ing the forest 97 per cent of the surface was field, meadow, or heath, and afterward 80 per cent was forest and 20 per cent was roads, open field, and heath. Around this station, pretty evenly distributed, and within 50 miles, there are thirteen rainfall stations, which have been carefully established and presumably are comparable with the Lintzel station in the midst of the growing forest. There is no means of knowing whether any of these stations have been changed or not, but for our purpose we may consider the material homogenous and treat it accordingly. Records from 1882 to 1896 (fifteen years) are available. Charts were prepared for each year showing the ratio between the Lintzel record and that at each station of the thirteen. There is no space for these charts, but, in place of them, I give here the mean of all the thirteen station ratios for each year: 1882, 81; 1883, 83; 1884, 101; 1885, 103; 1886, 82; 1887, 98; 1888, 93; 1889, 122; 1890, 97; 1891, 100; 1892, 90; 1893, 96; 1894, 142; 1895, 128; 1896, 136.

These figures are extremely significant, and may be further elucidated as follows: The smaller ratios show a less rainfall at Lintzel, or, these figures are the percentage of rainfall at Lintzel as compared with surrounding stations. It is impossible to determine whether these trees have reached the culmination of their effect or not. In 1896 most of them would be seventeen years old, and the ground would probably be fairly covered. It is a great pity that the environment was changed or some accident happened at Lintzel so as to vitiate the three last years. (An inquiry was sent to Germany regarding the error, but no response has yet been received.) The record does not seem to show any appreciable effect upon the precipitation; in 1884 the ratio was 101, while in 1893, nine years later, it was 96. It is probable that no definite and unassailable result can ever be obtained either by the method adopted in France or this later one in Germany. The rainfall is so variable within a distance of even a mile or two, and it is so difficult, if not impossible, to obtain similar environments at all the stations, that no decisive result can be obtained. It will be seen readily that the multiplication of stations will do no good, and, above all, that the observation of rainfall under trees in a forest is absolutely useless for any such discussion or study as this.

It seems probable that if two or three lines of stations could be established a mile or two apart on four sides of an enormous forest, each line to have a dozen stations or so, about 3,000 feet apart, four of the stations to be outside of the forest and the others each in a large, cleared space of at least 2 acres extent in the forest, something decisive might be obtained. It should be noted, however, that from the evidence already accumulated there would be very little to be gained by a further study of the question. It is certain that the effect, if there be one, is almost inappreciable. The favoring conditions over the forest are balanced by those not favoring and the integrated effect is practically the same in the two cases.

Prof. H. F. Blanford, of India, determined from a most careful series of records, from which all known errors had been eliminated, that the forest had a tendency to give 2 per cent more rain than contiguous open fields, That is, if an open place had 50 inches of rain in a year a near by forest would have only 51 inches, which is practically inappreciable.

It would be an interesting study to select all those cases in experiments in forest and near by fields in which the wind was blowing either from the forest to the field, or *vice versa*. It is evident that if there is any effect on rainfall by the forest, it would be vitiated if not exactly reversed by such winds.

There is a class of visual observations which seem to show an effect upon rainfall by the forest. Probably many have seen heavy clouds passing over a plain, but which only precipitated as they passed over a forest. Also in a hilly region it is a frequent phenomenon that fog and low lying cloud hover near a forest, and not over an open plain. One also notes very often in passing into a forest on a damp day that the trees drip moisture, possibly condensed from moisture evaporated from the damp earth underneath. Observations of this nature, however, can not ordinarily be checked by instrumental means, but show in a general way that the forest tends to conserve vapor and moisture which, in the case of the open field would be diffused into the atmosphere.

REPORT ON THE OPERATION OF THE MOUNT TAMALPAIS STATION FOR SEPTEMBER, 1897.

By W. H. HAMMON, Forecast Official.

The station is on a comparatively narrow neck of land (about 8 miles wide) between the ocean and the Bay of San Francisco, and across the Golden Gate (entrance to San Francisco harbor) from San Francisco and about 13 miles distant therefrom. It is on a very abrupt peak, 2,592 feet high, at the eastern end of a short range of mountains running east and west across the peninsula. From the peak the surface declines very abruptly almost to sea level on the north, east, and south faces.

It is an ideal place for an observatory, in that nothing obscures the outlook and because the point is above all disturbing influences of local conditions and topography. At San Francisco wind directions and velocities are greatly influenced by the surrounding hills. Moreover, the intense heat of summer in the interior valleys of the State causes a most remarkable indraft from the sea on summer afternoons and nights, which more than half the time in such seasons is laden with fog, and the latter either surrounds the observer or obscures the sky at the hours of observation. On fourteen out of the twenty-three p. m. observations which have been repeated to me from the city a westerly wind exceeding 20 miles per hour has been reported. On but four of these occasions has the wind at this station reached that velocity, and three of these were during a severe northwest gale, which occasioned a most unusual cold wave in the Pacific Coast Region. More than half the time at the hours of observation the valleys and sea below have been obscured by fog, but only on three occasions has the fog enveloped the peak. While the sky has been reported obscured at fifteen of the observations repeated from San Francisco, on only five occasions has that been the case here.

It is believed that the conditions observed here are of especial value to the forecaster. Rain has been recorded at some of the stations in northern California on fifteen weather maps. On fourteen of these occasions it has been preceded from twelve to forty-eight hours on the mountain by high winds and gales, amounting to 350 miles or more per day, the force of the wind being in a measure proportional to the extent and severity of the storm. The one exception was a trace of rain at San Francisco, which was merely a mist precipitated from a low cloud or fog entirely below the summit of the mountain. With one exception there has been no instance when the wind has reached a movement of 400 miles per day that rain has not followed within thirty-six hours. The exception was when a gale on the 13th continued on the 14th and rain occurred on the night of the 13th and 14th.

Another indication of rain which is especially observable here is the unusual visibility of the air.

From this peak cumulo-stratus and cumulo-nimbus clouds, which precede and accompany local showers in the valley, can be seen and their courses followed for 100 miles or more at times when the smoke and dust of lower elevations would obscure them at much shorter distances. The dust and smoke of forest fires usually ends quite abruptly at about 1,500 or 2,000 feet elevation.

There have been two occasions this month when marked falls in temperature have occurred. In each instance a sudden decline has been observed on the mountain, accompanied by a severe northwest gale, the greatest fall being from one to two days before the marked fall has occurred in northern California and Nevada.

The a. m. and p. m. observations of September 6 showed falls of 16° and 7°, respectively, at the mountain station and a northwest gale prevailed from the evening of the 5th to morning of the 8th. The p. m. observation of September 7, and a. m. of September 8, twelve hours later, showed changes of from 10° to 30° at all interior stations in Oregon, Idaho, California, Nevada, Utah, and Arizona, the fall being to freezing in western Oregon and northern Nevada. On the 13th a moderate northwest gale prevailed, but no fall in temperature occurred here or in northern California. On the 14th, however, the temperature fell from 8° to 15° throughout the greater portion of Oregon, Nevada, Utah, and Arizona. On the 20th a moderate gale sprung up from the northwest, and on the morning of the 21st quite a moderate fall in temperature occurred. The p. m. observation showed a similar fall in the interior valleys of California. The a. m. observation of the 26th showed an abrupt decline of 23° on the mountain, accompanied by a northwest gale, which continued until the night of the 27th, the temperature continuing low. On the morning of the 26th changes of from 8° to 10° were reported from Redbluff, Fresno, and Carson City, which were followed by further declines until the p. m. observation of the 27th, which showed changes aggregating from 14° to 30° in the interior of the State, and on the evening of the 28th and the morning of the 29th changes of from 10° to 20° occurred in western Oregon, Idaho, Nevada, and Utah, resulting in freezing weather in northern Nevada.

While the barometric conditions accompanying northers in California are quite well understood, it has frequently been impossible to accurately predict the time when the temperature will begin to rise upon the approach of a "norther," and likewise to determine the date of its ending. Frequently the wind will be high from the north in the valley for several days and no marked change in temperature will occur, and again it will begin to rise with the first north wind. From my observation this month I believe the conditions on the mountain will aid materially in these forecasts. Usually during warm weather in the interior there is a most remarkable temperature inversion between this station and the city. At times the temperature here is more than 20° warmer than at the base of the mountain. The anomaly is so great as to cause the correction of the barometer for elevation, based on the mountain temperature, to be too small by nearly 0.10 of an inch. With the passage to the northward of a high from the sea to the interior (the usual norther condition) there is at first, here, a northwest gale, accompanied by cool weather, during which time there is no rise in temperature in the interior valleys, but as the gale diminishes the wind shifts to north or northeast, and the temperature begins to rise, although the wind may still be west on the coast below, and no change in direction occurs in the valleys. Likewise, in cooling after the passage of the "norther" no marked change will occur until the temperature falls on the mountain with a return of westerly wind.

Further, it seems likely that this remarkable temperature inversion will furnish the key to an explanation of the fogs which prevail so frequently at San Francisco and at other points on this coast, and perhaps lead to a means of more satisfactorily forecasting the commencement of each period and its severity. The temperature inversion occurring, as it does, with an area of high pressure to the northward, is certainly evidence of an overflow of warm air from the interior toward the coast. This results from the less density of the hot air of the interior compared with the colder air over the ocean, which apparently causes a reversal of pressure gradients at a moderate elevation, and the warm air of the interior is carried westward over the sea, where it must rapidly give up its surplus heat, at the same time sinking toward the surface. Thus, a local circulation is set up between the valleys and the sea near the shore. As the warm air passes over the sea it receives moisture by evaporation, at the same time lowering its temperature until the amount received is in excess of what it can hold as vapor when cooled to the sea temperature and fog results.

While I have not had the time to carefully study this question as yet, I have observed many evidences of this tendency for a reversal of air movements with elevation during heated periods in the interior and preceding and during foggy periods on the coast. Among these evidences are the inversion of temperature and the decidedly smaller proportion of westerly winds on such occasions at this elevation than in the city. Frequently east and northeast winds prevail here during at least a portion of the day, while such is very seldom the case in the city.

In making this report I have confined my attention to conditions made manifest at this station, and not so observable elsewhere. Also, I have referred to merely those conditions of which it would seem that the knowledge gained by this station gave promise of an improvement of forecasts. It must be remembered that I have had no opportunity of observing during a winter storm and for but one month in summer, but I am sure the additional information obtained of summer rains, so injurious to drying fruits and raisins, and the warnings given of cold waves, which a little later in the autumn and in the early spring result in the destructive frosts, are sufficient to warrant the maintenance of this station.

I have not referred to the opportunities here offered for the investigation of many subjects of interest to the science of meteorology outside of those useful to the forecaster, although this peak, at the extreme western edge of the continent, is well adapted to such purpose.

Among other uses which will render the station valuable must be mentioned the possible use of it as a reporting station of vessels approaching this port.

NOTES BY THE EDITOR.

OLD WEATHER RECORDS.

In the "Transactions" of the New York State Agricultural Society for the year 1859, there is published an elaborate report by the Hon. George Geddes, of Fairmount, on the history, geology, climate, and agriculture of Onondaga County. In this Report, at page 296, Mr. Geddes states:

Observations of the temperature have been taken at Fairmount at a point 520 feet above the sea for more than sixty years; and during that time a standard instrument in the shade, protected from all reflection, has never been observed to mark more than 94° in the hottest weather, and this but once in many years; and there have been but few days in the coldest weather that the mercury was not, at some time in the day, above zero. February 5 and 6, 1855, were the coldest days ever known here (February 5, 6 a. m., 28° below zero; February 6, 6 a. m., 30° below zero). During this unprecedented weather the sky was nearly cloudless, and as there was no wind, the severity of the weather was not so apparent.

As Mr. Geddes was a resident of Fairmount it seems plausible that he refers to some record of the temperature kept at