

WEATHER AND THE BERKELEY FIRE.

By GEORGE W. ALEXANDER.

[Weather Bureau Office, San Francisco, Calif., Oct. 15, 1923.]

Each recurrence of the dry, almost rainless, summer, which is a characteristic of the climate of California, witnesses a period during which the forest-fire hazard throughout the State is normally quite acute. August and September are the months of greatest danger, being marked by a minimum of rainfall and a maximum of campers, hunters, and other visitors to the hills and mountains, their carelessness being responsible for the origin of most of the fires.

As compared with other years and with the preceding portion of the current season, the period from September 10-20, 1923, showed a marked increase in the number of fires and in the damage therefrom. A vast acreage of both Federal and privately owned brush and timber lands in central and northern California was devastated. Many summer resorts and camps, notably along the picturesque Russian River and in Sonoma County, just north of San Francisco Bay, were destroyed. On September 17 the climax was reached in the great fire which destroyed over 50 square blocks of dwellings in the city of Berkeley, the seat of the University of California.

Berkeley, a typical residential city of detached houses, with gardens and shade trees, lies on the eastern shore of San Francisco Bay, at the foot of and partially upon the slopes of a range of hills which average about 600 feet in height and are partially forested with artificial plantations, mostly of eucalyptus, and are otherwise covered by grass and small brush. In winter and spring these hills are beautifully verdant, but grass and undergrowth dry and wither during the summer. Likewise the vegetation within the city limits, where not irrigated, becomes drier and less fire resistant during this period.

Some time during the 16th of September small grass fires occurred on the San Pablo watershed, to the north and east of the city. During the night and the morning of the 17th these had increased in intensity and spread so that by noon they menaced both Berkeley and the contiguous city of Oakland. As to this the city manager of Berkeley is quoted in the *Gazette* as saying: "I have found the fire which came down into Berkeley did not start until 12:15 o'clock on the afternoon of September 17 and swept over from the San Pablo watersheds. At the same time Berkeley was calling for help from Oakland the latter city was preparing to ask for help from Berkeley. There were six serious fires raging in Oakland, and in Berkeley the fire department responded to nine calls in 45 minutes at the time the city was being threatened by the more serious blaze." Fortunately the fire was held in the hills to the east of Oakland and no serious damage was done in that city.

In Berkeley, once the fire was communicated to the city itself, it spread rapidly, although all available forces were called on to combat it. The flames appeared uncontrollable, and despite the most strenuous opposition swept from block to block, destroying everything in their path; the bungalow of the commuter, more pretentious dwellings, fraternity chapter houses, residences of faculty members (Dr. Benjamin Ide Wheeler, president emeritus of the university, was one of the sufferers), were consumed. At one point the flames reached to the limits of the campus of the university itself. It seemed that the greater part of the city was doomed. But at about 5 o'clock in the afternoon the situation was changed for the better, the dry northerly wind which had continued

for some 36 hours ceased and was replaced by a gentle southwesterly breeze from off the bay and the Pacific. Immediately the fires seemed to decrease in violence and within an hour were under control.

At the same time a similar condition obtained in the national forests in the State. On the 16th the fire situation in the California, Eldorado, Trinity, and Sierra Forests was very bad; during the night of the 16th and on the 17th the fires increased in fierceness and spread rapidly, about 25,000 acres being affected. During the night of the 17th-18th, however, all fires subsided and were practically brought under control, although not entirely extinguished.

As to why these fires, in the forest and in the city, raged so fiercely for a period and subsided so quickly, almost simultaneously, the daily weather maps and the records from the California stations of the Weather Bureau give some very pertinent information. They show the inception, duration, and breaking up of a typical "fire-weather" condition.

Of primary importance is the distribution of barometric pressure for this period. On September 13 quite normal distribution prevailed; a HIGH over the North Pacific impinged on the coast and gave a gentle gradient toward the semipermanent LOW over Arizona and southern California. During the 14th and 15th the HIGH gained in energy and moved eastward over Oregon, with a wedge-shaped extension over northern Nevada, while the Arizona LOW gained in area and depth. On the 16th this condition was intensified, as was the case to an even greater extent on the morning of the 17th. The HIGH covered southern British Columbia, Washington, Oregon, Idaho, Montana, and northern Nevada, while the LOW covered Arizona and southern and central California, the gradient being from 30.36 inches at Kamloops to 29.56 inches at Yuma. Northerly and easterly winds were experienced in California, with a total absence of the usual westerlies and their concomitant fogs, clouds, and high humidities. On the morning of the 16th fire-weather warnings were issued, for points in Oregon and California, from the San Francisco office of the Weather Bureau.

The 8 p. m. map for the 17th shows a decided change. The center of the HIGH over the plateau separated from that over the North Pacific and moved southeastward. Comparatively low pressure appeared over Alberta and Saskatchewan, with extensions toward the Arizona LOW. The northerly and easterly winds ceased or lost force. During the 18th the continental HIGH continued to move eastward, and by the 19th conditions were substantially the same as on the 13th. The type of pressure distribution shown on the 16th and 17th may be called an ideal one for the causation of Foehn or Chinook effects, easterly and northeasterly winds sweeping from the arid and semiarid plateau, the air mechanically warmed by compression during its descent into the California valleys, with extremely low relative and absolute humidity and its capacity for absorbing moisture greatly enhanced.

The curves of relative humidity at Berkeley and at San Francisco show a remarkable similarity. The most striking feature is the failure of the usual nocturnal rise for the night of the 16th-17th, which clearly indicates an abnormal condition. The humidity curves corre-

spond inversely, moreover, with the wind velocity curve for San Francisco. An interesting feature is the sudden rise in the humidity for San Francisco, followed by an equally sudden drop between 8 and 9 p. m. on the 16th, during which period the wind decreased in force and shifted for about half an hour from northerly to southerly. There is no record of wind direction for Berkeley, but anemometer records for the period of the rise in humidity there, 2 p. m. to 9 p. m., show very light winds, from 1 to 2 miles per hour, increasing to from 10 to 20 miles per hour at about 10 p. m., the time of the sudden fall in the humidity. Northerly winds continued, shifting through northeast and northwest, at San Francisco until about 3 p. m. on the 17th, when a shift to west occurred. A sudden rise in the humidity curve is synchronous with the shift in the wind, the percentage of relative humidity increasing from 21 per cent at 3 o'clock to 64 at 5 o'clock, with a continuing normal nocturnal rise. There is a lag in the Berkeley curve, doubtless due to the fact that normally the westerly wind would be observed earlier at a point nearer the ocean. In fact, fresh northerly winds were observed in Berkeley until about 5 o'clock. At that hour a change to southerly occurred, together with a sudden rise of over 60 per cent in the relative humidity, and the fires in the city, which had seemed uncontrollable, were extinguished within a short time.

While, naturally, the changes in absolute humidity are not absolutely synchronous at all stations in northern and central California, there appears generally a tendency to reach a minimum about noon of the 17th,

with a rapid rise on or before 5 p. m. of that date, continuing for the next two days.

In the Pacific Northwest members of the Forest Service have established a definite correlation between the fire hazard and the percentage of relative humidity, the first increasing as the latter decreases. The effects of winds in aiding the spread of fires, forest or otherwise, are a matter of common knowledge. The records show that in California, for the period from the 14th to the 17th of September, all meteorological factors were such as to materially increase the fire hazard, namely, a gradual decrease in humidity, both relative and absolute, accompanied by strengthening winds from the north and east. These conditions reached their climax on the afternoon of the 17th, and it is a matter of record that the fires in the several parts of the State reached their climax of destructiveness at the same time. With the change in weather conditions during the night of the 17th the fires were brought under control. The conclusions of the Forest Service officials appear to be well founded.

In the Alpine regions, or in the Plains States of America, such a Föhn condition may cause only a welcome thaw and lessening of extreme cold; in California it causes a very unwelcome and dangerous increase in the ever-present menace of forest fires. Fortunately, such conditions can be forecast before reaching their maximum of danger, and it is believed, with the lessons of the September fires fresh in memory, the forecasts will receive more general attention from the public than has heretofore been the case.

RECORD-BREAKING RAINFALL IN SOUTHERN MICHIGAN.

R. M. DOLE, Observer.

[Weather Bureau Office, Lansing, Mich., Oct. 2, 1923.]

One of the heaviest rainfalls ever recorded in Michigan occurred on July 7, 1923. On the weather map of Friday, July 6, 1923, were marked disturbances over the Great Banks and also in Canada, some distance north of Winnipeg. Between was an irregular high pressure area with centers near Birmingham, Ala., and some distance north of the Great Lakes. The latter was moving slowly southward increasing in strength.

An offshoot of the Canadian disturbance moved south-eastward, thence east-southeastward, and Saturday morning July 7, 1923, was central over southern Lake Michigan. North and east of this disturbance rising pressure blocked its progress. This distribution of pressure was ideal for heavy downpours in that part of the area of activity where the gradient was steepest and where the most resistance obtained, namely, in the northeast portion, which was over southern Michigan about the noon of Saturday, July 7, 1923.

Exceptionally heavy rains, accompanied by moderate lightning, fell in a narrow strip running north and north-west from Hillsdale County, through Jackson, Eaton, Ingham, Ionia, Clinton, Shiawassee, through Montcalm into the southern portion of Mecosta County,

in the southern section of the Lower Peninsula of Michigan.

The rainfall was such as one encounters in the South, but is unusual for Michigan. The heaviest rainfall measured fell near Jackson, amounting to 3.34 inches (0.04 of an inch fell during the night). The observer there recorded the time as from 12:50 p. m. to 1:45 p. m., or less than one hour. At Lansing, in Ingham County, 2.33 inches fell from 9 a. m. to 2:30 p. m. In one hour the amount was 2.06 inches, exceeding all previous records for that length of time. The tabulated record follows:

	Minutes.										
	5	10	15	20	25	30	35	40	45	50	60
Rainfall.....	0.05	0.16	0.36	0.41	0.45	0.63	0.96	1.33	1.65	1.92	2.06

Charts showing the distribution of pressure at 8 a. m. July 7, 1923, and the area of heaviest rainfall are given on next page.