

followed the western edge of the Typhoon as it recurved to the northward. Its first direction had been from ESE, and the storm appeared to be retarded at the point of recurvature.

There were also 2 Tornadoes in 1878; one on April 11th exceedingly violent, and about 200 yards in diameter, with a speed of 8 miles an hour, travelled in a NE direction over Canton, doing unparalleled damage, and causing great loss of life. Another on May 22nd, having a diameter of 180 yds., travelled quickly over the town of Tai-wan-fu on the SW coast of Formosa, doing great damage. On the previous night we had had a grand thunderstorm at Hongkong, the lightning being continuous; 9 ins. of rain fell in 6 hours, the lower clouds driven rapidly from SW. This, the first of the SW monsoon, arrived at Tai-wan-fu at 5 p.m. on the 22nd, and there met some black clouds, which had been passing over that town rapidly from N. The Tornado probably commenced within a mile or two of the town.

A small Tornado passed over Canton in 1877, and another over Wenchow on July 8rd, 1877. There were besides a few minor gales reported as "tail-ends" of Typhoons in the Japan seas.

Summing up then—1st. We find 6 distinct and destructive Typhoons in the China seas in 1877 and 1878, and a few minor ones in the north: 2nd. That when yet some distance from the coast, they were travelling W to WNW; that, on nearing or striking the coast, 4 out of 6 ran on a NW by N course nearly, 2 recurved northward and NE, and one which had commenced W½S struck on a WNW course: 3rd. That the average rate of progression was 11 miles an hour.

During these Typhoon months the Japan current sets 30 to 40 miles a day NE up the whole China coast, and along the SE coast of Japan; this belt of warm water may perhaps form a wall of heated air that tends to divert the course of the Typhoon.

During these same months the barometer curve showed 7 day waves; during the first 2 days of the anterior incline the weather would be thundery, with probably some wet. It would then clear with rising wind until the maximum was reached; after which calm and variable winds set in on the posterior decline, ending with squally and wet weather at the bottom of the curve.

The amplitudes of the curves were so small that a very slight irregularity was sufficient to resolve these waves into 10 day and 4 day periods, or 9 day and 5 day periods. The diurnal variation of the barometer on that coast was .008 in., and was so regular that a fall of .012 in. at 10 a.m. on July 31st instead of the usual rise warned us that a disturbing element was about.

Note on the Reports of Wind Force and Velocity during the Tay Bridge Storm, December 28th, 1879. By ROBERT H. SCOTT, F.R.S.

[Read February 18th, 1880.]

I HAVE recently received an application from Mr. C. Barlow, C.E., for information as to the reports of the wind when the Tay Bridge was carried

away ; and I have thought that it might interest the Society if I were to communicate to it the facts I have already sent to Mr. Barlow, and supplement them by a few notes of other serious storms which have been registered by our self-recording anemometers.

The following are the data which I furnished to Mr. Barlow :—

“ The greatest number of miles registered in any 60 consecutive minutes on the evening of December 28th, 1879, was 71, at Glasgow, between 6.20 and 7.20 p.m. At Aberdeen the maximum registered was 63 miles, between 8.50 and 9.50 p.m. Both these velocities are higher than any shown in the tabulation sheets, the values in which are for the intervals between 30 minutes before and 30 minutes after the hours.

“ Taking much shorter periods than 60 minutes the traces show still greater velocities. Thus at Glasgow I should estimate the *hourly* rates for the under-mentioned intervals as follows :—

| | | |
|-----------|--------------|--------------------|
| From 6.25 | to 6.30 p.m. | 96 miles per hour. |
| „ 6.55 | „ 7.0 „ | 72 „ „ „ |
| „ 7.15 | „ 7.18 „ | 120 „ „ „ |
| „ 7.30 | „ 7.35 „ | 84 „ „ „ |
| „ 7.45 | „ 7.50 „ | 96 „ „ „ |
| „ 8.43 | „ 8.46 „ | 110 „ „ „ |

“ Similarly, at Aberdeen, from 7.15 to 7.20 p.m., 8 miles were registered, equalling a velocity of 96 miles per hour.”

With reference to these very high velocities, I should remark that the scale of our anemograms is so contracted that I do not myself claim for such figures very precise accuracy. Any unsteadiness in the action of the spiral recording pencils of the instruments might produce temporary irregularity in the trace, which might give an apparent excessive velocity for a few minutes.

On the other hand, as already stated in my Paper (Quarterly Journal, Vol. II. p. 109), it is not possible to compare satisfactorily the indications of velocity and pressure anemometers, so that our instruments cannot record correctly the phenomena of sudden gusts.

These considerations being granted, it will be interesting to place on record the extreme velocities recorded during the storm at other stations not very far distant from Dundee.

At Alnwick Castle the anemometer recorded 65 miles between 6.40 and 7.40 p.m., and 60 miles an hour for the next two hours.

At Seaham Harbour the hourly velocity did not exceed 40 miles at the time of the wind's greatest force, say from 6 to 9 p.m. ; but at 6.50, during a squall, the rate must have been at least 150 miles per hour. A note by the observer states that “ the gusty force of the gale on Sunday night stopped the mill vane of the anemometer.”

At Stonyhurst the total velocity never exceeded 30 miles in 60 minutes ; there were, however, heavier gusts, and 60 miles per hour is shown for 10 minutes between 5 and 6 p.m.

At Armagh the maximum velocity recorded was 26 miles, between 6.30 and 7.30 p.m., but in a squall at 7 p.m. at least 80 miles per hour are shown,

and in a shorter squall at 5.30 p.m. a far greater velocity than this was reached.

At Holyhead and Sandwick Manse, both usually very windy stations, no velocities worth notice were recorded.

It may be interesting to give one or two instances of other exceptional gales.

In the tremendous southerly gale of January 24th, 1868, the Glasgow anemograph was the only instrument we had working in Scotland, for the instrument at Sandwick Manse was not in good repair, and the pendulum of the clock was stopped by the wind at a critical period of the storm. The Glasgow trace is unfortunately in an unsatisfactory condition. It was faint and was roughly pencilled over by the observer, so that it is now hopeless to trace out the original instrumental record. The highest velocity in an hour was 66 miles.

On February 20th, 1877, the Holyhead anemograph registered 82 miles an hour for 2 consecutive hours, and during the gusts the velocity was at least 200 miles per hour.

On November 16th, 1877, the Sandwick anemometer registered 83 miles in 60 minutes, and in this case also the gusts must have been very heavy; a 2 minutes' trace gives an hourly rate of 180 miles, and a 4 minutes' trace one of 120 miles.

It is not a little remarkable that these very high velocities at Holyhead and Sandwick did not do material injury to buildings situated close to the respective anemometers.

I have received various notes indicating the violence of the gale of December 28th in other parts of Scotland, but I do not think it worth while reproducing these in print, as they are not instrumental records.

DISCUSSION.

Mr. WHIPPLE said that he did not agree with the opinion expressed that the Robinson Anemometer did not give the true wind velocity in high winds; he believed the cups revolved with sufficient rapidity to follow any changes, but the fact was, that whilst they made 5,000 revolutions the pencil only moved over about $2\frac{1}{2}$ ins. For discussing such storm effects as those described in the Paper, a more open scale than the present one was desired, and no obstacle but the cost of paper for registration prevented the use of a time scale of a foot or more to the hour. Undoubtedly, high winds blew in gusts, and this was very evident when observing with a Hagemann's Anemometer, which would run up in rough weather from 0 to 9 or 10 in less than a minute. As an example of the effect of gusts, he had recently upon the roof of the Kew Observatory a massive wooden tripod with heavy iron top, but loaded at the base with sufficient weight to keep it steady, and probably necessitate the strength of 3 men to overturn it. A gust of wind blew it down, although the anemometer a few feet distant failed to register a higher velocity than 30 miles in the hour in question.

Mr. LAUGHTON said that it must not be forgotten that the Staff-Commander of the 'Mars,' lying a very short distance from the bridge, had estimated the force of the wind as not exceeding 11 on the Beaufort Scale, in the squalls. With this, as the estimate of an officer of long experience, he could not see what reason there was to suppose that the wind had any exceptional velocity. He himself was inclined to believe that the bridge did not give way to the mere force of the wind; but that as squall succeeded squall, a rocking or vibratory motion had