Watching for and Preventing Forest Fires

How the Forest Service is Protecting Our Standing Timber

By Day Allen Willey

THE greatest problem connected with the conservation of the country's natural resources is the care and protection of the woodlands in charge of the Forest Service. The many ways in which trees can be destroyed by fires, by heavy gales, and by drouth which dries up the earth below the roots, gives the ranger a task of great responsibility, particularly when it is considered that these men have over 160,000,000 acres of timberland in their charge.

To appreciate the problem one must have a clear conception of the type of country included in the National Forests, and also some idea of its extent. Except for small areas in Florida, Minnesota, Michigan, Kansas, and the Dakotas, the National Forests include the great mountain watersheds of the West. They lie along the crest of the main divides of the Rockies, the Cascades, and the coast ranges. The country is therefore rough and mountainous, cut by gorges and canyons, and broken by almost impassable ranges and by unscalable peaks. There are two general forest types—open park area with timber confined to the north slopes, and densely forested regions where timber grows on both exposures. In the main, the park country of the principal divides and the very heavily timbered regions are in the west.

The work of fire prevention and control, although theoretically the same for both types, differs essentially in practical application. Each national forest, the unit of administration, contains from 1,000,000 to 2,000,000 acres. This is equivalent to an area from 30 to 50 miles wide and from 40 to 60 miles long. To protect such an area from fire, especially in view of the difficulties of transportation and communication, is exceedingly difficult.

Fire insurance appraisers, who have investigated various causes of ignition in cities and towns, concur in the conclusion that fully 90 per cent of the fires were due to causes which could have been

Building an observation tower to watch for fires.

Rangers' telephone for giving fire alarms and reporting to their chief.

avoided. Much of the loss by the flames in the woodland can be prevented. This statement is based on the opinion of the heads of the Forest Service division throughout the West, who have carefully studied the situation. As a result of their efforts, the service has already begun to execute plans which have proved to be practical and successful, either in preventing fire or in extinguishing it so soon after its origin that it did no damage. The burning of the timber means not only a loss in stumpage, but a community loss in wages of approximately \$10 for every thousand board feet destroyed. When it is realized that it is not uncommon for the timber to run from 50,000 to 100,000 board feet per acre in the dense forests of the Pacific Northwest, it is clear that it does not take very many burned acres to run the figures up to six or seven places. For example, from one year's fires in Montana and northern Idaho the loss was 6,000,000,000 feet board measure, with an estimated value of \$20,000,000. Aside from the value of the timber the danger to lives and to town property from these large fires is a very great menace.

Always the first question when the fires are mentioned is: "How do all these fires get started?" The usual causes in the order of their frequency are: Railroad engines, lightning, careless campers, fishermen, and hunters; settlers burning brush to clear land for cultivation; logging engines and sawmills; malicious incendiaries. Out of 3,138 fires reported, 1,186 were caused by locomotives, and their setting was due to three principal reasons—the use of coal as fuel, the lack of proper clearing of the right of way, and the non-use of spark arresters.

The railroad's right of way is usually from 100 to 200 feet wide. In many places within the National Forests the brush and debris have never been properly cleared up on the right of way after the larger timber has been removed, and

(Continued on page 56.)

Running telegraph lines through reservations for rangers' use.

Ranger sweeping the Rocky Mountains for forest fires.

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[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

The Technique of Clam Digging

To the Editor of SCIENTIFIC AMERICAN:

It is amusing, when we think we know a thing thoroughly, to find we do not know all about a given subject.

Clam digging and its technique is a simple matter, yet Mr. Johnson of Seattle has never "dug" the festive "fan" clam, and, though living in a clam country, and a city whose people certainly cannot be accused of clam natures, would probably dispute the fact that there are clams in the waters of Puget Sound that swim. The clam commonly known as the "fan" clam must be taken with a rake or can on the end of a pole as long as a rake handle out of a boat.

I have had hours of sport getting these beautiful shells with the living clam in them.

They lie on top of sandy stretches of the beach, close to or under sea weeds, and are very quick in their zigzag motions when disturbed, darting up, around, and through the water, and if the "clam hunter" is not expert and knows nothing of the habits of the "fan" clam, it is doubtful if he ever sees them, to say nothing of capturing any.

The shells are covered with a fuzzy substance which falls off after the clam is boiled, leaving thin, delicately colored, ribbed shells, the ribs radiating like the leaves of a fan—hence their name.

The most common clam and the most edible is obtained by digging, as described by Mr. Johnson.

There is yet another clam that requires a totally different technique. It is commonly called the "geoduck," but the dictionary spelling is "geoduck," which I translate "earthduck."

This clam has to be dug for in earnest, not as you would dig potatoes, but as you would dig a deep hole for a telephone pole. Its neck is stretched as much as six feet, and its shells are as large as a man's hand. The body protrudes, so that the shell on either side cannot meet opposite the hinge.

This clam is often dug out of clay banks along the edges of the Sound, and again at the very lowest tides it can be found deep down below the surface.

I have found five distinct "species" of clams in quantities in Puget Sound, and do not pretend to be well acquainted with the clam family.

GEORGE LAWLER.

Tacoma, Wash.

Are There Any Holes in the Air?

To the Editor of SCIENTIFIC AMERICAN:

The numerous fatal accidents which have occurred in aeroplane work, and which have involved the most skillful navigators of the air lead one to look for some cause which is not allowed for or fully appreciated. We hear of "holes in the air" and such expressions, which are very indefinite and more or less illogical. In thinking over this matter, it appears to the writer that the fatal conditions are substantially two, and they are conditions which may overtake the most skillful and leave him entirely unprepared and entirely helpless. One of these is the "following gust" and the other is the "slackening head wind." Let an aviator be flying in comparatively still air in which his speed of progress with respect to the air around him is say thirty miles an hour; now let the air back of him, as a "following gust," suddenly increase to a speed equaling his own, and let this increase take place in a period of time which is too short for his machine to accelerate, or let the increase be of such a character that in spite of what little acceleration he gains, the "following gust" overtakes him and leaves him in still air relatively to the machine; that is, the machine and the air in which he is immersed are moving forward at the same rate. At this moment all control apparatus fail; vertical rudders, horizontal rudders, ailerons, everything, even the main planes, fail to have an effect, and the aeroplane is just like a kite in the air with the string cut, liable to plunge in any direction to earth,

without the possibility of help or assistance from any of the devices provided. Fortunate the aviator is if, before the aeroplane is much disturbed, the conditions change so that he has a speed relative to the air. This may save him; but if the conditions occur to a degree or for a time which prevent his righting himself, a confused action of the machine and a fall is inevitable.

The other dangerous condition is that of a head wind which is holding the aviator back, and which head wind suddenly has a flaw, or ceases; instead of being an acceleration of wind back of him, it is a retardation of the wind velocity ahead of him. This, again, will leave him with insufficient forward motion of his machine and in a condition of instability, as in the other case, which is only to be recovered by his acceleration or by the retardation of the wind within a short period. Should the condition of his lack of relative motion with respect to the air around him, which is in both cases the secret of the trouble, exist for a time, he is helpless, and may become the victim of an accident.

It is manifest that a gustiness of the wind which strikes him sidewise is not dangerous, but sudden accelerations and retardations of the air current in the direction of his motion put him in imminent danger by depriving him of all effective means of control.

I do not know how far these actions are understood, but I have never seen them discussed as the true causes of danger and difficulty in navigation of the air by aeroplane.

ELIHU THOMSON.

West Lynn, Mass.

Watching for and Preventing Forest Fires

(Concluded from page 48.)

dry punk logs and debris form the most inflammable kind of material for ignition by a spark from the engine. Furthermore, the heavy grades in the mountains require a full and forced exhaust on the engines in order that sufficient steam may be kept up. Most of the spark arresters now in use interfere with the draft and, as a result, the wire screen must be knocked out or opened up, so that the engine may get up the difficult grades. The more modern and larger locomotives have a return draft, by which the larger cinders are forced back to the fire box before being emitted through the stack.

Despite improvements, both in engines and spark arresters, the railroads still hold first place as a cause of forest fires. The second great cause of fires, and the only one which can be classed as non-preventable, is lightning. During the dry season in 1910 there were many electrical storms in the timber region and innumerable small fires were found immediately afterward. If the storm is accompanied by rain there is, of course, little or no danger, but it is more usual for these mountain electrical storms to be unaccompanied by rain. In 1909 there were reported 294 fires originating from this cause.

Over 400,000 people go to the National Forests for recreation each year. Many of these people are out for a week or two at a time to hunt, fish, or just to enjoy outdoor life in the hills. Unfortunately many of the campers either are careless or are ignorant of the proper handling of camp fires. The carelessness takes the form of leaving the fires unextinguished, or of throwing about cigar or cigarette stumps or knocking out pipes. The usual Turkish cigarette is a slow fuse that burns continuously to the end. The ignorance is shown in the failure to keep camp fires small and in not building them in fairly open places and away from punk logs and debris. Frequently a large fire is built when a little one would serve the purpose better and be safer. Everyone who has been in the hills has run across the skeletons of old teepees that mark the Indian camping grounds. The fireplace gives the impression of having been used for generations. It is simply a depression in the ground about 2 feet square, surrounded by a cleared space about 10 feet in diameter. Their fire protective methods might well be followed. The clearing of timbered lands for cultivation by settlers contributes materially to the fire danger each season. The debris must be burned and, in many cases, for lack of market, even the logs

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themselves are thus disposed of, in order to clean up the land. The increasing use of donkey engines in logging has brought about a corresponding increase in fires, and logging locomotives passing through cut-over area is another source of some of the largest forest fires.

In the National Forests, of course, fire engines can not be used; but the reporting of fires, the quick calling for assistance, and the keeping in readiness of necessary tools and equipment are of much aid in preventing the spread of flames.

Modern devices are now being employed in the operation of the Forest Service. Of these the telephone is one of the most valuable. Already several thousand miles of line has been laid, with trees as poles. At intervals of a half hour or an hour's run, the ranger can reach a tree telephone and notify the nearest station of any danger. What this safeguard means, is shown by the former alarm system. Before the installation of the telephone, it was necessary for the ranger to ride to the nearest settlement, where he gathered such help and supplies as he could with the least loss of time, and returned to the fire, after sending a messenger on to headquarters to give the alarm. But, in the mean time, hours had been lost, and they meant thousands of dollars waste to the nation. In one fire, because a privately owned telephone line in the national forest was out of repair, seven million feet of timber burned in one afternoon. The forest supervisor bought that telephone line before another season opened.

In the forest reserves of Montana and other parts of the Rocky Mountains the most important duty of the ranger is to watch for fires. It is a very dry country, and the woods are like so much tinder, which a spark may ignite. The ranger, from his post of outlook on the top of a mountain that may be two miles high, locates the fires with the help of a field-glass, and "plots" them on a sketch chart of the surrounding region. Then, descending to his cabin or to some other station of communication, he telephones to other guards of the forest—it may be over distances of fifty miles or more—and gives them warning of what he has observed. Of course, they likewise have been on the watch, and by such means the entire forest is covered by a complete fire alarm system.

The telephone wires run in all directions through the forest—the instruments simply attached to trees, being so distributed that a ranger can always put himself, at brief notice, in communication with other guards, to give information or to call for help. It is a matter of no little difficulty to keep the service always in first-rate running order, for falling trees, blown down by storms, are liable at any time to dislodge or break the wires. When a fire has been located the first thing requisite is to get as many men as possible to the spot to fight it. But they must have food and other supplies, which have to be brought long distances over difficult trails. Formerly this was a very arduous matter, involving long delays, for a week might easily be consumed in transporting the provisions, etc., from the nearest source of supply to the scene of active operations; and meanwhile the fire burned on. The obstacle has been overcome to a great extent, however, by establishing, in various parts of the forest, depots which are drawn upon in any emergency.

Another means of fire warning of much importance are the watch stations, from which signals can be made. They are situated on some eminence, such as a bare mountain top or rock formation that is higher than the surrounding country, and notice of a fire is given in the day time by waving flags, or flashing the sun's rays from mirrors. The method is very similar to that of the army signal service. Some watch stations are made of wooden framework with a railed platform, possibly an inclosure at the top. From the platform an unobstructed view can be obtained.

Each forest watcher is usually provided with a marine glass as well as a signal mirror, so that in the western mountains, with the aid of the lens, he has a range of 25 to 50 miles. The watch tower is always located so as to be seen distinctly from one of the forest stations, and a ranger is continually on duty during the day to look for signals. At some of the watch towers gasoline torches are

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provided for signaling if a fire should be discovered in the night.

The fire watch tower is also being constructed in the East. The Massachusetts Forest Commission has erected a series of steel framed towers in different portions of the State forests. At the top, a shelter of sheet steel is built for the watchman, the sides being of glass set in iron frames. One located at Plymouth, Massachusetts, is over 100 feet high, and the watchman has a view of 30 miles in all directions.

Curious Light Phenomena of the Indian Seas

(Concluded from page 51.)

The captain was especially struck by the fact that the larger spots of phosphorescence in the sea appeared to light up more brightly as the rays reached them, and to fade out in the dark intervals. When the center was right abeam the rotation was so fast that the rays passed about once a second. When the rays were no longer visible the bigger spots of phosphorescence for some time lighted up at regular intervals, as if they were still passed by the rays. Gradually this decreased, and the phosphorescence shone as usual in the bow-water and along the vessel's side. The lookout and the helmsman also observed the phenomenon.

The Danish Meteorological Institute has collected a few reports of other observations somewhat similar to the above. A similar case was reported in the *Annalen der Hydrographie und maritimen Meteorologie*, 1899, p. 483, as follows: On November 21st, 1897, the German ship "Arethusa" encountered a curious illumination of the sea after midnight, when in the Bay of Bengal, lat. 14.2 degrees N., long. 96.5 degrees E. As far as the eye could reach the surface of the water shone with myriads of lights, which the officers declared had the effect of search-lights in a hazy atmosphere. The ship's log says: "It was a splendid but also an uncomfortable sight." At 2 A. M. it began to rain, and the phenomenon suddenly disappeared. The wind was south-southeast and east-southeast, its force 4, and the weather cloudy.

A more recent case was reported by Captain Breyer, of the Dutch steamer "Valentijn." At midnight August 12th, 1910, this vessel was near the Natuna Islands, in the South China Sea. The course was magnetic south, the speed eight knots. Suddenly the easterly horizon became illuminated with a light which commenced to oscillate rapidly and regularly. The phenomenon soon passed into a rotation of flashes above the water. It looked like a horizontal wheel, turning rapidly, the spokes being the rays of light running over the water. The rotation was against the sun and very regular, one ray passing every half second. The bundles of rays diverged very little and were not curved. The center could not be discerned as an isolated point. Gradually the rays grew clearer and somewhat narrower, until the source of light appeared to be beneath the ship. The water around the ship seemed to be in rapid oscillating motion, and it was as bright as at full moon (the moon had set at 10 P. M.). This lasted about five minutes; then the rotation recommenced with the center on the opposite side of the ship. The rotating rays gradually decreased in brilliancy and breadth, and at 12:40 A. M. the phenomenon had quite disappeared in the northwest to west.

In this case the ordinary phosphorescence of the water was not observed. The sea was rather smooth and the air clear. The phenomenon was observed by the captain, first and second mates, and first engineer, and on all of them it made a somewhat uncomfortable impression.

Similar observations have occasionally been reported to the Meteorological Office at London by the captains and officers of British ships.

No complete explanation of the phenomenon can be given. It is well known that in many marine organisms the capacity to produce light is awakened by sudden movement. Thus disturbance by the blade of an oar produces luminescence in the seat—commonly called "phosphorescence," though phosphorus has nothing to do with it. Also the wind

rippling the surface of the water evokes the same luminosity from myriads of minute protozoa and crustacea, and the crests of the ripples are marked with light. The luminous rays seen in the cases above described appear to have marked lines of disturbance in a sea abounding in organisms capable of phosphorescence; in other words, long and regular waves, having a systematic movement of rotation. Such waves, however, appear to be altogether anomalous.

The Highest Balloon Ascent and Other Achievements of the Weather Bureau

TUCKED away in a corner of the annual report of the Chief of the Weather Bureau for the past fiscal year is the casual statement that a sounding-balloon sent aloft at Huron, South Dakota, September 1st, 1910, by the aerological staff of the Mt. Weather Observatory, reached an altitude of 18.9 miles above sea-level. This fact is in no way exploited, and the reader is left to find out for himself that never before in the history of science has any human contrivance traveled so far away from Mother Earth. The previous "record," an even 18 miles, was attained by a balloon sent up at Uccle, Belgium, November 5th, 1908. The modest way in which this remarkable occurrence is announced may perhaps be explained by the well-known unreliability of the barometrically determined altitudes of all high balloon ascents; the figures in this case may indeed be inaccurate to the extent of several hundred feet. The interesting fact remains, however, that meteorology has pushed its probe a little farther upward; and the details of this newest achievement, as yet unpublished, will be awaited with interest.

The Weather Bureau has now carried out four campaigns with sounding-balloons, comprising in all ninety-one ascents. For the benefit of readers who are unfamiliar with the methods of the "new meteorology" it may be explained that a sounding-balloon is allowed to go free, bearing with it some very light self-registering meteorological instruments. The expansion of the gas at great altitudes (where the pressure of the air is extremely small) bursts the balloon, and the gentle landing of the instruments is insured by means of a parachute. This sometimes occurs as much as two hundred miles away from the place of ascent. A label attached to the apparatus offers a reward (in this country two dollars) for its safe return to headquarters; and in eighty-one of the ninety-one ascents just mentioned the instruments were recovered.

The exploration of the upper air that has been carried on all over the world during the last ten years has led to a number of well-defined ideas about the atmosphere above the highest cloud-level; all of which have been recorded from time to time in our columns. The noteworthy feature of the recent remarkably high ascents made by the Weather Bureau is that they are not altogether consonant with existing views. Thus it does not seem to be uniformly true in this country that the "upper inversion"—the lower limit of the region in which the air stops growing colder with ascent—is at a lower level over cyclones than over anticyclones. It is, however, slightly lower in winter than in summer, as found in European ascents. The lowest temperature registered in a Weather Bureau ascent was 92 degrees below zero Fahrenheit.

The official report under review records some other notable researches in the field of pure science. A good beginning has been made in a pyrheliometric survey of the region west of the Great Lakes and the Mississippi; i. e., the measurement of the intensity of solar radiation. This work is a response to the demands of biologists for accurate data of the amount of heat received by plants from sun and sky; as well as a contribution to the general physics of the atmosphere. The study of atmospheric polarization is being carried on in connection with these investigations.

Turning to the more practical work of the Bureau, it is interesting to learn that wireless weather reports from vessels at sea have at last begun to yield useful results. Thus the first definite news of

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