JAMAICA. OCTOBER 3, 1881. No. 4.

FIRST REPORT ON EARTHQUAKES

IN

JAMAICA

(1880 February 17th to 1881 August 13th inclusive.)

FROM THE JAMAICA GAZETTE.

September 22nd, 1881.

QC
987
.J25
W34
1880-81

Published by Authority.

JAMAICA:
GOVERNMENT PRINTING AND STATIONERY ESTABLISHMENT, 79 DUKE STREET, KINGSTON.
1881.

LIBRARY
N.O.A.A
U.S. Dept. of Commerce

National Oceanic and Atmospheric Administration

Climate Database Modernization Program

ERRATA NOTICE

One or more conditions of the original document may affect the quality of the image, such as:

Discolored pages
Faded or light ink
Binding intrudes into the text

This document has been imaged through the NOAA Climate Database Modernization Program. To view the original document, please contact the NOAA Central Library in Silver Spring, MD at (301) 713-2607 x124 or www.reference@nodc.noaa.gov.

LASON
Imaging Subcontractor
12200 Kiln Court
Beltsville, MD 20704-1387
March 28, 2002

FIRST REPORT ON EARTHQUAKES.

ATTENTION was called to Earthquakes in Jamaica by a rather strong shock on the night of the 30th December, 1880; the shock or rather the series of tremors was divided by an interval of about two seconds of time; and as this peculiarity had been noticed in a previous Earthquake on the 16th July, a notice was sent to the Newspapers, calling attention to what were termed *double* shocks, and asking for co-operation in commencing and maintaining a register of shocks felt in Jamaica.

The following brief remarks were at the same time offered as an explanation:—"As far as we are able to judge these light shocks are similar in their character to those so frequently felt in Scotland, and less frequently in the south-west of England; they are probably caused by small disturbances in the strata composing the Earth's crust. A stratum under high tension suddenly gives way; and the jarring effect travels to the surface of the Earth accompanied with sound.

Now as the commotion is propagated from the centre of disturbance in all directions, it becomes a spherical wave, and it is first felt at that point on the surface which is vertically above the centre of disturbance. This point becomes another centre of commotion, and circular waves diverge from it, as when a stone is thrown into a pool of water. Places on the surface at a distance from the vertex will therefore receive waves from both the centre and the vertex; and generally speaking there are two series of tremulous waves separated by a second or two of time."

The Earthquake on the morning of the 12th of August 1881 afforded a very good example of the double shock; the first shock was nearly vertical and lasted about one second; after an interval of about three seconds there were several horizontal oscillations which made the houses swing to and fro; and this series lasted about four seconds.

Again, as this Earthquake confirmed some meteorological effects or conditions previously noticed in other cases, it seemed advisable to publish this first Report on Earthquakes although there are at present but few cases to consider.

It must be remembered that we have no instruments in Jamaica to register shocks of Earthquake, and that we have to trust to the evidence of our senses; and as this evidence is very uncertain, or even misleading, with regard to the direction of the oscillations, the question as to the direction of the shocks will not be considered.

Those shocks which have lately been felt in Kingston under the usual atmospheric conditions will be first discussed; then the shocks felt or supposed to be felt during the Hurricane on the night of the 18th August, 1880, will be criticized; and finally brief allusion will be made to some light shocks felt among the mountains near Kingston.

The following are the shocks of Earthquake which have been felt in Kingston under the usual atmospheric conditions since the commencement of the year 1880.

No.	Date.		Local Mean Time.		Intensity of Shock.	Duration.			
						First Shock.	Interval.	Second Shock.	Total.
			Hour	Min.		Sec.	Sec.	Sec.	Sec.
1	1880.	Feb. 17th ...	11	25 a.m.	Light	–	–	–	–
2	"	July 16th ...	10	25 p.m.	Light	1	1	2	4
3	"	Oct. 15th ...	7	30 a.m.	Very light	–	–	–	–
4	"	Dec. 30th ...	11	58 p.m.	Strong	2	2	4	8
5	1881.	Jany. 7th ...	6	25 p.m.	Light	1	1	1	3
6	"	Jany. 8th ...	10	0 a.m.	Light	–	–	–	–
7	"	April 21st ...	7	40 a.m.	Light	–	–	–	–
8	"	July 4th ...	3	30 p.m.	Light	–	–	–	–
9	"	Aug. 12th ...	5	20 a.m.	Moderate	1	3	4	8
10	"	Aug. 13th ...	7	35 p.m.	Light	–	–	–	2

No. 1 occurred when I was in England, and the meteorological conditions given for this shock are taken from Mr. Gall's register, corrected and modified. According to Mr. Burger, the morning was very still and hot, and he noted the time as given above; but Dr. Manners noted the time in the Port Royal Mountains as 10 hr. 30 min. a.m.; so that there is clearly a mistake of an hour in either the first or second statement. The shock was also felt at Buff Bay.

No. 2 was a light double shock; it was felt over the greater part of the Island—from Buff Bay and Kingston as far as Falmouth. In Kingston, a gentle N. E. breeze was blowing, the sky was clear, there had been no rain for some days, the day had been hot, and the pressure normal.

No. 3 was a very light shock felt by only two or three persons in Kingston; in the register it was marked (?) as doubtful; but it will be seen that the meteorological circumstances are highly in favour of its occurrence.

No. 4 was a strong double shock, which was felt throughout the Island, excepting, indeed, the extreme western end. In the parish of Portland it did a good deal of damage by cracking the walls of the houses; but elsewhere it did little or no harm. In Kingston the wind had failed during the day; instead of the usual Sea-breeze there had been a very light Land-breeze; the sky was clear, there had been little or no rain for two or three days, and the temperature was normal; but the Barometer had been rising since the 28th, and was unusually high at the time. At Port Antonio a second, but very light shock was felt by Mr. Macnab at 1 o'clock a.m., or about an hour after the first shock; and a third at 5 50 a.m. These light shocks were not felt in Kingston, or elsewhere, as far as I have been able to ascertain.

No. 5 was a light double shock felt in the eastern part of the Island. In Kingston the sky was clear, temperature normal, and wind as usual; but the Barometer was high, having risen somewhat suddenly.

No. 6 followed No. 5 in fifteen hours and a half; the weather had remained unaltered; and the Barometer was still high.

In the preceding cases 1 to 4 inclusive, the action of the wind was checked; in the sixth case the wind was apparently much as usual; but it appears that the wind gradually decreased from January 6th to January 8th, and increased again on January 9th, according to the tables given below. Numbers 5 and 6 have therefore to be considered together as far as the wind is concerned; and they strongly confirm the idea of some connection between shocks of Earthquake and the decreased action of the Sea-breeze.

No. 7 was a light shock fell in the eastern part of the Island; as I happened to be near Montego Bay at the time, I cannot say whether it was a double shock or not.

In this case the Barometer was lower than it was the day before or the day after, but the Sea-breeze was checked the day before as well as on the day of the shock.

No. 8 also occurred during my absence from Kingston. The Sea-breeze was checked as usual, and there was a little rain.

No. 9 has been alluded to already: the Sea-breeze stopped suddenly at 3 p.m. the day before, and the Land-breeze came down from the mountains at once, which made the weather cool and pleasant. During the middle of the 12th, or about six hours after the shock, the water in Kingston Harbour rose about eighteen inches above its mean level.

No. 10 is the last we have to consider at present. In some respects it seems to be connected with No. 9, but in the following circumstance it was distinct:—the Land-breeze commenced as already said at 3 p.m. on August 11th, and it continued with calm intermissions until about 5 p.m. on the 13th, when the *Land-breeze* this time was checked, and it remained calm all that night.

The following day there was but little wind; but after that the wind blew again as usual.

We shall now examine the Meteorological Register kept in Kingston, and we shall commence with the Barometer.

The Barometers used are mercurial standards; they are carefully read at 7 a.m., 3 p.m., and 11 p.m. local and Washington mean time: the readings are corrected to the Kew Standard and reduced to 32° and the Sea-level. It may be remarked that the self-registering aneroid indicates no change or disturbance at the time of each shock; and that in order to detect any change in the atmospheric pressure we cannot do better than examine the careful and delicate readings of the Standards taken every eight hours.

The following table contains the readings nearest to the time of each shock, and the readings eight, sixteen, and twenty-four hours before and after. These readings were not only corrected and reduced as usual, but they were also corrected for the diurnal variation, which goes on within the tropics with great regularity:—to the 7 a.m. readings 0·010 was subtracted, to the 3 p.m. readings 0·040 was added, and to the 11 p.m. readings 0·030 was subtracted. These corrections were applied lest the diurnal variation should mask any slight change such we apprehend may exist.

No.	Barometer Corrected and Reduced, &c.						
	24 hours before.	16 hours before.	8 hours before.	At time of shock.	8 hours after.	16 hours after.	24 hours after.
	In.	In.	In.	In.	In.	In.	In.
1	29.965	...	30.018	29.993	...	30.072	30.070
2	29.997	30.023	30.013	30.014	30.016	30.007	30.016
3	29.975	29.969	29.954	29.966	29.947	29.943	29.970
4	30.040	30.053	30.081	30.062	30.063	30.048	30.041
5	30.016	30.010	30.052	30.037	30.031	30.043	30.033
6	30.052	30.037	30.031	30.013	30.033	30.014	30.003
7	30.023	29.983	29.958	29.982	29.990	29.962	30.014
8	30.014	30.014	29.999	30.013	29.985	30.010	30.023
9	29.956	29.997	29.985	29.974	30.019	30.003	29.977
10	30.003	29.977	30.005	29.993	29.989	30.009	29.956
Mean.	30.004	30.007	30.010	30.008	30.008	30.011	30.010

It thus appears that in some cases two small atmospheric waves pass over Kingston about the time of an Earthquake; that the first wave passes about 8 hours before the shock; that the second wave passes about 16 hours after the shock; and that the shock itself takes place during the small depression separating

them. In the remaining cases two small depressions pass; and then the shock occurs during the passage of the crest separating them. Consequently the mean results for the ten cases must be received with caution.

We must now consider the change in the action of the Wind. With regard to the *direction* of the wind an "Osler" anemometer records changes about the time of an Earthquake in the Sea and Land-breezes. The Sea-breeze at Kingston usually sets in from the S. E. about 9 or 10 o'clock in the morning, and lasts until 4 or 5 o'clock in the afternoon; the Land-breeze from the North commences three or four hours after the Sea-breeze stops, and stops three or four hours before Sea-breeze commences next day.

It is to be regretted that the pencil-tracings of the anemometer cannot be published; a verbal description of the tracings for any day would certainly be tedious, and might perhaps be misleading.

The total number of miles of wind per diem is found by a "Robinson" anemometer, well exposed to the wind, and registered at 10 o'clock every morning.

No.	Total Miles of Wind.		
	Day Before.	Day of Shock.	Day After.
1	200	60	80
2	61	96	91
3	65	50	71
4	111	33	31
5	144 { 154	123 { 125	144 { 122
6	125	122	166
7	72	72	127
8	119	78	102
9	65 { 64	62 { 66	68 { 58
10	66	58	78
Mean.	104	76	93

It appears from this table that the motion of the air receives a decided check about the time of an Earthquake; sometimes the check seems to occur the day before, and sometimes the day after; but part of this irregularity is probably due to the method of registration; and it is to be regretted that the anemometer cannot be registered every eight hours.

We shall now consider the temperature of the air as recorded by superior thermometers (corrected for their errors) exposed above grass in a "Stevenson" screen:—the mean temperature of the day is assumed to be the mean of the three readings at 7 a.m., 3 p.m., and 11 p.m.

No.	Temperatures of the Air.								
	Day Before.			Day of Shock.			Day After.		
	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.
1	76°.0	78°.0	83°.0	71°.0	76°.0	83°.0	71°.0	76°.0	83°.0
2	71.4	77.9	88.2	71.3	81.0	91.2	73.5	81.5	91.9
3	69.8	79.6	90.0	69.4	79.1	89.6	70.9	77.3	88.4
4	67.7	74.5	84.2	68.6	74.2	86.1	68.7	75.4	86.1
5	69.7	76.1	84.7	66.7	76.0	88.9	66.6	73.3	86.8
6	66.7	76.0	88.9	66.6	73.3	86.8	68.7	71.9	86.4
7	68.7	78.0	87.4	70.4	78.4	86.7	69.2	78.3	87.8
8	74.5	82.6	90.8	72.9	77.9	89.3	73.5	81.5	88.2
9	72.3	76.8	87.0	71.2	78.3	87.8	71.3	78.3	88.0
10	71.2	78.3	87.8	71.3	78.3	88.0	70.0	77.0	88.1
Mean.	70.8	77.8	87.2	69.9	77.2	87.7	70.3	77.0	87.5

It appears that the mean temperature of an Earthquake day is a little lower than the mean temperature of the day before; and the fact that the weather often feels unpleasantly warm before a shock of Earthquake is due to the checking of the Sea-breeze, and not to an actual rise of temperature. The maximum temperature on the day of the shock and on the day after is about half a degree higher than on the day before; this is but a small difference, probably due to the stopping of the wind. On the other hand, the minimum temperature is about a degree lower; so that the range of temperature the day before is smaller than the range the day of the shock, or the day after.

This is the more noticeable as the sky is clearer before than after; because, as a rule, the clearer the sky the greater the range; so that there is some kind of thermal disturbance about the time of an Earthquake, but of a very delicate nature.

No.	Clouds and Rain.					
	Day Before.		Day of Shock.		Day After.	
	Cloud.	Rain.	Cloud.	Rain.	Cloud.	Rain.
	Per cent.	*Inches.*	*Per cent.*	*Inches.*	*Per cent.*	*Inches.*
1	25	0 .00	62	0 .00	100	0 .00
2	30	.00	0	.00	17	.00
3	67	.01	42	.00	25	.00
4	25	.00	42	.02	58	.00
5	33	.00	25	.00	42	.00
6	25	.00	42	.00	50	.05
7	17	.00	50	.00	17	.00
8	75	.09	79	.30	92	.00
9	70	.00	43	.00	33	.00
10	43	0 .00	33	0 .00	40	0 .00
Mean	41	...	42	...	47	...

With regard to Rain, the idea is prevalent that shocks of Earthquake often follow heavy rains; but as the weather has been for the most part unusually dry since these registers were commenced, we are not able to say anything definite on this subject. The checking of the Sea-breeze, however, ought to allow a little more rain to fall about the time of an Earthquake than just before or after; the last table shows that clouds increase; and of course the chances of rain are also increased.

Now these meteorological effects or conditions are all closely related. Our Land-breezes move very gently from the North; our Sea-breezes blow freshly from the South-east; and when the number of miles of wind per diem is diminished, the check applies to the Sea-breeze, as is further shown by the self-registering instruments. But the Barometer always rises when the wind gets round to the North, or when the usual winds are checked by northerly currents; the mean temperature always falls when the air is northerly; and clouds and a tendency to rain are obvious effects.

There are two remarks to be made in connection with these results:—that the increased amount of cloud indicates a lateral movement of the northerly currents, as in the winter time, and not a downwards motion of the air as when the daily Land-breeze sets in and dissolves all the clouds before it; and that the Sea-breeze is often checked by westerly winds without Earthquakes following. At the time this was written the weather was unusually warm and oppressive; the Sea-breeze was checked for three or four days by a westerly tendency of the wind caused by a Cyclone to the north; but there was no subsequent Earthquake.

We might find an explanation of small movements of the air through the upheaval of large areas of the surface of the Earth, in the same way that the Sea is often disturbed; and these movements would be shown by the Barometer: but how can any such action stop our strong Sea-breezes? Let us again consider shock No. 9. The Sea-breeze was blowing as usual, during the morning with a velocity of about 10 miles per hour; at 3 p.m. it suddenly stopped, and a light air came down from the North! This was fourteen hours before the shock.

We must now refer to the shocks of Earthquake supposed to be felt during the passage of the Cyclone on the night of August 18th, 1880. If the shocks were really felt, they show some kind of atmospheric reaction upon the interior of the Earth, perhaps similar to the reaction we have noticed under usual circumstances and atmospheric conditions, or perhaps dissimilar; but we must first bring forward the evidence for and against the reality of the shocks in question.

In Kingston, Dr. Anderson assured me that he felt three shocks of Earthquake during the passage of the lowest barometric pressure over Kingston, or between 9.15 and 9.30 p.m.

"It is reported," says the *Colonial Standard* of August 19th, "that a shock of Earthquake was felt by some people while the storm was at its worst, but it is probable that the sensation was produced by the violence of the Harricane." We may here remark that the storm was at its worst about an hour after the time of lowest pressure.

Shocks were felt at Halberstadt, the mountain residence of the Hon. Stephen Mais, which was fully exposed to the Hurricane and suffered considerable damage.

At Stony Hill, "the country people state that several shocks of Earthquake were felt," according to information published in the *Daily Gleaner* of August 20th.

Remarkably consistent information was published in the *Daily Gleaner* of August 23rd. At Spanish Town, "the Rio Cobre rose some 20 feet, and two distinct shocks of Earthquake were felt during the atmospheric commotion." At St. Ann's Bay, "during the storm rumbling sounds were heard, and many persons attributed them to two distinct shocks of Earthquake."

"A correspondent in the St. Dorothy district intimates that the storm was severe there and that two distinct shocks of Earthquake were felt."

Then again from Annotto Bay it was reported that "whilst the Hurricane was at its height something similar to an Earthquake was felt, indeed it was said by many persons to have been one": *Colonial Standard*, August 26th.

Among the Clarendon mountains "a shock of Earthquake was also felt during the storm": *Daily Gleaner*, August 27th.

On the other hand no shock was felt at King's House by His Excellency Sir Anthony Musgrave; and there is plenty of further negative evidence against the occurrence of the shocks.

My own impressions are that there were some jarring effects to the house I was in, which should have been noted at the time instead of being merely assigned to the shaking of the house by the wind.

Now almost all our shocks in Jamaica are very local in their action; most of them occur in the eastern half of the Island, some of them do not extend their effects beyond a mountain range or two, and some are perhaps still more local and only felt at a single place; and it would appear that during the Hurricane of the 18th August, 1880, there were a few light shocks of an extremely local character about the time of the lowest barometric depression and also about the time of the greatest force of the wind; so that while two shocks were felt in many places, in other places no shocks were felt at all.

If this conclusion is correct, it follows that there may be very delicate reactions between the surface of the Earth and small depths below the surface.

When a Hurricane passes over the sea, the water rises within the area of low pressure to restore the equilibrium; when a Hurricane passes over the land, no such compensation can be made, and a slight superficial disturbance must ensue; and the same must occur in consequence of the resistance of the surface to the cyclonic action of the wind.

With reference to the last section of the present Report, light shocks were felt by Dr. Manners at Mount Sinai in the district of St. David on the following days:—3rd December 1880, 28th January 1881, and 11th February 1881. Another light shock was felt at Halberstadt in the same neighbourhood on 6th February 1881; and another light shock was felt at Plantain Garden River on 8th February 1881. These shocks were not felt elsewhere as far as I am aware.

Between the 28th January and 11th February this year there were therefore four light shocks felt in the same part of the Island, affording an example of the tendency of shocks to occur in series, so noticeable in Southern Europe and elsewhere.

With regard to the tendency of shocks to occur in distinct localities, I believe that Geologists consider that lines of *faults* are favourable to shocks.

In the maps attached to the Report of the Geological Survey of Jamaica we notice lines of *faults** in the districts of St. David, Port Royal, St. George, and Metcalfe. These are without doubt our Earthquake districts; and at Low Layton, near Buff-Bay, in the district of St. George, there are the remains of an extinct Volcano.

But at the extreme western end of the Island there are much the same lines of *faults*;† and from correspondence and personal inquiries, I gather that Earthquakes are almost unknown there. Nevertheless, the first Earthquake I ever felt was in that part of the Island in November or December, 1872; it was a long continued series of tremors, distinctly divided into two parts.

In order to continue the study of Earthquakes in Jamaica, I shall be glad to receive brief notes from my correspondents respecting the direction of the wind and general weather, both before and after the occurrence of any shocks they may notice. In the mean time I must ask them not to lay too much stress upon the details given above respecting the few shocks already noticed; at most we may consider that they have established the opinion prevalent in Jamaica for at least two hundred years that before an Earthquake the weather is generally close and sultry, and that they have shown that these effects are produced by a diminution in the strength of the Sea-breeze.

MAXWELL HALL.

Kingston, August 30th, 1881.

---

* The faults occur between the black shale and the metamorphosed series, the black shale being remarkably displaced.

† The faults occur between the black shale and the white limestone, the black shale being displaced as before.