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EARTHQUAKES, CLOUDS, AND GALES AT PORT CAROLINA, SOUTH AUSTRALIA.[1]

By GEO. H. STYLES, Harbormaster and Subcollector, Port Caroline, South Australia, dated March 21, 1901.

The weather during the month preceding the earthquake of May 10, 1897, had been thick and squally, with the wind all round the compass. On the day of the disturbance its force, which had been 6 to 8 for several days, fell to 2. The direction was northeast and the weather fine with cirro-stratus clouds.

My residence and place of observation is on the beach, latitude, 36° 30′ 6′′ south; longitude, 139° 51′ 13′′ east. The noise of the earthquake was heard for about seventy seconds, coming from north to south, and was followed by a shock which damaged every house for miles around. One house 8 miles north of Robe was thrown down and many others were rendered uninhabitable. In places on the flat country there were fissures in the ground some hundreds of yards in length, and open down to the level of the water in the wells. About 10 square feet of the limestone crust was lifted several feet by the pressure of water underneath, and the water flowed outward for two days. From Robe to Beachport the ground subsided in places 20 feet. There was an upward pressure from below which filled some wells to the brim with tightly pressed sand. Water percolated through the ground in places, as if forced through a colander. The tide ebbed some 8 feet immediately before the shock, and an hour later it rose 10 feet. Pendulum clocks stopped at the same minute from Port Augusta in South Australia, to Sydney in New South Wales. The center of the disturbance, or more properly speaking the center of its manifestation, was around Mount Benson, between Kingston and Robe, about 20 miles south of this place. The lower the land the greater the shock. Buildings damaged showed the effects of a twist (apparent[2]). Chimneys not thrown down were twisted from their bases. Hanging pictures were in many instances turned with their faces to the wall. Ornaments on a mantelshelf were thrown across the room on to a table. Persons and dogs were made giddy, and vomited. A 7-inch horseshoe magnet, hanging by its armature on a copper nail in my window, was swung round and hung by its bow, still keeping its armature. This was repeated some months later, on which occasion the armature was flung off. Other shocks followed, minor ones, force 4 to 6, averaging two per hour, during the month of May. In June they averaged four each day; in July, two daily. Since then they have gradually decreased in number, and only one was recorded last month, and one, force 4, this month (March, 1901). Their intensity lately has been 2, 3, and 4 on the Rossi-Forel scale.

* * * * * * *

During all these tremors the sky was usually covered with heavy cumulus clouds, one or two of them bright, as though lighted by the moon even during the darkest moonless nights. No two cumulus clouds ever coalesced. On one overtaking another, they were mutually repelled, and drifted away in feathery flakes. I never saw one, even the largest cumulus cloud, reach the opposite horizon. It had to melt into clear sky. We have no longer the blue sky of the old days; it is of a milky and watery color, and never deeper blue than that on Plate XI in the United States Hydrographic Office classification of clouds. * * * We have also a thin cigar-shaped cloud, parallel with the horizon. This cloud, or there may be two, is very dark, and it is sharply defined. Having no ragged edges, it is as though it had been shaped with an edged tool, and though a gale may be blowing at force 10 the cloud will be stationary. I saw one once for twelve hours, when night hid it.

* * * * * * *

A reference to the sailing directions for this place will show it to be an open roadstead exposed to the fury of the worst storms. Yet the bay is seldom rough, and then only for a few hours. During the worst weather that I have seen here for over twenty-three years, a vessel could lie in safety at the anchorage. No one has yet accounted for it satisfactorily. In my opinion, the smoothness of the bay is caused by a fresh water river, which I have found running through the sand under the sea into the bay, and also, by fresh water springs which, in many places, may be seen coming up from the bottom in the bay. Their influence may be inferred from the fact that I have tested the density of the water with a salinometer on several occasions, and have found it to be one-third fresher than average sea water. I account for the absence of wind in

[1] In printing the above letter the Editor has omitted a few sentences suggesting possible magnetic and electric relations, but has retained the interesting meteorological facts.

[2] Mallet demonstrates that these twists are probably merely the resultant of the straight line motion of the earth combined with the irregular form, or unequal strength, or fastenings of the damaged object.—*C. A.*

two ways: First, a granite reef crosses from Kangaroo Island to the mainland, at a place 10 miles north of Kingston jetty. It is marked on the chart "Nation Reef" and "Granite Rocks." I have never known a thunderstorm from the northward to cross this reef. It invariably follows it into the interior. The rains may come on here, in part, but the storm follows the reef. A gale was reported to me by the head keeper, Cape Jaffa Lighthouse, 11 miles south of this place, as having been the heaviest he had known during twenty years duty there. The sea broke over the lantern, which is 120 feet above the sea level. During that day there were 8 fishing boats out from here, small centerboard luggers, with two men in each boat. They fished about 6 miles out and for want of wind had to pull home. The wind and sea were dead calm in Lacepede Bay; the gale went over our heads and descended about 10 miles inland, doing considerable damage. I have seen many similar instances, and have never heard them accounted for, as there is nothing to give us a lee. In ordinary weather the bay is full of cross currents of wind and sea.

* * * * * * *

Whatever may be the nature of the influence that generally prevents outside gales from blowing their proper course through the bay, it is intermittent, as gales occasionally blow home with undiminished force.

Mr. James Page of the United States Hydrographic Office adds the following note.—Ed.:

Kingston (Port Caroline) is situated in Lacepede Bay on the south coast of Australia; latitude 36° 50′ 16″ south; longitude 139° 50′ 56″ east. Robe is on the coast 20 miles to the southward. Concerning Lacepede Bay the Australia Directory, Volume I, p. 361, states as follows:

"It is a remarkable fact that this bay, although apparently exposed to the ocean swell, affords safe anchorage in all weather, there being tolerably smooth water even on the highway of a westerly gale. Two reasons account for the smoothness of the water—the force of the prevailing swell from the southwest is broken by the reefs off Cape Jaffa, and that from the northwest and west by traversing, before it arrives near the anchorage, a long extent of undulating ground with shallow water over it, there being only 20 fathoms 16 miles west of Kingston jetty."

JANUARY GALES FROM THE GREAT LAKES TO THE MARITIME PROVINCES.

By B. C. WEBBER, Forecast Official and Inspector to the Meteorological Service of Canada, dated February 19, 1902.

In treating of the storms which have been experienced in Canada from the Great Lakes to the Maritime Provinces in January from the years 1874 to 1902, inclusive, the writer does not intend to enter to any extent into the question of the why and wherefore of the development of these storms, or to discuss whether or no the course of storms is governed by the anticyclones or the many other vexed questions upon the subject which have been from time to time considered. Having gained considerable assistance himself in forecasting, by the tabulation and study of the storms of the different months of the year, he may possibly be able to point out a few salient features which may be available to others in scientific weather forecasting. As a review of the twelve separate months would necessarily occupy a large amount of space, the month of January only will at present be considered. In the first place perhaps it will be as well to give a table of the number of low areas charted, the percentage of storms caused by them, and the percentage of storms caused by lows from the several directions.

In explanation it should be stated that northwest lows are those originating or moving from the region between the British Columbia coast and Manitoba; west lows, those from the Pacific coast and Western States between latitudes 48° and 35°; southwest lows, from lower California, Mexico, Texas, and the Gulf of Mexico; Atlantic lows, as designated; erratic lows, developing anywhere from the lakes east to the Maritime Provinces including the New England States.

TABLE 1.—*Number of lows and the direction from which they came.*

Total number.	Northwest.	West.	Southwest.	Atlantic.	Erratic.
330	129	61	87	24	9

TABLE 2.—*Percentage of low areas causing gales; also percentage of gales from areas moving from the several directions.*

District.	Total No. of gales.	Total per cent of areas causing gales.	Per cent from northwest.	Per cent from west.	Per cent from southwest.	Per cent from Atlantic.
Lakes	162	49.9	45.0	64.0	54.0	0.0
Lower St. Lawrence and Gulf	167	50.6	32.2	49.2	65.5	50.0
Maritime Provinces	176	53.3	29.5	50.8	78.2	75.9

In referring to Tables 1 and 2 we are at first impressed with the few erratic lows or abnormal developments, yet on second reflection we realize that were such conditions of frequent occurrence the efficiency reached to-day in scientific weather forecasting could not have been obtained; consequently we learn that normal movements are to be expected, not abnormal or highly improbable, as we are at times apt to endeavor to persuade ourselves is to be the case.

The percentage of gales caused by northwest lows diminishes rapidly as we proceed eastward; this is instructive, showing as it does that a considerable number of this class of areas decrease in energy as they progress toward the Atlantic. The same conditions hold good as regards the west lows, but to a lesser extent; a much larger percentage of west than of northwest lows cause storms however. This may in a measure be accounted for by the frequency with which in this class of areas the secondary developments occur, without which the primary system does not as a rule long retain its energy. Referring to the southwest lows we find the conditions practically reversed, for the percentage of gales caused by these areas increases rapidly as the eastern portion of the continent is reached. This knowledge is again useful, indicating as it does that a considerable number of these important disturbances do not affect the Lake region to any extent. When we come to the Atlantic series of areas, or those disturbances which either pass up toward the Maritime Provinces from the United States Atlantic coast or from far out to sea, it is seen that in the long period herein considered none of these areas gave a storm in the Lake region; and further, that a large number moved so far to the southward of Nova Scotia that their influence did not extend as far to the northward as the Gulf of St. Lawrence, suggesting that the gales caused by them are more likely to be backing than veering.

The gales of January have been separated into three classes: those of great violence, the fresh gales, and the moderate storms. Combining the first two classes, the percentage of the fresh to heavy gales for the districts is as follows: lower lakes, 46.3 per cent; lower St. Lawrence and Gulf, 65.9; Maritime Provinces, 53.4. Therefore fresh to heavy gales are more numerous in the Maritime Provinces than in the Lake region, and still more frequent in the lower St. Lawrence and Gulf. In the Lake region the gales of a marked heavy type were 25, or less than 1 for each January. In the lower St. Lawrence Valley and the Gulf the maximum was reached with 68, while in the Maritime Provinces there were 54.

The question naturally arises, what is the cause of these violent gales? Can any reasons be given for their development, and are there any guides to aid in anticipating these great atmospheric disturbances? In the first place the violent