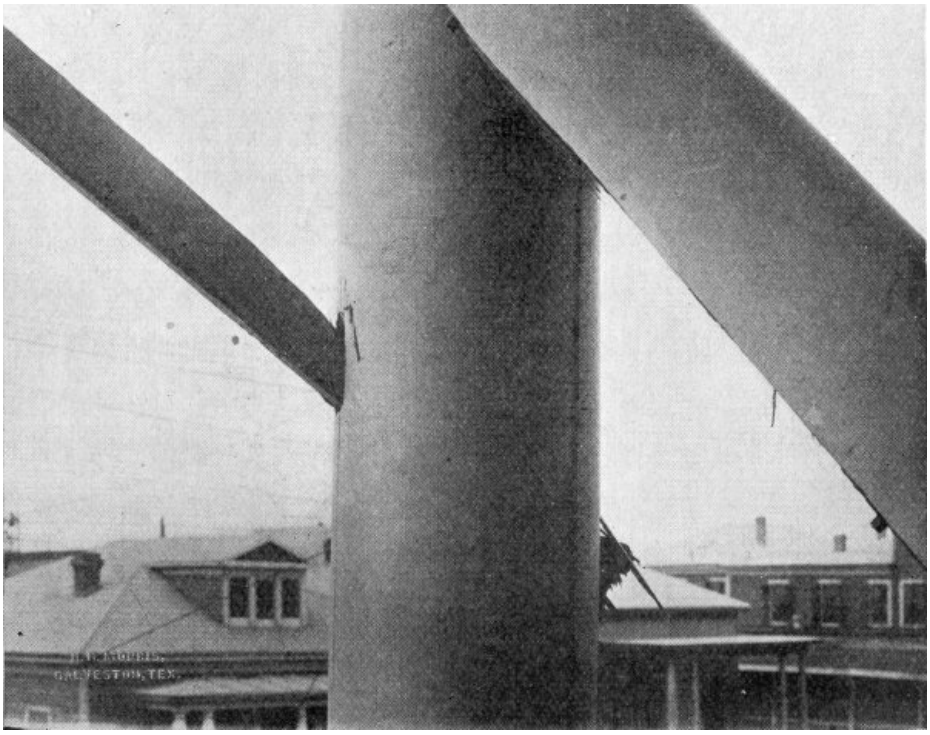
"Steadily the sea rose, all day Monday, and equally steadily the wind increased. The Fire Department joined in the work of protection. The police joined in the work of saving. As yet the hurricane had not come, but, through the Weather Bureau warnings, no one was allowed to pass into a fool's paradise of security.

"The summer evening came on with the whistling whir of the wind changing its note to an angry rage. In our little office at the top of the building, it looked as though we should be blown away. But there was too much to do for any man to leave. Still, had it not been for the thoughtfulness of one friend, none of us would have had anything to eat. We did not have a let-up of any kind for fifty-six hours.

"A wall of water swept towards the island, and before it became too dark to observe, in the early twilight one could see the wind-lashed waters of the bay begin to heap themselves into broken and irregular waves, each striving to overtop the other in their plunge upon the city. They broke, indeed, into the back door of the city, and then, with a suddenness that seemed to rock the very foundations of the earth, the wind struck us, in three nerve-racking blasts.

"With the savagery of the elements at their worst, the registering-pen of the anemometer in our office began to write its message. Raging in fury, the tempest leaped to eighty miles an hour, to a hundred miles an hour, to a hundred and twenty miles an hour. The air in the middle of a hurricane is estimated to have the weight of half a million ocean liners and four hundred and seventy-three million horsepower. Imagine a weight of several billion tons being hurled with five hundred million horsepower at a speed of two miles a minute! That, boys, was the storm that plucked at our little office in the sky, and that was the force which picked up the billows of the sea and hurled them at the seawall built by the hands of Man.

"At the signal given by the titanic winds, the waves drove in from the gulf and from the bay and smashed into a thousand pieces the houses of the lower section of the city. But the wind and the waves found nothing on which to wreak their vengeance except the empty shells of houses. Without our warnings, thousands of people would have been there and thousands of lives lost. But the hurricane was foiled of its prey, because of the writing of the little instruments at the top of the Weather Bureau tower.



SHOT FROM THE GUN OF A HURRICANE.

Thin strips of weather-boarding driven through a porch post, a marvellous example of the force of a hundred-mile-an-hour wind. Straws have been driven into brick walls in similar fashion.

(Upper photo taken from across the street; lower photo at close range.)

Courtesy of I. R. Tannehill, U. S. Weather Bureau, Galveston, Tex.

"When the storm was at its height, our anemometer blew away. When she went, the wind was howling cheerfully along at seventy-five miles an hour. The chap who was with me, a plucky fellow, suggested that we should go up on the roof and put up a new one. I thought myself that if we went up there, we'd be carried off like a couple of straws. But I wasn't going to have him think that I was scared. So up we went. My word, boys, but it was blowing! We worked for half an hour when the gale got under my coat and blew it open like a sail. In a fraction of a second I was being driven breathless to the parapet.

"Through the storm I heard a faint voice crying:

"'Take it off!'

"I tore the coat off and it flew up in the air like a crow, but it was almost too late. I was thrown against the parapet like a bullet. My shirt-sleeve tore and flew to ribbons, and I became conscious that my arm was hurting horribly. I fought my way back against the wind over to the roof and helped the other chap with the anemometer, which had nearly been erected when the wind caught me, and we got down the trap-door to the office of the Bureau. Then I keeled over. My arm was broken. My partner fixed it up as best he could."

"And you went on working?" asked Fred.

"Naturally," the young observer answered. "I wasn't going to give in just because of a broken arm. Besides, there was work to do, work worth doing.

"Far out to sea, meanwhile, was occurring one of the strangest stories of the sea. The annals of the ocean hold many thrilling escapes, but none, perhaps, more startling than that of the stranding of the three-masted schooner *Allison Doura*, which passed through the eye of the Galveston hurricane. Obed Quayle, a Cape Cod sailor who was one of the men on board, told me the story.

"'We were six days out of Progresso, Mexico,' he said, 'with a cargo of bales of sisal. The weather had been fair, with a goodish bit of head winds, but we reckoned to make Mobile on Sunday, the fifteenth. On Friday the weather began to look dirty and there was a long rollin' swell from the eastward that I thought was going to yank the booms out of her.

"'At eight bells of the second watch, the wind shifted, and any one could see with half an eye that there was trouble brewin'. The sea smelt of a storm. We made everything snug alow and aloft, put in double reefs and lay by.

"'At two bells of the afternoon watch, the gale struck us, and it struck us hard. Captain Evans Wood, the skipper, a mighty good seaman, handled the craft well, but our foretopmast was snapped right out before the gale had been on us an hour.

"'The jib-boom, too, went with the crash and the nasty mess of timber and shrouds, floatin' to leeward, began to hammer at our hull in an ugly fashion. A couple of us got at the wreckage as best we could, but before we had cut it adrift, the *Allison Doura* had sprung a leak and four of us

went to the pumps.

"'While we were workin' at the wreckage of the foremast, the schooner was pooped and the wheel was carried away. Bill Higgins, a young fellow who was at the wheel, was swept against the rail and had his head split open.

"'I've seen some bad weather in my time, but never just in that way. With the mizzen boom we rigged up a fore jury-mast and made shift to hoist a storm staysail to give us steerin' way and rigged up a tiller for steerin'. The wind was whistling like all possessed. It was askin' more than any vessel had a right to stand, and around midnight the fore staysail was blown clean out of the bolt ropes and she lost steerage way again. We couldn't hold her to the wind.

"'With losin' steerage way so much and without bein' able to hold her up to the wind at all, we couldn't run out of the storm. The gale drove us in and in to the centre of the hurricane. Somewhere around dawn on Sunday mornin' the wind decided to show us what it really could do. We were runnin' before the wind with a triple-reefed mainsail and not another stitch. "Why weren't we under bare poles," you asks? Because there was a sea chasin' after us with every wave looking like a whale out of water. We weren't lookin' to get pooped, any more than we had to. The mainmast went with a crash.

"'That left it nasty. The mizzen-mast, bein' the only one left standin', took her down by the stern and the waves runnin' along behind slapped us in the quarters good and proper. The skipper he give us orders to cut away the mizzen-mast, to lighten her.

"'It didn't take much cuttin' neither. The axes hadn't more than gotten through one of the weather shrouds, when the gale took the mast and chucked it over the side. That left us with the fore jury-mast that we'd rigged up, but not a stitch of canvas. The ship was as naked as a nigger baby in the Cannibal Islands.

"'We did our best with it, of course, and dug up a stretch of storm canvas about the size of a leg-o'-mutton sail and lashed that to the jury foremast and the stump of the bowsprit. With that gale cuttin' off our ears, it was all the sail she could carry. Bill, we had him lashed near the tiller we'd rigged up, not havin' a wheel, and by-n-by, most of us was wishin' we was lashed. But the old hooker stood up under it well, and though she was buried nearly all the time, her nose came right out of the green.

"'We'd have done anything in the world to beat north-east, for we knew the hurricane was goin' to the north-westward, but we couldn't do anything but run before the wind in our crippled state and the wind was blowin' north-east. It was shifting northerly and then westerly and we all knew that we were bein' driven into the very middle of the storm. The gale grew fiercer and fiercer, the sea was lashed to a mass of foam and in the shriekin' of the hurricane we couldn't tell, half the time, whether we were under water or above it.

"'Bill, with his broken head, stayed put at the tiller, the skipper never went below, Cookie tried to get some grub and the other four of us were lashed to the pumps. It was rainin' in torrents, too, but that didn't make any difference, for there was so much water that you couldn't tell whether it was the waves or the spray or the rain that was drownin' you; all we knew was that we were gaspin' for breath in an atmosphere that seemed about half air and half water.

"'Then, quite suddenly, the wind died down, and the rain fell from the sky as though the sea had been picked up and were bein' tilted over the ship. The clouds, racin' by and so low that they seemed almost as if you could reach up and touch them, flew overhead so fast that you couldn't believe it was a real sky you were lookin' at. It seemed like a painted piece of metal driving across the sky on an aeroplane. It fairly made me giddy to watch them. The winds died down, and suddenly became quite calm.

"'I've seen some seas, too, in my time, but never nothin' like this. Waves, no matter how high, I've been used to all my life. I've seen seas over the banks of Newfoundland that would look like a mountain, but waves like those in the eye of the hurricane I never saw before and I never hope to see again. They came from the east and the west, from the north and from the south. They met in the middle and struck each other, making whirlpools that set the schooner spinnin', they rose up and fought against each other, they swerved and leaped and jumped. One end of the schooner was yanked this way and a wave would come along and yank it to the other, cross currents pitched her nose down, and while her bow was down, another would slap her in the stern.

"'We was all lashed to the pump wheels. We were bruised and battered and sore. I never thought we'd get out of it. And, steadily, while lyin' almost without enough wind to fill our one small sail, we were pitched and tossed and shaken as a terrier shakes a rat. How the timbers of the ship ever held together, I don't know. We sprung another leak and while, before, we had been able to have ten minutes' spell in every hour, now we not only had to keep pumping steadily, but we had to keep those handles going at a swingin' pace. Cookie came and gave us a hand at the pumps and started some of the old chanties. The sun came out and shone clear above us and all the clouds disappeared. You might have thought it was a warm, mild day in summer, only for the orange-colored ring all round the sky and that boiling spot of a sea. We went on pumpin'.

"'It got so quiet in the eye of the hurricane that I felt as if I wanted to scream, and when Cookie stopped singin' for five minutes, I could see the glare of madness comin' into the men's eyes. For all I know, it may have been in my own. Bill was the first to go. He dropped the tiller and came shriekin' along the deck with his sheath knife, yellin' for the wind to begin again. The skipper

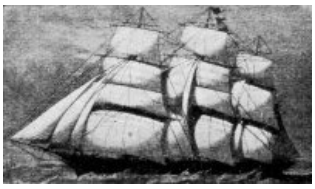
drew a revolver, ready to shoot him if necessary. But I saw Bill was comin' for me, and before he could reach me with his knife, I got him one in the right on the point of the jaw. One of the other men went to the tiller, while Cookie and the skipper lashed Bill fast to the stump of one of the masts, standin' him upright, so that when he came to, he wouldn't be able to hurt any one.

"'The other men at the pumps began to talk wildly. We hadn't no water. Our deck-casks had been carried away, with all our boats and everything movable, and we couldn't get at the tanks below, because we couldn't open the hatches. They was battened tight and if you so much as lifted a corner of the tarpaulin, the whole Gulf of Mexico would tumble in and there would be the end of us.

1. ZEPHYR

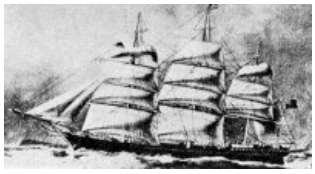
2. LIGHT BREEZE

3. FRESH BREEZE

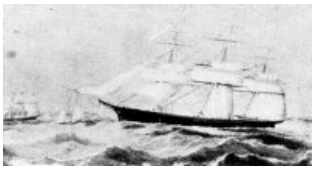


4. MODERATE WIND

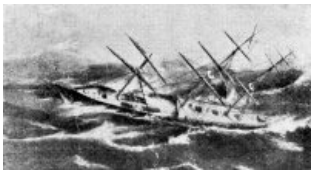
5. STRONG WIND



6. GALE



7. FULL GALE



8. STORM

9. HURRICANE

SCALE OF WINDS ILLUSTRATED BY REDUCTION OF SAIL ON AMERICAN CLIPPER SHIPS.

Note.— This is a combined scale with average wind velocities as follows:—(0) CALM;—(1) 2 miles an hour;—(2) 7 miles an hour;—(3) 11 miles an hour;—(4) 16 miles an hour;—(5) 22 miles an hour;—(6) 27 miles an hour;—(7) 32 miles an hour;—(8) 45 miles an hour;—(9) 60 miles an hour or more.

"'One of the chaps, however, insisted on scoopin' up with his hands the briny water that flowed from the pumps. It was mixed with bilge water and smelt horribly. He went mad, too. But we couldn't afford to lose any man's work and we lashed his hands to the pump handle. He went mad in a happy fashion and pumped wildly, singin' and talkin' in a way that made your heart curdle to hear it. Still, he pumped. The clouds began to form again round us, the same racin' clouds, the orange rim came nearer and we knew that we were once again approachin' the edge of the hurricane. There happened to be a little food in the galley and a scrap was given to each man. If we were going under, there was no need to drown hungry. So, faintly, but with quickenin' loudness, the whirring roar of the hurricane rose into a shriek and the fury hit us again.

"'I suppose I went on pumpin', I suppose we all went on pumpin', for the vessel stayed afloat, but what happened after we passed into the hurricane again, I can't tell you. I was deafened, stunned, blinded. I think I must have gone mad, too. Our trysail blew out right away, and the tiller that we had rigged up went as well. The bulwarks were laid flat with the deck. The skipper and one of the men were lashed to the stump of the mizzen mast, Bill, who had come to again and was ravin', was lashed to the jury foremast, and the other four of us were lashed to the pumps.

"'Whether I pumped for a day, a week, or a century, I'll never tell you. It seemed to me that I had been drivin' round that pump wheel for thousands and thousands of years. I remember that I thought that I was dead and that I had been sentenced to turn the wheel of a ship's pump forever. On Saturday afternoon I started my trick at the pumps, and maybe half a dozen times before midnight, I had ten minutes' spell. On Sunday I never left the handles and the last bite I had to eat was in the evenin'. All day Monday the four of us, lashed to the pumps, had never a stop, nor a bite to eat, nor a drop to drink. We laughed; how we laughed! I must have laughed for hours. We would have killed each other to stop, but the skipper had lashed our wrists to the pump handles. Did we stop? No one could ever tell. Did we pump without stoppin'? No one could ever tell that, either. Once in a while my brain cleared, and I saw the skipper, sagged, unconscious, dead, I thought, by the mizzen mast, and I heard the ravin's of Bill, lashed to the fore.

"'In the night, I suddenly saw the lights of a town. It was Galveston, and we were drivin' right on for it. I was so glad that I sang and shouted. At last, at last we were goin' to be wrecked. Then, perhaps, there would be rest, unless indeed I were already dead and pumpin' forever. We drove on and on, while I shouted—and went on pumpin'.

"'A sea picked us up and threw us at the sea-wall, the seventeen foot high sea-wall. Just before we struck, I saw the Captain move and look up. The schooner was thrown out of the water, as a porpoise jumps, vaulted the sea-wall and came to solid ground with a crash that broke every timber. We landed stern first, and the wave that followed us tore off our bow and foredeck and threw them clear over the vessel. The foredeck was found, after the storm, a hundred yards southeast of the maindeck. The bow was found eight blocks away, in the centre of the business district of the city.

"'We stopped pumpin'. There weren't any pumps any more. Of the seven of us, five were unconscious when a rescuin' party reached us, through the hurricane, four hours later. Two of us were crippled for life, and it was many a long day before Bill was free from the madness which had begun with the crack on the head when the wheel was swept away.

"'Daylight of Tuesday found me in bed, with an army surgeon straightenin' out my broken bones. The hurricane still raged over Galveston. We had been derelict for two days and a half, at the pumps for fifty-seven hours, without food or water for forty hours, yet not a man was lost. No other dismasted vessel has ever lived through the eye of a hurricane and been tossed over a sea-wall into the business streets of a city. Yet seven of us, all Americans, still live to tell the tale.'"

The young observer paused and looked at the boys. They were all very still.

"And the beach," the young observer continued, "that once white beach with its stretches of sand, what did that look like, beyond the engineers' parade ground, where the wrecked schooner lay? Mis-shapen, distorted, blotched, drabbled and crimsoned, it spread away to the horizons, east and west, its scars showing under the rays of the sun which shone out from the mares' tails of the departing hurricane. Part of it had disappeared under the waters, now rapidly subsiding. The great causeway was a mass of ruins, but the sea-wall, the two-million dollar sea-wall, stood with its front to the ocean, grimly defiant still, the conqueror against the rage of the tempest, and an unwrecked Galveston shone triumphant.

"But I should do the hurricane a grave injustice," he continued, "to leave you boys with the story of Galveston alone. Its terrors were far more widespread than that. On my way here from Galveston, I saw the ravages of the storm inland. Everywhere on the flat prairie near Texas City were ruined houses and outbuildings, many of them absolutely abandoned, others still with a corner occupied by their ruined owners. Trees were broken short off or up-rooted and lying prostrate. The hurricane which had been foiled of the slaughter which had been granted to its predecessor fifteen years before, had swept on, mile after mile, for hundreds of miles, slaying and wrecking as it went. Acres of pear orchards were stripped as though the giant of the winds had drawn each separate branch through his clenched fists. For twenty miles inland the prairie grass lay prostrate. Twelve miles from the shore I saw a fishing schooner there, her masts still standing, and near it lay a child's rocking-horse, a cradle, a boy's baseball-bat and a five hundred pound bale of cotton.

"Not fifty yards from the hastily relaid railway track, I saw a strange example of the fury of the waves and wind. On the floor of the first story of a negro shack, without a scrap of furniture around it, with no wreckage or piece of wood to be seen in any direction, a rude cabin indeed, was a large grand piano, its boards warped by the water and the sun, but otherwise uninjured. From what house in Galveston had this floated, to find a resting-place on the floor of an un-roofed and un-walled negro's cabin? Around it was not a sign of wreckage save the bodies of scores of drowned horses and cattle and, among them, many human forms.

"No census will ever tell how many were killed in that stretch of prairie between Galveston and Texas City. Years hence men will stumble over human bones on that grassy plain and give burial to some victim of the greatest storm that ever visited American shores. Yet, withal, that the hurricane of 1915 claimed six hundred victims instead of tens of thousands was due alone to the warnings of the Weather Bureau, to the heroism of the men and women of Galveston and to the craft, skill and honesty of the men who built the great sea-wall."

CHAPTER X

STRUCK BY LIGHTNING

There was but little further interest in kite-flying that afternoon, when the young observer ended his story of the Galveston hurricane. The boys had been brought close to danger and they crowded around the stranger with questions concerning the hurricane. The lads were all the more thrilled by reason of the fact that the sky was becoming dark and ominous, and that, even while the stranger spoke, the clouds grew more threatening.

"There might be a hurricane coming now," said the youngest of the group, looking fearfully at the sky.

"No," answered the observer, "that's nothing but a thunderstorm. You'll never forget the look of the hurricane as it comes near, if you've seen it once."

"Nor a tornado," put in Ross, and he told of Dan'l's death and of his narrow escape with Anton.

"I was in the St. Louis tornado," the observer rejoined, and in turn he told of the devastation that had struck the city in 1896.[1]

1 While this book was in press a most destructive series of tornadoes visited the United States, Illinois especially suffering. Hundreds of deaths were recorded.

Meantime the thunderstorm was drawing closer and the thunder and the lightning grew gradually nearer.

"Do you suppose, sir," asked Tom, "that it would be safe to send up the kite? I've been listening to the hurricane story, and haven't taken the weekly observation yet. Franklin sent up a kite in a storm."

"It might be safe, but I wouldn't advise it," answered the Forecaster. "Franklin did it deliberately, for a different purpose, and it was because of his experiment with a kite that we first found out about lightning."

"Yes," answered Tom, who knew the story well, "and he collected sparks from the string. But that was a silk string, Mr. Levin. I should think this piano wire would be much worse."

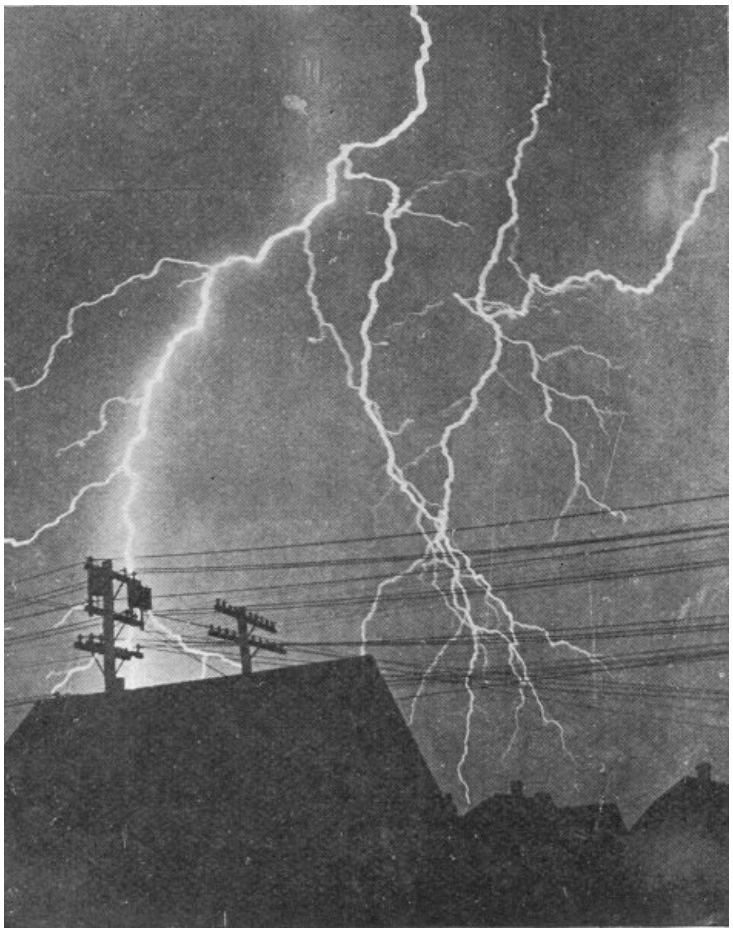
"Why?" asked the Forecaster. "On the contrary, it would act as a lightning-rod. Your kite reel is of metal and fastened to the ground. Wire is a much better conductor of electricity than the body, so that there's less likelihood of your being struck."

"Is it the difference between a good conductor and a bad one that makes people put up lightning-rods?" asked Fred.

"Certainly. All that a lightning-rod does is to convey to the ground the electricity that is about to strike a building. That's the whole system of lightning protection. I can explain it to you fairly well by trees. You know in fairy tales that some trees are supposed to be wicked and other trees are supposed to be good?"

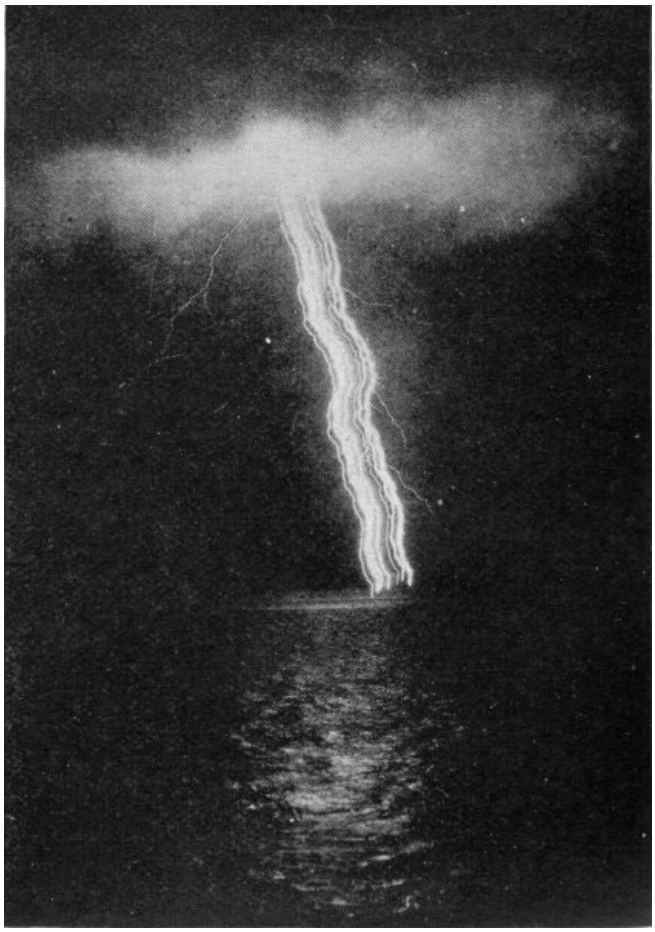
"Yes, sir," put in Anton, "Dan'l used to talk about that. He always used to say that the oak tree was a black witch tree and that the beech tree and the alder tree were white witches."

"Like nearly all folk-lore," replied the Forecaster, "there's a mighty good reason for that superstition. Folk-lore, after all, is merely keen observation reduced to a saying or a story. It is true that the oak-tree is a black witch so far as lightning is concerned and that the beech and alder are white witches. The proportion of trees struck by lightning has often been counted and for every fifty-four oaks struck, only one beech, or birch, or maple or alder is struck. Elms are fairly dangerous, being forty to the beech's one, and pines are less so, their ratio being fifteen. Not only this, boys, but a good deal depends on the way in which a tree is struck. An oak-tree may be riven into splinters, showing the terrible resistance that it gives to the stroke. A beech-tree, usually, is killed outright, yet shows but little outward injury. The oak has resisted the current, it is a bad conductor; the beech has allowed the current to flow directly to the ground.



BRANCH LIGHTNING.

Copyright by H. E. Clark, Indianapolis. Courtesy of U.S. Weather Bureau.



MULTIPLE FLASH.
Courtesy of General Electric Co., Schenectady, N. Y.

"So, boys, if you are in a mixed forest and stand beneath a tree, the figures show that you are fifty-four times as likely to be struck with lightning when standing beneath an oak, instead of a beech. Not only that, but if the oak be struck, the lightning may jump from the tree to you more surely than it would from a beech-tree.

"It's surprising," he went on, "but even trees of closely related character show very different effects of lightning. 'Nothing but lightning,' writes John Muir, 'hurts the Sequoia or Big Tree. It lives on through indefinite thousands of years, until burned, blown down or undermined, or shattered by some tremendous lightning stroke. No ordinary bolt ever hurts the Sequoia. I have seen silver firs split into long peeled rails radiating like spokes of a wheel from a hole in the ground where the tree stood. But the Sequoia, instead of being split and shivered, usually has forty to fifty feet of its brash knotty top smashed off in short chunks, about the size of cord-wood, the rosy-red ruins covering the ground in a circle one hundred feet wide or more.

"'I never saw any that had been cut down to the ground, or even to below the branches, except one about twelve feet in diameter, the greater part of which was smashed to fragments. All the very old Sequoias have lost their heads by lightning. All things come to him who waits, but of all living things, Sequoia is perhaps the only one able to wait long enough to make sure of being struck by lightning. Thousands of years it stands ready and waiting, offering its head to every passing cloud, as if inviting its fate, praying for Heaven's fire as a blessing, and when, at last, the old head is off, another of the same shape immediately grows on.'"

"And then, I suppose," said Fred, "it will never be struck again. Lightning never strikes twice in the same place."

"Oh, yes, it does," said the Forecaster. "That's all nonsense. Take the Eiffel Tower in Paris, for example. That's struck nearly every time there's a thunderstorm. But lightning can't hurt the Eiffel Tower because practically the entire building is a lightning-rod and it has been very carefully grounded into deep wells, a long way below the ground."

"I've been wondering," said Anton thoughtfully, with his characteristic opening, "just how a thunder-and-lightning storm happens. You promised to explain it to me, Mr. Levin," he continued, "and you never have."

"Very good," said the Forecaster, briskly, "I'll explain it now. And you couldn't have picked a better day for your question, Anton, because we can see the tail end of that thunderstorm going off to the east, and, if I'm not mistaken, there's another one coming up to the south-west. Do you see that layer of cirro-stratus clouds?"

"Yes, sir."

"And do you notice those festoons of cloud, slowly coming down and dissolving—you see there's one small one there, and another one a little larger, behind?"

"Sure!"

"Well, those are the heralds of a thunderstorm. We've only seen those since my nephew began talking about the hurricane, about an hour ago. Away off on the horizon, though, you can see a bigger bunch of those festoons, dropping from the five-mile height of the cirro-stratus and condensing away down lower. This heat that we're now feeling will diminish, just as soon as that cloud covers the sun, not because the sun is hidden, but because of a change of wind."

"But the storm's coming up at right angles to the wind," said Tom, "the wind's a little east of south."

"It'll blow from the north-east presently," declared the Forecaster oracularly.

"Directly opposite to the storm?" ejaculated the kite expert in surprise.

"Certainly," was the answer, "that's a part of the thunderstorm formation. You can see now," he continued, "how the thunder heads of cumulo-nimbus are beginning to show, leaden in color below, with the white billowy tops. They're very thick, those masses of cloud, perhaps two miles thick, and the gray rain curtain trails along behind them. Well, Tom, what is it?" he added, turning to the boy, who was claiming his attention.

"The wind's shifting," answered the lad.

"To the eastward? Of course. It'll be north-east in a minute or two, as I told you. It's got to be."

"But why, sir?" asked Tom. "I don't see why a surface wind should have to blow up against a storm."

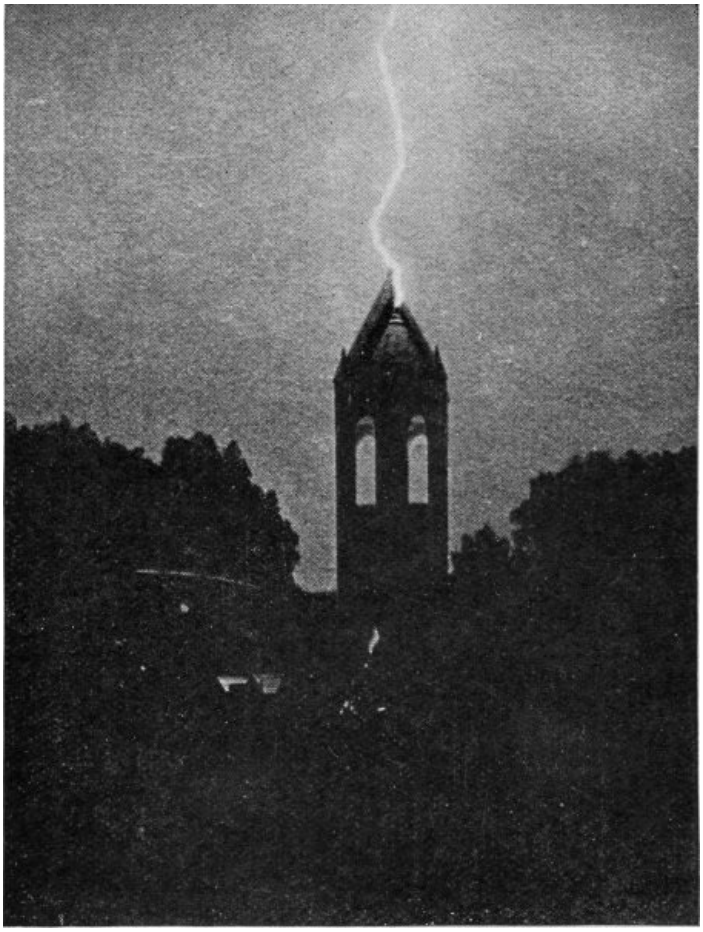
"That," said the Forecaster, "is quite easy. If the rain is falling, it brings down a mass of cold air with it, displacing the warm air that lies before the advancing storm. The warm air is driven forward, but, at the same time, the descending cold air requires warm air to replace it in its turn, and the warm air, therefore, curves backward and flows into the upper portion of the storm cloud, where its moisture is condensed as rain. So, my boy, a little distance in advance of a thunderstorm there are three currents of air, an upper current of cold air, traveling in the same direction as the storm, and driving the cirrus clouds before it; a current of warm air, going in the opposite direction to the storm and pouring a torrent of warm air into the cloud; and the cold squall, which drives out from under the thunder-cloud and which comes in violent gusts."

"But I thought," said Fred, "that thunder and lightning came from two clouds banging together. If most of the thunder storms travel from the west, where does this banging come in?"

"It doesn't come in at all," the Forecaster replied; "thunder and lightning do not result from clouds striking each other. It's not quite so simple as that.

"The lower air is full of positive electricity just as the surface of the earth is charged with negative electricity. As you know, boys, rain is formed by a lot of little drops of moisture combining to form one large drop, which, when it is heavy enough, falls to the ground. Now the surface of every drop of moisture is charged with electricity. When these drops come together to make one big drop, the surface of the big drop is proportionately much smaller than the combined surfaces of all the small drops. There isn't room enough on the surface of the big drop to hold all the electricity that existed on the surface of the larger number of smaller drops and, therefore, a great deal of electricity is set free.

EIFFEL TOWER STRUCK BY LIGHTNING.
Unusual example of attraction of electric discharge. This great structure in Paris is struck in almost every thunderstorm.



LIGHTNING FLASH STRIKING BUILDING.
Single disruptive discharge of great intensity, at Greensboro, N.C. This non-branched form is rare.
Courtesy of Gen. Electric Co., Schenectady, N. Y.

"Only a few flashes of lightning reach the earth. Most lightning-flashes occur between two cloud masses in the body of the thunder-cloud. Photographs of these show them to consist of scores of fine branches which jump from one cloud to the other, the flash being strong or weak according

to the distance to be jumped. You can see that a very faint flash could jump a distance of an inch, but that it would take a stronger current to jump a yard, and that a terrific force of electricity must have accumulated before the current is strong enough to break down the resistance of the non-conducting air and jump a quarter of a mile. When lightning is attracted by the earth, it means that the air between the thunder-cloud and the earth is being subjected to a constant strain, and the weakest place gives way first. The weakest place, generally, is the place when the jump is shortest and there is a good conductor available.

"One of the reasons that buildings and trees are struck by lightning is because they project up into the air, and according to their height, they remove a corresponding amount of the poorly conducting air. If the lower edge of a thunder-cloud is two thousand five hundred feet above the air, and the spire of a church is five hundred feet high, it follows that it is easier for a flash to jump two thousand feet than two thousand five hundred. So when the electricity-bearing cloud comes over the church spire the flash will leap to the church, five hundred feet of obstacle being removed. The highest building, therefore, is usually struck first, or the highest tree in a forest.

"A lightning-rod or conductor is the best preventive against the destruction of a building by lightning, if the rod sticks up in the air above the building, even a couple of feet. The current will more readily strike the lightning-rod. As these are made of metal—copper or iron, generally—which are extremely good conductors, the current flows through them to the ground without harming the building.

"The big lightning flashes that you see, boys, aren't always a single flash, but often a whole series of flashes, which occasionally run up as well as down. The resistance of the air being broken down, makes a path for the electrical discharge, so that the conductor does not have to stand the entire strain of the cloud at once, but only in a series of discharges. Photographs of lightning flashes show these very clearly."

"I've never done any lightning photography," said Ralph disgustedly, "I'd never thought of it."

"You try it," said the Forecaster, "and you'll find that there are no two flashes of lightning that look alike. Some of them are several miles long. One thing you will notice at once, Ralph, and that is that lightning is never zigzag, the way you see it in pictures, but runs in an irregular line, winding a little like a river-course."

"How about sheet-lightning?" asked Ralph.

"That's just the same as any other kind of lightning," was the reply, "except that it doesn't come to the earth or is so distant that the earth flash is not visible. It is generally due to discharges between upper and lower clouds, and the lower clouds are illuminated by the lightning. Heat-lightning, as it is called, is pretty much the same thing."

"Father told me once," said Fred, "that during a thunder-storm, a ball of fire came down on the chimney and rolled all around the room like a bubble of quicksilver and then struck a shovel that was standing in the corner, when it blew up with a bang. What was that, Mr. Levin?"

"That's globe, or ball lightning," was the reply. "There have been some very curious freaks done with these electric balls. One of them, in a baker's shop at Paris, jumped into an open oven door and exploded, giving off so much heat that a pan of biscuits was baked in the fraction of a second. At least, so Flammarion tells the story, though it sounds a bit queer."

"But what's the cause of ball-lightning?"

"We don't know," answered the Forecaster, simply.

"A couple of days before the Galveston hurricane," put in the young observer, "I noticed two or three examples of St. Elmo's fires, and even had them from my fingers."

"What are St. Elmo's fires?" queried Fred.

"Corpse candles, they used to be called," the young observer answered, "or St. John's fires. They are brush-like discharges of electricity, being discharged from the earth towards the sky, and generally gather on elevated points, such as the masts of ships, the tips of trees or the iron railings around a roof. It was on the top of the Weather Bureau building in Galveston that I saw them, just the other day. They look like a bluish flame, and give a crackling sound. I had my hand on the rail and was reaching up with the other hand towards the anemometer when I noticed from my third and little fingers two blue flames burning. It looked exactly as if my hand were alight."

"Weren't you afraid of being killed?" the boy asked.

"No," said the observer, "that's not the way that one gets killed with lightning. The St. Elmo's fire is a very weak electric discharge. My fingers tingled a little, that was all."

"But do many people get killed with lightning?" queried Ross. "I thought that it was really quite rare."

"Not as rare as you would think," the Forecaster answered. "About five hundred people are killed by lightning every year in the United States and there is an annual property loss of eight million dollars."

"Is that high as compared with other countries?" Anton asked.

"Yes," the Forecaster replied, "more people are killed by lightning in the Western States than in any place in the world. In the Dakotas, out of every million deaths twenty-seven are due to lightning; in Missouri, twenty-one. In Hungary sixteen out of every million deaths are due to lightning; in the United States as a whole, ten; in Germany, six; in England, four; in France and Sweden, three, and in Belgium, two. The greatest number of deaths by lightning are on the plains, the fewest in the cities."

"I should think lightning would be much worse in the city," said Ross, "because if a building is struck with a lot of people in it, they'd all be killed."

The Forecaster shook his head.

"Not at all," he said. "Last year, for example, a church was struck by lightning on a Sunday morning, during a religious service. There were three hundred people in the building. It was a bolt of unusual force, which practically wrecked the church. Only six people were killed by lightning, thirty were injured from the falling timbers, seventy were made unconscious by shock, and two hundred were absolutely uninjured.

"The largest number of persons killed by lightning at any one time in America was in an amusement park in Chicago. Eleven people had huddled into a zinc-lined hut under a pier, for protection from the rain. The lightning struck the pier and jumped to the hut. If the hut had touched the wet sand, none of them would have been hurt, but the hut was on posts a couple of inches above the beach. The lightning could not escape to the ground and it spread from the zinc sides, killing every one there. A piece of wire a sixteenth of an inch thick and six inches long, running from the hut into the ground, might have saved every life."

In the distance a flash of lightning followed by a low rumble of thunder told of the nearer approach of the storm.

The Galveston observer took his watch from his pocket and counted the seconds between the flash and the thunder.

"Fifty seconds!" he continued. "The front of the storm is still ten miles away."

"Do you reckon five seconds to a mile between the lightning and the thunder?" asked Anton.

"Yes," the observer replied, "light travels so fast that for something as near as a lightning flash, you can reckon it as instantaneous, while sound only travels at a little more than a thousand feet a second."

"But why does thunder make a noise?" asked Fred. "You told me the clouds didn't bang together."

"They don't," the Forecaster answered. "Thunder is caused by the electric discharge. You've heard Bob's big wireless outfit crackle, when he sends out a spark, haven't you?"

"Sure," said Fred, "you can hardly hear yourself talk, when Bob's got his wireless busy."

"And why does that crackle? Do you know, Bob?" he asked, turning to the wireless expert.

"No," answered the boy.

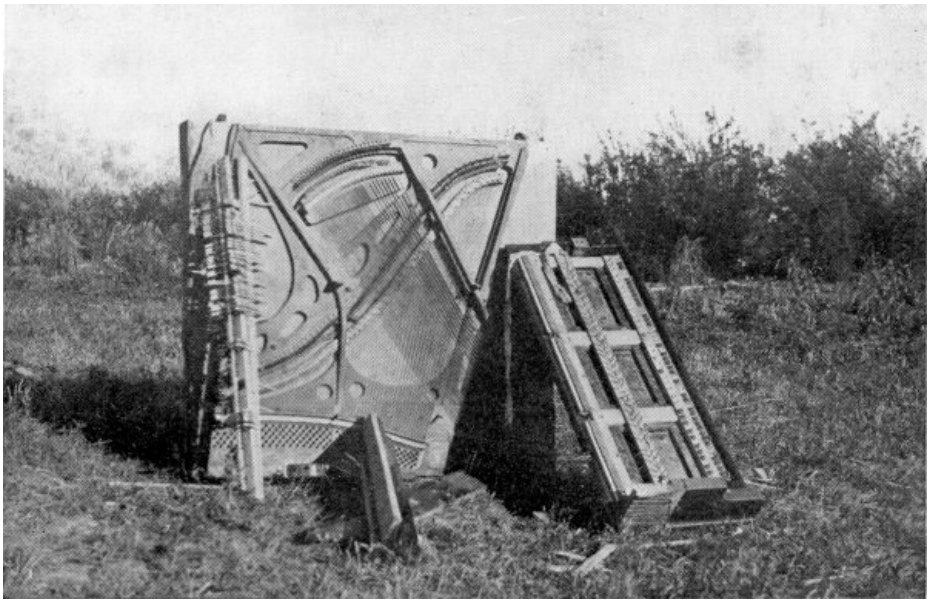
"You've often heard the crackling of a near-by thunder compared to an irregular volley of rifles, haven't you?"

"Yes."

"Naturally, because that's exactly what it is. A rifle shot is an explosion caused by the firing of a powder, which, in turn, means the expansion of the powder into gases, the force of that expansion driving forward the bullet. Sound, as you know, is a series of air vibrations. The explosion wave sets up a series of these vibrations, by compressing the air in front of it.

"Lightning does the same thing. When a lightning flash breaks down the resistance of the air, and passes through a channel of air, it heats the air suddenly to a temperature of two or three thousand degrees, causing a terrific expansion along the entire length of the flash and starting an explosion wave. This compresses the air on all sides and sets sound vibrations in action. As soon as the flash is discharged, the air rushes back to fill the partial vacuum that the heating by electricity has caused, adding force to the vibrations.

CARRIED IN THE AIR THREE MILES FROM THEIR STABLE.



GRAND PIANO PICKED UP BY A TORNADO AND DROPPED IN A COW-PASTURE.
Courtesy of T. B. Jennings, U.S. Weather Bureau, Topeka, Kans.

"That's why you hear the crackle of near-by thunder. You are near enough to hear the explosions made by all the little side-branches of the lightning flash—you can hear the same sometimes when you comb your hair or rub a cat's fur—while the big crashes are due to your hearing, all at once, the main wave of sound set in action by the flash jumping from the cloud to the earth or from one cloud to another.

"The rumble of the thunder—which used to be thought the rolling of a chariot in the sky, is due to the different distances of various portions of the discharge, to the echo of the explosions from the projecting hills and valleys of the cloud forms, and to the irregular shape of the earth, when the sound waves strike the ground."

"Hail is electric, too, isn't it?" said Anton. "In a hail-storm the other day I noticed that the hail jumped up a lot higher from an old piece of iron that lay on the ground than from a stone right beside it. I tried the iron and the stone with a marble, after the storm was over, and the marble bounced higher from the stone. I figured that there must be some kind of electric repulsion and that the hail must be electrified."

"It is, very often," the Forecaster answered. "In some very violent electric storms, you'll see hail jump up as if it were alive, when it strikes the earth. Of course, boys, there's some slight elasticity in a hail-stone, too, because a good many of them are made like an onion or a pearl, with a number of layers round each other."

"But why in the world should a hail-stone be made like an onion?" said Fred, with a puzzled stare. "Isn't hail just frozen rain?"

"No," answered the Forecaster, "frozen rain is sleet, which is never seen in summer. It is caused by the rain in the upper air falling through a cold layer of surface air and becoming frozen on the way. Sleet is ice, and transparent.

"Hail never falls in winter, only in summer, and almost always in connection with a thunderstorm. It is made by drops of moisture, like very fine rain, being carried by the strong upward currents of a thunderstorm to altitudes where the air is very cold, there becoming coated with a layer of snow, and becoming heavier, falling through the less active upward currents on the edge of a

storm. As these snow-covered frozen raindrops fall through the clouds, they grow bigger, because on their cold snow surfaces the moisture condenses and is frozen to a skin of ice. At the base of the cloud, they are often sucked in by the upward current and carried up again for another layer of snow, falling again through the clouds and being covered with another skin of ice. This may happen a dozen or a hundred times, the hailstones growing in size with every successive layer of snow and ice, until at last they become so heavy that they can no longer be carried up by the ascending currents, and fall to the ground."

"No wonder hailstones sometimes get so big!" exclaimed Fred. "I've seen them as big as pigeon's eggs. I never could understand it."

"I've seen hailstones that weighed more than half a pound," the Forecaster answered. "Not so very long ago, two ranchers and six hundred head of cattle were killed by hail in one Texas storm. Not a single animal was left alive. The loss from hail in our Western states is so large that most of the progressive farmers pay heavy hail insurance. Jagged bits of hail the size of a child's fist are not at all uncommon. If I'm not mistaken," he continued, "we may have some hail this afternoon, but nothing like that. This county isn't in the regular hail-belt."

During the description of the storm, Tom had been reeling in his kite and after the week's observations had been duly made and recorded, the boys prepared to scatter. Before they left, the Forecaster turned to them, his hand on Anton's shoulder.

"I think you boys ought to know," he said, "that I received a letter the other day from the Chief of the Weather Bureau. He's going down to New Orleans next month, and has promised to drop off here and spend the night with me. We were chums at college. He ought to meet the Mississippi League of the Weather."

An excited cheer went up from the boys.

"And what's more," the Forecaster went on, "I can tell you this—that just as soon as Anton is old enough, there will be a place waiting for him in the Bureau. He knows almost enough now to pass the Civil Service Exam, and in a couple of years he'll be as well equipped to enter the Service as any of the boys that are going in. I miss my guess if we don't find out, some day, that Issaquena County has given to the United States one of the best meteorologists of the next generation."

"Three cheers for Anton!" shouted Fred.

They were given heartily and the boys separated in groups, excitedly discussing what they ought to do to prepare for the visit of the Chief of the Weather Bureau. Anton and Ross drove home to Anton's place together, Ross driving and the crippled lad, with his eyes glowing with enthusiasm, talking about the work he intended to do in the ranks of the Weather Bureau.

Meanwhile, the storm grew nearer and nearer. The thunder, which had been rolling menacingly, now came with shorter and sharper claps.

"I wonder if we'll get home before the rain," said Ross and leaned forward to slap the pony with the reins.

At the instant that he leaned forward there was a blinding flash of light, and, almost simultaneously, a terrific crash.

For a second Anton was stunned, and then, as the frightened pony started to bolt, he saw he was alone.

Ross was gone.

The crippled lad cast a frightened glance over his shoulder and saw his chum lying on the ground beside the roadway, stripped to the skin. Some pieces of his clothing, burning and smouldering, lay a few feet away.

Grabbing the reins, Anton managed to pull the pony down to a walk and scrambled out, awkwardly, with the crutch, but rapidly.

The lightning, as so often happens, had snatched every stitch of Ross's clothes from him. There was not a mark of a burn on the boy's body, but he lay deathly still, with his arm cramped under him.

Anton, exerting all his strength, rolled his chum over on his back. Then, kneeling across him, as best he could with his lame leg, he took Ross's wrists, jerked his arms to their full length, brought the wrists back upon the chest and pressed. Again he stretched the arms out, again brought them back, and pressed. Again, and again and again.

Time passed and the perspiration stood out on the crippled lad's forehead and trickled down into his eyes and the corners of his mouth. Yet he did not pause for a second.

He stretched the arms out, brought them in and pressed down upon the chest.

Again and again and again.

Fifteen minutes passed, and there was no sign.

Probably further work was of no use, but Anton persisted. He could not stop, as long as there was a chance.

Out, in again, and pressure on the chest.

A clatter of approaching wheels caused Anton to look up. It was the buggy, with his father whipping the pony to full speed, returning along the road to find out what accident had happened. Anton shouted, but did not stop.

Out, in again, and pressure on the chest.

The buggy stopped and his father jumped out.

"Who is it?" he asked.

"Ross," answered Anton, "struck by lightning!"

"Dead?" queried his father.

"He can't be!" declared Anton passionately, and went on with his artificial respiration.

"Let me do that a while," said his father.

"Wait!" cried Anton.

He thought he saw an eyelid flutter.

Out, in again, and pressure on the chest.

"He's coming to!" the man declared.

Yes, that was a movement. The lips parted. There was a faint heave of the chest, and Anton's father, stooping down, felt a slight trembling of the boy's heart. It fluttered, hesitated, stopped; then trembled again, and struck into a low soft throb, irregular indeed, but still a definite throb.

Out, in again, and pressure on the chest.

For five minutes more Anton continued his artificial respiration, silently, and then Ross opened his eyes.

"What's wrong?" he asked, faintly.

"You've had a lightning shock," answered Anton.

"I thought you were dead," put in the lad's father, "but it looks as though Anton had pulled you through."

Ross smiled at his chum.

"Bully for you, old boy," he said weakly, "the sea-wall licked the hurricane and you've licked the lightning-flash!"

THE END

The life of a typical boy is followed in all its adventurous detail—the mighty representative of our country's government, though young in years—a youthful monarch in a vast domain of forest. Replete with information, alive with adventure, and inciting patriotism at every step, this handsome book is one to be instantly appreciated.

"It is a fascinating romance of real life in our country, and will prove a great pleasure and inspiration to the boys who read it."—*The Continent, Chicago*.

THE BOY WITH THE U. S. CENSUS

Through the experiences of a bright American boy, the author shows how the necessary information is gathered. The securing of this often involves hardship and peril, requiring journeys by dog-team in the frozen North and by launch in the alligator-filled Everglades of Florida, while the enumerator whose work lies among the dangerous criminal classes of the greater cities must take his life in his own hands.

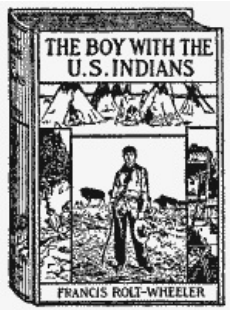
"Every young man should read this story from cover to cover, thereby getting a clear conception of conditions as they exist to-day, for such knowledge will have a clean, invigorating and healthy influence on the young growing and thinking mind."—*Boston Globe*.

THE BOY WITH THE U. S. FISHERIES

With a bright, active American youth as a hero, is told the story of the Fisheries, which in their actual importance dwarf every other human industry. The book does not lack thrilling scenes. The far Aleutian Islands have witnessed more desperate sea-fighting than has occurred elsewhere since the days of the Spanish buccaneers, and pirate craft, which the U. S. Fisheries must watch, rifle in hand, are prowling in the Behring Sea to-day. The fish-farms of the United States are as interesting as they are immense in their scope.

"One of the best books for boys of all ages, so attractively written and illustrated as to fascinate the reader into staying up until all hours to finish it."—*Philadelphia Despatch*.

THE BOY WITH THE U. S. INDIANS



This book tells all about the Indian as he really was and is; the Menominee in his birch-bark canoe; the Iroquois in his wigwam in the forest; the Sioux of the plains upon his war-pony; the Apache, cruel and unyielding as his arid desert; the Pueblo Indians, with remains of ancient Spanish civilization lurking in the fastnesses of their massed communal dwellings; the Tlingit of the Pacific Coast, with his totem-poles. With a typical bright American youth as a central figure, a good idea of a great field of national activity is given, and made thrilling in its human side by the heroism demanded by the little-known adventures of those who do the work of "Uncle Sam."

"An exceedingly interesting Indian story, because it is true, and not merely a dramatic and picturesque incident of Indian life."—*N. Y. Times*.

"It tells the Indian's story in a way that will fascinate the youngster."—*Rochester Herald*.

THE BOY WITH THE U. S. EXPLORERS

The hero saves the farm in Kansas, which his father is not able to keep up, through a visit to Washington which results in making the place a kind of temporary experiment station. Wonderful facts of plant and animal life are brought out, and the boy wins a trip around the world with his friend, the agent. This involves many adventures, while exploring the Chinese country for the Bureau of Agriculture.

"Boys will be delighted with this story, which is one that inspires the readers with the ideals of industry, thrift and uprightness of conduct."—*Argus-Leader, Portland, Me.*

THE BOY WITH THE U. S. LIFE SAVERS

The billows surge and thunder through this book, heroism and the gallant facing of peril are wrought into its very fabric, and the Coast Guard has endorsed its accuracy. The stories of the rescue of the engineer trapped on a burning ship, and the pluck of the men who built the Smith's Point Lighthouse are told so vividly that it is hard to keep from cheering aloud.

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