

hours of each day. For a load like electric heating, that extends over the entire twenty-four hours of each day, an even lower rate might be made with profit to the supply system.

When the cheapness of electric heat is better understood by the public, and the desirability of all-day loads is more fully appreciated by central station managers, a great increase in the application of electric current to heating for industrial and general purposes is sure to follow.—Alton D. Adams.

STUDY OF FOREST CONDITIONS.

A study of forestry seems to be especially esteemed in countries where there are no longer forests to study. Realizing how vital to the welfare of a nation is the preservation of its forests, the United States is making an endeavor to study and improve the forests of this country while there is yet time to preserve them. In furtherance of this work the United States Geological Survey has just published a paper which bears the title "Forest Conditions in the San Francisco Mountains Forest Reserve, Arizona."

The San Francisco Mountains Forest Reserve comprises portions of the broad summit and slopes of an elevated tract of land in north-central Arizona, which includes the southern part of the Colorado Plateau. The northern part of the area is dotted by several hundred volcanic cones and the southern part is gashed by numerous deep canyons. The altitude of the region ranges from 3,500 feet at Oak Creek in its southwestern portion, to 12,794 feet at the summit of San Francisco Peak.

Among the coniferous trees in the reserve the yellow pine constitutes over 99 per cent of the total forest. The aspen takes first rank among the broad-leaved species, but has a close competitor in the oak. The chief lumber tree at present is the yellow pine, which is extensively cut and furnishes all of the mill timber sawed, used in, and exported from the region. Its average total height is 85 feet, with about 10 feet of clear trunk. The diameter averages 18 inches, which corresponds to an age of 180 years. In the 812,500 acres of forest area examined 2,743,558,000 feet B. M. of standing timber were found, which gives an average of only 3,377 feet B. M. per acre. It is evident that the yellow pine stands, even where entirely untouched by the ax, do not carry an average crop of more than 40 per cent of the timber they are capable of producing. This condition is chiefly attributable to the numerous fires which have swept over the region within the last two hundred years, destroying seedling and sapling growth.

The chief agencies through which the forests in the reserve suffer destruction are cutting, grazing, and fire. Logging operations have been carried on in most of the central forested areas that are tributary to railroads. The forest has been culled or cut from 148,845 acres. The timber cut on these tracts has been converted into tie, stall or round mining timber, and saw logs.

Grazing, especially sheep herding, is ruinous to the seedling growth of a young forest. Sheep are especially fond of the young aspen, which springs up as the first restockage on the non-forested park lands at the base and on the slopes of the San Francisco Mountains. It was found that the destruction of seedlings on any particular tract of land ranged from 50 per cent to total after a single passage over such ground by 2,000 head of sheep.

Fires have been of frequent occurrence in all portions of the reserve. The badly-burned areas, on which the destruction has been 60 per cent or more, aggregate 6,790 acres. The origin of fires in recent years may, in part, be ascribed to the carelessness of sheep herders, in part to sparks from engines on the Atchison, Topeka & Santa Fe Railroad, but by far the larger number of fires are due to lightning, and this cause has, of course, always operated. Sections exist on which 50 per cent of the mature yellow pine has been either wholly or in part killed by lightning strokes.

Among other interesting questions considered in this paper are the low reproductive ratio of the yellow pine, the influence of the forest on run-off, the grazing value of the reserve, and the effects of sheep herding on the forest floor. The bulk of the paper is devoted to detailed descriptions of the areas, by range and township, that make up the reserve.

LONG-DISTANCE NON-STOP RAILROAD RUNS IN GREAT BRITAIN—A NEW WORLD'S RECORD.

A new record in railroad traveling has been established by the Great Western Railroad, of Great Britain. On July 1 a regular non-stop daily train service was established between the London terminus at Paddington and Plymouth. The distance is 246 miles, and the "Cornishman Limited Express" is scheduled to cover the journey in each direction in 265 minutes without a single stop. This supplies an average speed of 55.69 miles for the journey. This, therefore, constitutes the longest non-stop railroad run in the world.

Ever since the year 1896 this railroad has retained such a non-stop record. For in that year the railroad

company initiated a through non-stop train from London to Exeter, 194 miles, covered in 3 hours 45 minutes. During the subsequent years, however, this run has been increased to 3 hours 30 minutes, equal to an average speed of 51.7 miles per hour. In the recently inaugurated run, however, the time between these two points has been still further reduced by five minutes, increasing thereby the average speed to 56.7 miles per hour. Hitherto this railroad has not been able to make the journey a non-stop one beyond Exeter, owing to the absence of the water trough between the tracks from which to replenish the engine's water supply. Now, however, a trough has been laid down at Starcross, between Exeter and Plymouth. Furthermore, the coal capacity of the engine has been considerably increased, and larger lubricating boxes have been supplied, so that the oil boxes can contain a sufficient supply for the entire journey.

Meritorious though this run of 246 miles in 265 minutes is, yet, if the necessity arises, the speed can be considerably accelerated. This fact was demonstrated on May 9 last, with the mail-train run in connection with the North German Lloyd liner Kronprinz Wilhelm. On this occasion the train covered the distance of 246 3/4 miles from the dock at Plymouth to Paddington in the remarkably short time of 3 hours 46 minutes. The run, however, was not a non-stop, as a mail van was detached and engines changed at Bristol, necessitating a halt of 3 minutes 43 seconds, which stop, however, was included in the time of the run. The average speed on this occasion was 65.49 miles per hour for the whole journey, and the last 36 miles of the run to Paddington was covered at the rate of 79.17 miles per hour. On the occasion of the trial run of the "Cornishman Limited Express," a new record was made between London and Bath, the 107 miles being completed in 102 minutes.

The road, although not so level as that between Camden and Atlantic City, is yet comparatively easy, but after leaving Exeter the road becomes more difficult. Especially so is the last 52 miles into Plymouth, the track abounding in stiff gradients of 1 in 40, with numerous sharp curves, which militate considerably against fast traveling.

There is strenuous friendly rivalry at present existing among the various English railroad companies to establish non-stop records. The London and North-Western Railroad is contemplating the establishment of a through non-stop service between London and Carlisle, a distance of 299 1/4 miles. They have already made such a run with a "special," which covered the journey in 5 hours 43 minutes, an average speed of 51 miles per hour. With their latest type of engines, however, this railroad company could considerably increase this speed if desired. On the occasion of the Postal Congress at Glasgow last year, the train containing the delegates, and representing a weight of 450 tons, was hauled over the 401 1/2 miles between the two cities, both on the outward and return journeys, without a stop in 6 hours and 6 hours 5 minutes respectively, at average speeds of 66.9 miles and 66 miles per hour.

Already the boat trains running from Liverpool to London in connection with the incoming American mails, three or four times a week, cover the 192 miles in 3 hours 45 minutes, an average speed of 51 miles per hour. Other notable long-distance non-stop runs on this system include Wigan to Willesden, 188 1/2 miles, in 3 hours 41 minutes, average speed 51.1 miles per hour; London to Stockport, 183 miles, in 3 hours 18 minutes, speed 55.4 miles per hour; London to Chester, 179 miles, in 3 hours 33 minutes, speed 50.4 miles per hour.

The Midland Railroad also have inaugurated several noteworthy long non-stop runs. The record is that recently instituted between London and Leeds, 198 miles, in 3 hours 45 minutes; speed, 52.8 miles per hour.

The Great Northern Railroad, which for many years has been considered the crack fast railroad of Great Britain, but which has since lost its reputation in this respect, is also completing arrangements whereby it will be able to regain its lost prestige. Several of the through northern expresses cover the journey every day between Grantham and London, 105 miles, without a stop. Their present longest non-stop run is between Wakefield and London, 175 3/4 miles, in 3 hours 10 minutes, an average speed of 55.5 miles per hour. Owing to the institution by the Midland Railroad of a through express between London and Leeds, the Great Northern, which also serves the latter town, is instituting a similar service, the 185 1/2 miles to be covered in 195 minutes—an average speed of 57.07 miles per hour.

The Great Northern Railroad also proposes considerable accelerations in connection with the East Coast expresses. For this purpose mammoth powerful engines have been constructed. These are designed by the railroad engineer, are of the compound "Atlantic" class, and represent the limit of the dimensions of a locomotive of the normal type in Great Britain. They have been specially designed to work the East Coast route express trains at a speed varying from 55 to 60

miles per hour, with loads of from 380 to 400 tons behind the tender.

The special feature of this type of engine is the length and circumference of the boiler. The inside diameter of the boiler is 5 feet 6 inches, and the length of the tubes, representing the distance between the smoke-box and the fire-box, 16 feet 3 inches. The heating surface furnished by the tubes aggregates 2,800 square feet, while that of the fire-box supplies about another 200 square feet. The grate area is 32 square feet. The working steam pressure is about 185 pounds per square inch. The two outside cylinders measure 18 inches diameter by 24-inch stroke, and the diameter of the four driving coupled wheels is 6 feet 8 inches. The length of the engine and tender is 58 feet over all, and their combined weight in working order is 110 tons.

SCIENCE NOTES.

A new local anæsthetic of the cocaine order has been discovered. It is called "eucaïne," and the advantage of the drug will enable the carrying out of those operations otherwise impossible with chloroform, owing to heart weakness of the patient. It will also enable the surgeon to take more time over his work. Although scarcely adaptable for amputations, it will be useful for treatment of the thyroid glands. The eucaïne is injected by means of a hypodermic needle under the skin at the place where the incision is to be made. After a few moments the skin may be cut without the patient feeling anything. As different and independent parts are exposed, the drug is dropped at intervals of a few minutes. A highly successful operation with this anæsthetic was recently carried out in a London hospital, the operation lasting one and a half hours.

The use of an automobile to form a portable station for astronomical work was brought out in a paper recently read before the Académie des Sciences. The work was carried on by Messrs. E. Tronchet and Henri Chrétien, accompanied by the well-known chauffeur Maurice Farman. The report relates to the study of the Leonids in 1903 and the determination of their altitudes by the method of simultaneous observations. The systematic observation of the Leonids was carried on during that year at the Observatory of Chevreuse, with a view of determining the relative position of these bodies with greater precision. To carry this out, the observations were made simultaneously at two different stations situated about 18 miles apart. This distance is large enough so as to make the errors of observation relatively small, and, on the other hand, it is sufficiently short to allow of a sure identification of the meteors which are observed by the double method. The first station was located at the Chevreuse Observatory, whose co-ordinates are: West longitude, 0 deg. 19m. 6s.; N. latitude, 48 deg. 42m. 33s.; altitude, 163 meters. The second station was placed in the Beauce region at Authon la Plaine (co-ordinates 0 deg. 23m. 1s.; 48 deg. 27m. 16s.; altitude, 145 meters). The rectangular distance between the stations measures 28.7 kilometers, and the azimuth of the first, relative to the second, is +10 degrees. As at that time of the year the weather was not generally favorable, in order to make the work easier to carry out the second station was formed by an automobile equipped with the necessary apparatus, which could be driven to the observation point in less than an hour in case of favorable weather. This method of arriving at the spot was all the more appreciated as the radiating point of the Leonids did not rise until very late and the observation had to be made during the latter half of the night. The observations were made on the nights of the 13-14th and 14-15th of November from 1 to 5 o'clock, and were registered on a special chart which was furnished by the Meteor Commission of the Astronomical Society. Chronometers (checked up before and after) gave the exact time. The number of meteors registered was 83 and they appeared to come from four principal radiants. The co-ordinates of these sources are as follows:

A. R.	D.
137 deg.....	+23
75	45
110	32
67	17

The meteors which were observed simultaneously at the two stations were identified by the coincidence of the readings. Out of twenty-two such coincidences, twelve presented sufficient guarantees of exactitude to allow of calculating the altitudes. The report gives the various data for the twelve meteors, together with the altitudes. The mean height of apparition is 103.6 kilometers; that of the disappearance is 75.8 kilometers. The mean length of trajectory is 35.2 kilometers.

Mr. Lyman B. Brainerd, the treasurer of the Hartford Steam Boiler Inspection and Insurance Company, has been elected to the presidency of that corporation to succeed the late J. M. Allen. Mr. Brainerd has had a large experience in the management of corporations, and he will retain his office as treasurer.