REPORT

OF THE

FIFTIETH MEETING

OF THE

BRITISH ASSOCIATION

FOR THE

ADVANCEMENT OF SCIENCE;

HELD AT

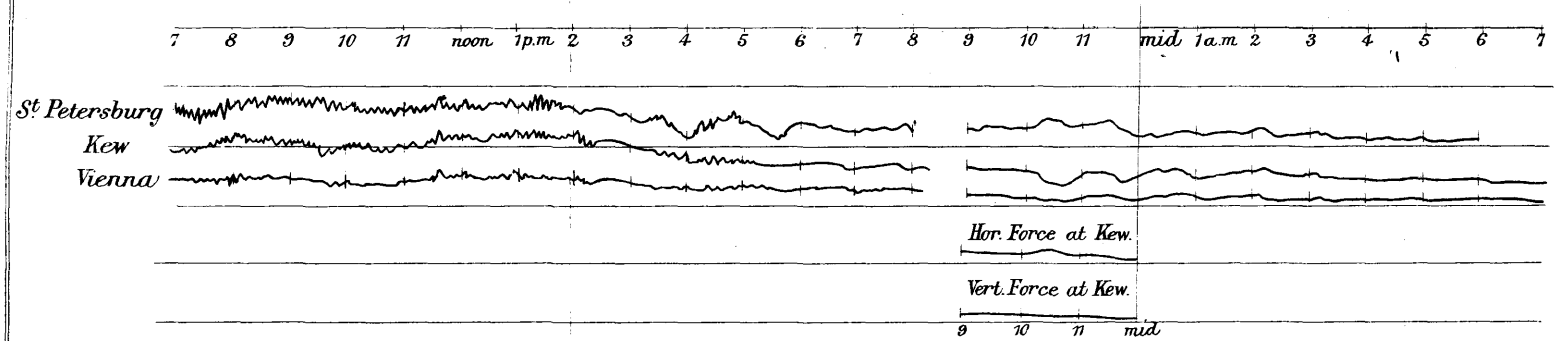
SWANSEA IN AUGUST AND SEPTEMBER 1880.

LONDON:
JOHN MURRAY, ALBEMARLE STREET.
1880.

Office of the Association: 22 ALBEMARLE STREET, LONDON, W.

DECLINATION.

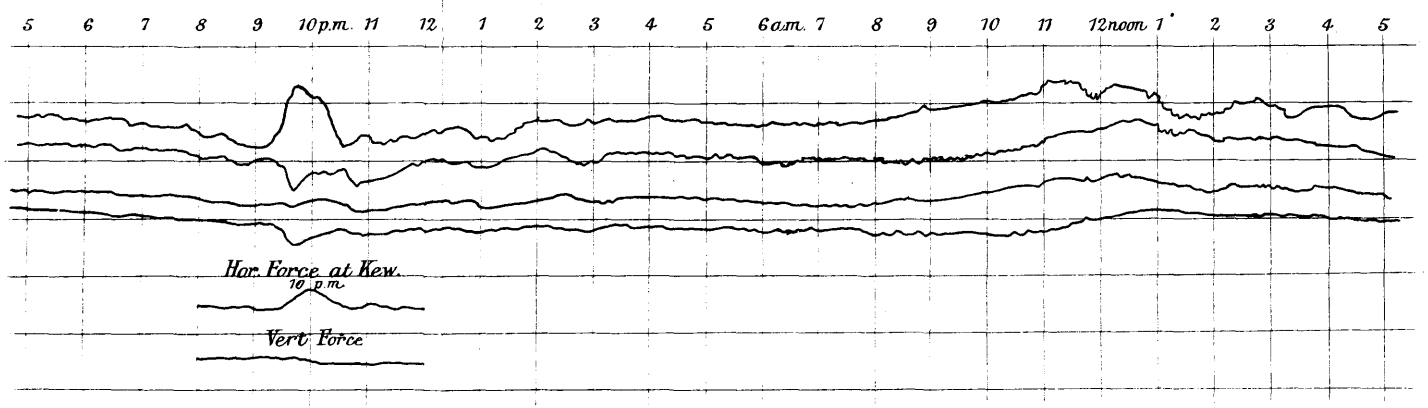
March 3rd 1879.



DECLINATION.

March 15-16. 1879.

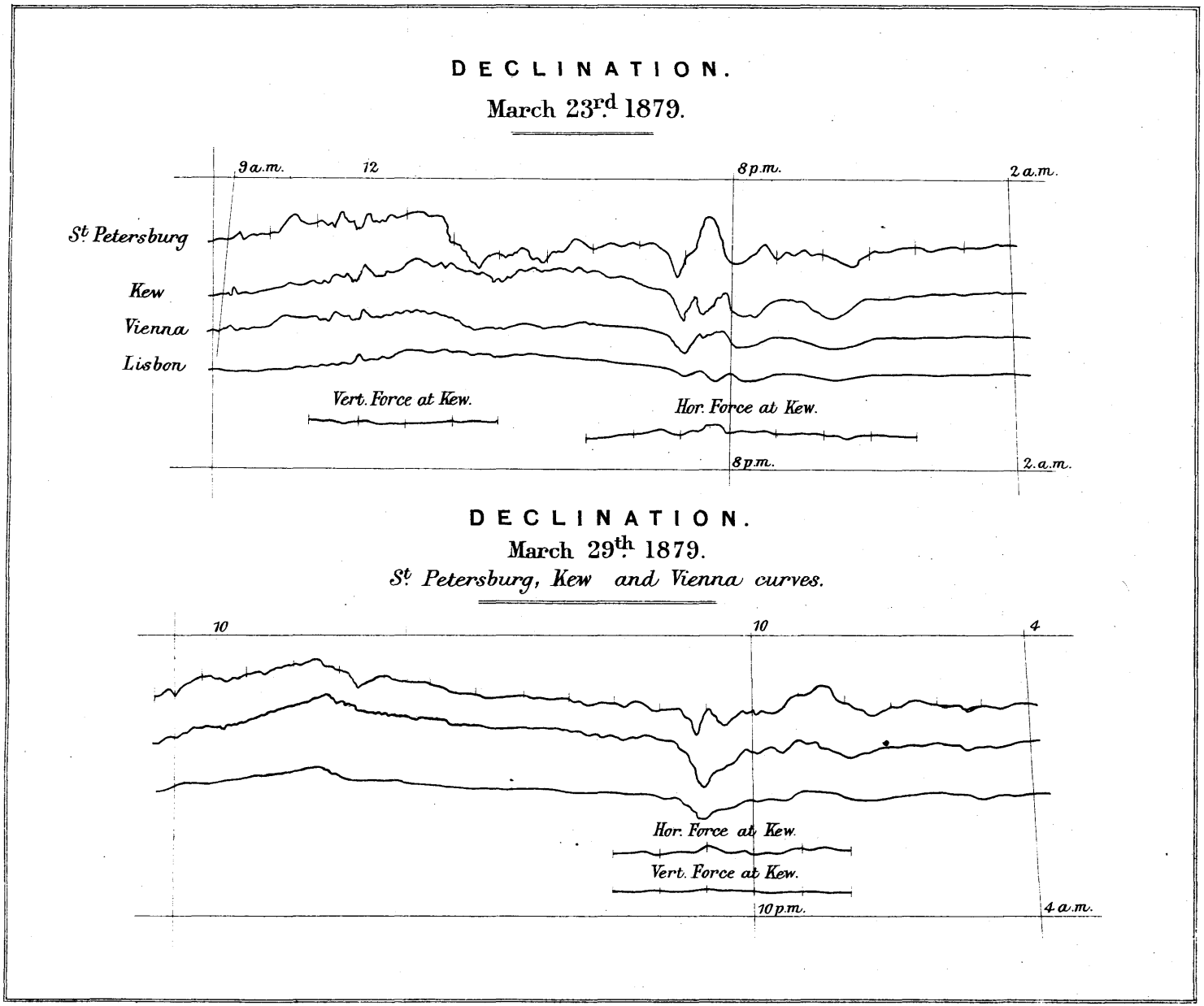
St. Petersburg, Kew, Vienna and Coimbra.



Spottiswoode & Co. Lith. London.

Illustrating Professor W. Grylls Adams' Communication.

Comparison of Curves of the Declination Magnetographs at Kew, Stonyhurst, Coimbra, Lisbon, Vienna, and St. Petersburg.'



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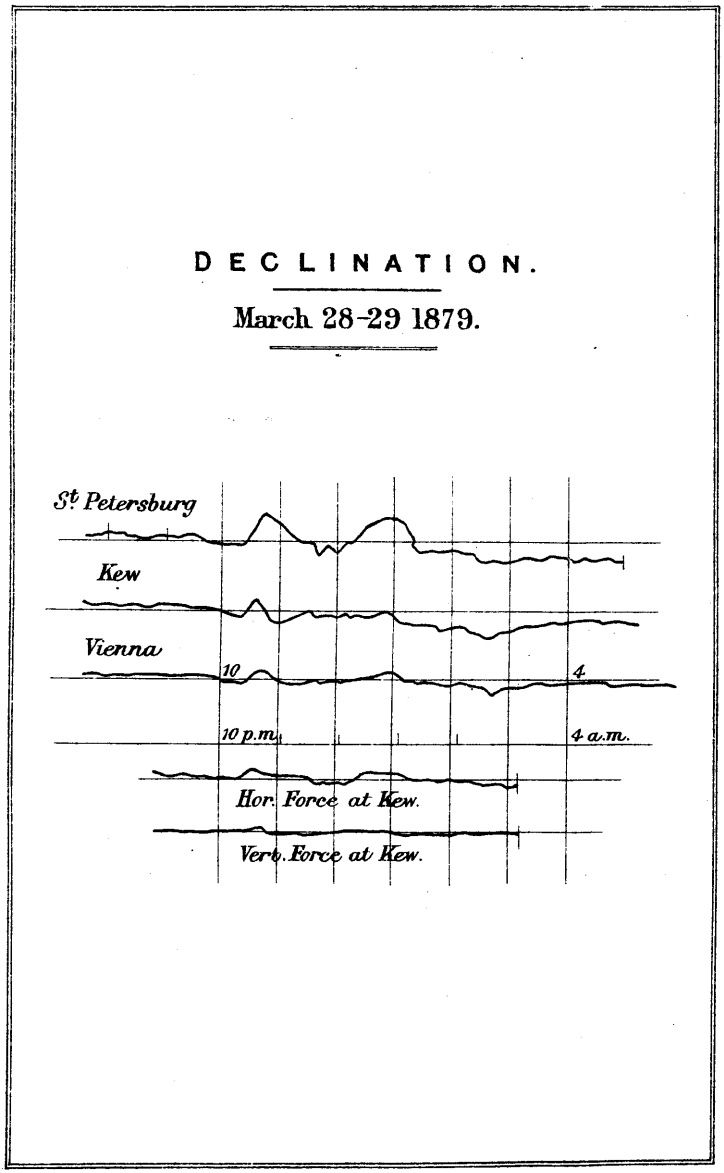

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result constantly obtained when very small pressures were employed, and which may have arisen from the effect of the remanent occluded gas, there also appears to be a sudden diminution of the capacity at about 0·19 millimètre pressure. To make sure that this was not an accidental result, the air was pumped out again when the pressure was about 3 millimètres until it was reduced again to about 0·1 millimètre, when the same diminution of capacity at about 0·19 was again observed. Now although these numbers are merely now given as a preliminary indication of the results obtained by the Committee, there is this interest about them, as has been pointed out by Mr. G. F. Fitzgerald of Dublin, that the values obtained for the capacity between about 0·02 and 0·2 millimètre's pressure bear a general resemblance to those obtained for the Crookes' force.

One difficulty met with in the investigation consists in an apparent change in the capacity of the condensers *B* and *C* (partly, no doubt, arising from changes of temperature) from day to day. A similar difficulty was met with in the previous investigation made in Japan, but it was overcome by making alternate measurements of the capacity of the closed condenser, first with air, then with vacuum, then with air, &c., &c. In the present case this is, of course, impossible, since on account of the large internal capacity of the condenser *A*, and the considerable quantity of gas occluded in so large a mass of aluminium, it takes several days to obtain a vacuum of 0·001 of a millimètre even, although, at the suggestion of Mr. Gimingham, induction sparks from a large induction coil (not shown in the figure), are kept passing between the two sets of aluminium cylinders at all times that a measurement of capacity is not being made. Probably the best method of procedure is that followed on August 28, the last day of the investigation, viz., first obtain slowly a very perfect vacuum, no measurements of capacity being necessarily made, then admit into the pump, drop by drop, mercury, occluding air, and make, during a couple of hours or so, a complete series of measurements of capacity as the pressure rises from, say, 0·001 of a millimètre up to ordinary atmospheric pressure. Such a set of experiments being performed several times would probably give a fair indication of the curve for capacity. As it is also extremely desirable that the experiments should be made with *statical* charges of electricity, the Committee have had constructed a somewhat modified form of Thomson's quadrant electrometer, which they also propose employing for the measurement of the specific resistance of gas at different pressures—the second half of their work, which they have not yet commenced.

Comparison of Curves of the Declination Magnetographs at Kew, Stonyhurst, Coimbra, Lisbon, Vienna, and St. Petersburg. By Professor W. GRYLLS ADAMS, *F.R.S.*

[PLATES VII., VIII., AND IX.]

[A communication ordered by the General Committee to be printed *in extenso* among the Reports.]

DURING the month of March, 1879, there were several very considerable magnetic disturbances, and therefore there were several favourable opportunities for comparing the effects of magnetic disturbances at different

stations wherever photographic records similar to those at Kew are obtained.

Mr. Whipple was accordingly instructed by the Kew Committee to write to the various observatories where declination magnetographs are photographed, to ask that *fac-similes* of the records taken at those stations might be sent to the Kew Committee for comparison.

In answer to this request, Dr. Hann, Director of the Observatory at Vienna, and Senhor Capello, Director of the Observatory at Lisbon, have kindly lent the original negatives, and Rev. Prof. S. J. Perry, Director of the Observatory at Stonyhurst, and Dr. Da Souza, Director of the Observatory at Coimbra, have kindly forwarded positives printed from their original curves, and Dr. Wild, Director of the St. Petersburg Observatory, has kindly forwarded very careful tracings of the St. Petersburg photographs. These have been compared with one another, and with the original negatives taken at the Kew Observatory, and much valuable information has already been obtained. Other records have been asked, but a sufficient time has not yet elapsed for them to come to hand; it is hoped that, as soon as they arrive, a complete discussion of them will greatly extend our knowledge as to the causes of magnetic disturbances over a considerable area of the earth's surface.

A disturbance began at 4.20 a.m., Greenwich time, on the 3rd of March, 1879, which is described in the Stonyhurst record as 'a tremulous motion of the declination magnet, which lasted for about thirteen hours, accompanied by a gradual increase of westerly declination.'

About 5.30 a.m. the agitations west and east became greater, and at 7.30 a.m. there were sudden and great disturbances, the maximum westerly declination being reached about 8 a.m.: again marked disturbances, not quite so sudden, occurred just before 10 o'clock; then, after a slight motion eastward until 10.30 a.m., there was again an increase in the westerly declination, accompanied by great agitations, until 1 p.m., after which there is a decrease in the westerly declination, and the disturbance ends at about 5 p.m.

During the whole time of this increase in the westerly declination the agitations of the declination needle, including some twenty-four maxima and minima values, are absolutely coincident in time, and very often equal in magnitude, at Kew and at St. Petersburg.

At Stonyhurst also the curves are coincident with those at Kew and are almost *fac-similes* of them.

On comparing the photographs at Coimbra and at Lisbon with those at Kew and at St. Petersburg, it is found that the agitations in Portugal are not so clearly marked, but are coincident in time with those at the other stations.

Comparing the Vienna photographs of the same disturbance with those at Kew, they are found to be almost *fac-similes* of one another—every agitation westward or eastward at one place is coincident in time with a similar agitation at the other. The Vienna photographs are remarkably clear, but the agitations are usually not so large as those at Kew, and both are usually less than those at St. Petersburg, as given by the tracings; but the forms and periods of the successive agitations in a disturbance, as well as the duration of the disturbances, are the same at all the stations.

Between 5 and 6 p.m. on the 3rd there was a disturbance, first eastward and then westward, at St. Petersburg, which was not felt at Kew;

and between 10 p.m. and 12 there were simultaneous disturbances at Kew and St. Petersburg, but in opposite directions.

From about 10 to 10.40 p.m. there is a disturbance of a very regular kind, *i.e.* without much agitation, consisting of a motion of the needle towards the *east*, followed by a motion of the needle westward for about half an hour. This disturbance is strongly marked at Kew and at Stonyhurst; is less strongly marked, but coincident in time, at Coimbra and at Lisbon; and also very well shown, but is small, in the Vienna photographs; but in the tracing from St. Petersburg a disturbance begins at the same point of absolute time (*i.e.* about 10 p.m. Greenwich time), with a motion of the needle towards the *west*—this motion westward lasts for about 20 minutes, until 10.20 p.m., and is then followed by a gradual motion eastward until about 10.45 p.m.

The declination at St. Petersburg then remains nearly steady for a quarter of an hour, whilst the westerly declination at the other stations is regularly increasing, and from 11.30 p.m. (Greenwich time) the disturbances at St. Petersburg coincide in direction and in time with those at Kew and at the other stations.

Plate VII., fig. 1, represents the St. Petersburg, Kew, and Vienna declination curves for March 3rd, the time being Greenwich mean time for all stations.

On referring to the Kew curves for the horizontal force, of which Mr. Whipple has kindly prepared tracings for me, I find that whenever the deflections of the declination needle are eastward at Kew and westward at St. Petersburg at the same instant, as in this disturbance between 10 and 10.20 p.m., there is at the same time an *increase* in the horizontal force; and when the deflections are westward at Kew and eastward at St. Petersburg at the same instant, as between 10.20 p.m. and 10.45 p.m., there is at the same time a decrease going on in the horizontal force.

This statement is borne out by the comparisons of disturbances on other days throughout the month.

Three easterly movements of the needle occurred between 3 and 8 p.m. on the 5th of March.

One began about 2.45 p.m., which is only just noticeable at Lisbon and Coimbra when looked for, but which is clearly seen in the Kew and Stonyhurst photographs, and becomes much more important at Vienna, and is much larger still at St. Petersburg; but at all places the greatest easterly declination occurs at the same absolute time (at about 3 p.m. Greenwich time), and there is then an increase in the westerly declination until about 3.30 p.m.

From 5 p.m. to 5.20 p.m. there is an easterly movement of the needle, which is absolutely coincident in time and is well marked at all the stations, and the amount of the disturbance is as great at Kew and at Stonyhurst as it is at St. Petersburg. This is followed by a westerly movement, which is also precisely similar at all the places.

Another similar easterly movement begins about 6.20 p.m. (Greenwich time) at all the stations, and lasts for a quarter of an hour, followed by an equal movement westward for the next quarter of an hour, thus forming a regular V in the photographic curves. The second side of this V is continued to double the length in the St. Petersburg tracings, but the following greatest eastward declination is reached at

the same time (about 7.20 p.m.) at all the stations. Then the needle gradually returns to the westward, and the disturbance dies away.

This deviation of the St. Petersburg curves from the others occurs at 6.40 p.m., at which time there is a sudden increase in the horizontal force.

Another considerable disturbance, consisting of a general eastward movement of the north end of the needle, began about 6 p.m. on the 7th, followed by a westward movement, which ceased about 10 p.m.

In this disturbance, as in others, the Lisbon and Coimbra curves are like exact reproductions of one another, so also are the Kew and Stonyhurst curves. Placing the Lisbon negative behind the Coimbra positive, the dark lines of the Lisbon photograph are seen through the bright lines of the Coimbra curves; and in the same way, placing the Kew negative behind the Stonyhurst positive, the dark lines of the Kew curves are seen to coincide with the bright lines of the Stonyhurst curves, just as if one were an exact print taken from the other.

Comparing the Kew and the Vienna curves this disturbance is found to be of precisely the same character at both stations, but its range at Vienna is less than at Kew. In this case the periods of the disturbance occur at the same absolute time at all the stations.

At St. Petersburg the disturbance at the beginning is also similar in character to that at Kew, but previously at 2 p.m. (Greenwich time), there had been an easterly disturbance at St. Petersburg, which was not perceived at Kew; and just before 8 p.m., towards the end of the great disturbance, the westerly range of the needle is very much greater at St. Petersburg than at Kew, but the needle reaches its extreme positions either west or east exactly at the same absolute time at the two, and, indeed, at all the stations.

Unfortunately at Coimbra four curves are drawn on the same slip, and the zero line for one curve frequently runs into and coincides with the curve for another day, so that it is difficult or impossible to make out the character of the disturbances. The distance between the curve and the zero line appears to be the same as in the Kew curves.

At Stonyhurst three curves are photographed on the same slip, but the difficulty of dealing with the Coimbra curves is avoided by placing the zero or time line a long way from its own curve, but the curves for different days are placed so close to one another that occasionally they are apt to run into and confuse or cross one another.

At Kew, at Lisbon, and at St. Petersburg, two curves are drawn on the same slip, and sufficiently far apart not to interfere with one another, the distance at St. Petersburg being greater than at Kew, because, as a rule, the disturbances are of larger amount than at Kew.

At Vienna each curve is photographed on a separate slip, and the hours are numbered astronomically from 0 to 23, the slip being changed at or just before 21 hr., or 9 a.m. local time, *i.e.* about 8 a.m. Greenwich time.

The Vienna plan of photographing each curve on a separate sheet is the most convenient of all for the comparison of disturbances at different places, and there is an additional advantage in this plan because when there are two or more curves on a slip, disturbances occurring at the same hour on two successive days are not vertically above one another, and the want of agreement of the time lines for two or more curves is apt to be confusing.

From the Stonyhurst report we find that 'the chief disturbance of the month began about noon on the 9th, and lasted till 4 a.m. on the following day.'

On comparing the Lisbon and Coimbra curves for the whole period of this disturbance, they are found to be absolutely coincident throughout.

On comparing the Kew and Stonyhurst curves, they are also found to be absolutely coincident, both in range of disturbances and in time; indeed, this is one of the most remarkable instances that I have seen.

At Vienna the disturbances are nearly all of the same character, and take place at the same time, but the range is not quite so great.

On comparing the St. Petersburg curves, it is found that there are disturbances of the same character, and taking place—*i.e.* having their maxima and minima—at the same time as those at Kew and Vienna and the other stations; but superposed upon these are other disturbances, one to the eastward from 2 to 3.20 p.m., and to the westward from 3.20 to 3.40 p.m.; another violent one to the eastward from 4.20 to 4.50 p.m., followed by a quicker return to the westward until 5 p.m.; another, not quite so violent, eastward from 6 to 6.30, and westward from 6.30 to 7 p.m.; then, after a period of comparative rest, at 10.20 there is another disturbance westward for about ten minutes, followed by a return of the needle to the eastward until 11 p.m., superposed on those disturbances which are the same as the disturbances which are seen in the Kew curves.

The effect of these extra disturbances, which are so marked at St. Petersburg, is only just seen in the Vienna curves, the result being that the heights of some of the maxima are diminished or increased, or the slopes of parts of the curves are slightly altered, in consequence of the action of opposing or reinforcing disturbances.

These differences in the disturbances at St. Petersburg and at the other stations coincide in time with corresponding changes in the value of the horizontal force, as measured by the Kew curves. Thus from 2 to 3.20 p.m. the horizontal force is diminishing, then from 3.20 to 3.40 p.m. the horizontal force is increasing; from about 4.15 to 4.45 p.m. the horizontal force is diminishing, but again increases more rapidly until 5 p.m.; then from 6 to 6.20 p.m. it diminishes, and afterwards increases more slowly until a little after 7 p.m.; after a period of rest there is a large increase from 10.15 to 10.35, followed by a diminution of the horizontal force until 11 p.m.

It thus appears from these comparisons—and the statements are fully borne out by the other principal disturbances which have been examined—that:

A diminution in the horizontal force is accompanied by greater easterly deflections of the declination needle at St. Petersburg than at Kew. 2. Increase of the horizontal force is accompanied by greater westerly deflections at St. Petersburg than at Kew, or is sometimes accompanied by a westerly deflection at St. Petersburg and an easterly deflection at Kew.

On March 11, a disturbance, first eastward for a quarter of an hour until 9 p.m., then westward for an hour, causes a well-marked and regular depression in the declination curve.

This takes place at the same instant at Kew, Stonyhurst, and Vienna, but is not present at St. Petersburg; but at the time of the greatest eastward deflection, at 9.4 p.m., there is a slight westward deflection at

St. Petersburg, the other small disturbances at all the places being the same.

Again, on the 13th, there is a magnetic storm, lasting from 6.20 p.m. until 8 p.m., which takes place absolutely at the same time at all the stations, and for which the curves for places near together absolutely fit one another.

At St. Petersburg this storm was more violent than at the other stations, and was preceded by a violent storm, in which the needle deviated first to the east and then to the west, between 4.20 and 6 p.m. This preceding storm was only slightly felt at the other stations, and rather more at Vienna than at Kew or Stonyhurst.

About 2.30 a.m. on the 14th, there is a sudden disturbance of the needle to the westward, which is stronger at Kew and Stonyhurst than at Vienna or at St. Petersburg.

The next considerable disturbance was on the 15th, beginning at 9.20 p.m. and ending at midnight, followed by lesser disturbances arising from a distinct cause which lasted until 4 a.m. on the 16th.

This disturbance from 9.20 p.m. to midnight produced similar deflections at Kew and Stonyhurst, and also at Coimbra and Lisbon, first rapidly to the east until 9.50 and then to the west; but the range was not so great at these latter places. At St. Petersburg the deflections of the needle were in the opposite direction to those at Kew and Stonyhurst, and the opposite deflections occurred at the same time; and this remark applies to all the oscillations of the declination needle up to midnight. The disturbance westward was also much greater than the simultaneous eastward disturbance at Kew.

The disturbances between midnight and 4 a.m. take place at the same time at all the stations, and are precisely similar in character and in direction at St. Petersburg, at Vienna, and at Kew. They are also equal in amount, so that the curves almost fit one another. Here, then, we have a cause producing opposite disturbances at Kew and at St. Petersburg for more than two hours, followed by probably some other cause of disturbance producing identical effects at all the stations for a period of four hours.

At Vienna from 9.20 to midnight the disturbances were simultaneously in the same direction as, but were very weak in comparison with, those at St. Petersburg, so that this magnetic storm was very little felt at Vienna.

On reversing the Kew curve for this disturbance and comparing it with St. Petersburg, it is seen that the successive maxima and minima are absolutely simultaneous, so that the deflections opposite ways at the two places are seen to be due to the same cause; and the Vienna curve is very nearly coincident with the mean curve obtained by superposing the Kew and St. Petersburg curves.

Plate VII., fig. 2, represents the St. Petersburg, Kew, Vienna, and Coimbra declination curves for March 15th–16th.

The beginning of this disturbance was accompanied by a sudden and large increase of the horizontal force until 9.50 p.m., and then by a diminution until 10.45 p.m., followed by slight oscillations of the needle until midnight, which are simultaneous with the oscillations of the St. Petersburg declination needle.

The vertical force gradually diminishes from 9.20 to 10.30 p.m.

Nothing can show more clearly than this the direct relation between

the changes in the horizontal force and the differences in the declination curves at St. Petersburg and at Kew.

At 11.45 a.m. on March 18 there is a sudden kick to the westward, lasting for about two minutes and measured by a length of 2 millimètres on the Kew curve, *i.e.* giving a deflection of about 2′. This kick takes place simultaneously at St. Petersburg and at Vienna, and is nearly equal at all the stations. It is also felt at the same instant at Coimbra and at Lisbon.

A similar kick, but less marked at St. Petersburg, occurs next day at 11.30 a.m. (Greenwich time) at all the stations.

After an entire agreement between the curves through the day, at 10 p.m. a disturbance occurs which deflects the needle eastward at Kew and westward at St. Petersburg, but by midnight the curves coincide again, and remain coincident with the same very small variations through the night.

Between 3 and 4 p.m. on March 20 we get disturbances opposite ways, first westward at Kew and eastward at St. Petersburg simultaneously, again followed by coincidences through the day.

Another disturbance commenced by a tremulous motion of the magnet about 7 a.m. on the 23rd, and lasted until 11 p.m.

From the beginning of this storm until 1.45 p.m. the several east and west disturbances or oscillations of the needle are simultaneous and of the same character, and are very nearly equal in amount at Kew, Stonyhurst, and at St. Petersburg. From 1.45 to 2.30 p.m. the deflections to the eastward were far greater at St. Petersburg than at the other stations, but were still simultaneous at all the stations. The record at Stonyhurst shows that the vertical force increased in value about 2 p.m., so that here an increase in the vertical force is accompanied by greater eastward deflections at St. Petersburg.

The St. Petersburg curve remains below the Kew and Stonyhurst curves, with the same smaller disturbances, until 7.12 p.m., just after one but before another violent disturbance, each of which lasted half an hour. The first of these two violent disturbances was first eastward and then westward at all stations, but greater at St. Petersburg than at Kew, and was accompanied by a corresponding decrease, and then an increase of the horizontal force. At 7.25 p.m., according to the Stonyhurst record, the V.F. had diminished to its mean value, and simultaneously with this diminution the horizontal force had been increasing. The second violent disturbance was westward at St. Petersburg, and eastward at Kew and Stonyhurst. This second disturbance was also westward at Vienna, but less violent in character. The maximum was reached at 7.30 p.m.

The simultaneous disturbances become alike again in character and direction at 7.50 p.m., but from 8.15 p.m. until 11 p.m. (the end of the storm) the disturbances at Kew and at St. Petersburg do not correspond, but are at times in opposite directions. From 11 p.m. the curves are again agreeing with one another.

The time scales for different stations are nearly but not quite the same; the St. Petersburg is slightly shorter than the Kew scale, and the Kew is slightly shorter than the Vienna scale. They are so nearly equal that for short lengths the difference is not perceptible. In Plate VIII., fig. 1, where the disturbances during seventeen hours on March 23–24 are represented in one diagram, an attempt has been made to guide the eye by

drawing three oblique time lines at 9 a.m., 8 p.m., and 2 a.m. through the St. Petersburg, Kew, and Vienna curves. There is more difficulty in determining the exact instant at which any small disturbance occurs from the Lisbon photographs, as the curves are not divided into hourly or two-hourly divisions as at the other observatories.

From 7.20 to 7.30 p.m. there is a sudden and large increase in the horizontal force, which continues high until 7.40, and then suddenly diminishes until nearly 8 p.m.

On March 28, at 4.30 p.m., a slight eastward disturbance takes place at St. Petersburg, which is scarcely perceived elsewhere. From 10.20 to 10.30 at all the stations the declination needle is moving westward, and both the horizontal and vertical forces at Kew are increasing. From 10.30 to 10.40 the St. Petersburg needle continues to move westward, and the horizontal and vertical forces continue to increase, but the Kew needle moves back to the eastward from 10.30 p.m. until 11.5 p.m., and then westward to 11.30 p.m. From 10.20 p.m. to 1.25 a.m. on the 29th, during which time there are two large disturbances, there is a very close resemblance between the St. Petersburg declination curve and the Kew horizontal force curve, the disturbances being simultaneous, and a westerly deflection at St. Petersburg corresponding to an increase of the horizontal force at Kew. Taking the mean line of no disturbance as common to the two, the height or depth of the Kew horizontal force curve is about one-third of the height or depth of the St. Petersburg declination curve at the same point.

Plate IX. gives the St. Petersburg, Kew, and Vienna declination curves and the horizontal and vertical force at Kew from 10 p.m. to 4 a.m. on March 28–29.

The Vienna curve is very nearly the mean between the St. Petersburg and Kew declination curves between 10.30 and 11.30 p.m., but agrees absolutely with the Kew curve for the part of the disturbance after midnight.

This disturbance was only slightly felt at Lisbon or at Coimbra.

According to the Stonyhurst record, the horizontal force magnet was rather disturbed during these declination disturbances.

On the next day (March 29), at 8.20 p.m., an easterly excursion begins, which is identical at all stations until 8.45 p.m.; but at this point the St. Petersburg needle turns sharply back to the west, while the Kew and Stonyhurst needles continue moving to the east, giving the greatest eastern deflection for the month (15′ 49″). This point is reached at 8.55 p.m., whilst the corresponding western deflection at St. Petersburg is reached about 9.5 p.m. The St. Petersburg curve then falls again, reaching its lowest point at 9.30 p.m., after which the curves show a westward motion of the needles at all stations.

In Plate VIII., fig. 2, the time lines are drawn obliquely, as in the curve for March 23–24.

The Vienna curve is almost exactly the mean of the other two curves, and the Lisbon and Coimbra curves very closely resemble the Vienna curve for this disturbance.

About 10.40 and again at 11.15 p.m. the St. Petersburg needle is deflected to the west, and the Kew needle toward the east. The St. Petersburg needle reaches its maximum at 11.30 p.m., then both needles move eastward until 12.10 a.m., after which the Kew needle begins to move westward. At 12.30 a.m. the St. Petersburg needle also begins to move westward, the curves very closely agree, and the disturbance is very nearly over.

On July 19, before seeing the Kew horizontal force curves, I wrote as follows: *I am led to conjecture that at* 8.45 *p.m. on the* 29*th, and at* 11.15 *p.m., there is an increase in the horizontal force.*

On comparing the Kew horizontal force curves I find that from 8.45 to 9.5 p.m. the horizontal force is increasing rapidly, and that it decreases again from 9.5 to 9.30 p.m. At 10.40 the horizontal force again increases, and after a slight decrease about 11 o'clock, there is again an increase in the horizontal force, beginning at 11.15 p.m., and ending at 11.30 p.m., *i.e.*, when the St. Petersburg declination needle reaches its greatest westerly deviation.

On comparing an exceedingly good photograph from Vienna for March 26–27, with the photograph from Kew, which is also good, in a disturbance lasting from 5 p.m. to 7 p.m., in which there were twelve distinct deflections in each direction and a decided character given to the curve, but in which no excursion was as great as 2′ from the mean position, I found that the curves were absolutely coincident.

The Stonyhurst positives agreed with Kew as far as one could judge, but the agreements between the Kew and Vienna curves here spoken of are such as are entirely beyond the power of testing by a positive. Almost the whole of the Vienna photograph of the disturbance lies within the breadth of the base line in the Stonyhurst positive. The oscillations are also found to take place absolutely at the same instant of time at Kew and at Vienna. Similar instances occur on March 31 between 12 and 1 p.m. and between 6 and 7 p.m.

The St. Petersburg tracings also show the same disturbances occurring at the same times, but the agreement of these Vienna and Kew curves is far greater than any that can be tested by means of tracings; at the same time, there are numberless instances of comparison which might be given which show that the St. Petersburg tracings are remarkably good. They are also taken on a very excellent tracing paper, and the hours are carefully marked on the curves, so that there is no difficulty in arriving at the time at which any given disturbance occurs.

It would be easier to make accurate measurements of time if the base line were nearer to the curve than it is in the Vienna photographs, and if only one curve were photographed on each slip at all stations, as is the case in the Vienna photographs. For the comparison of magnetic disturbances it is important that the arrangement of lamps, lenses, &c., should be as exactly as possible the same at all stations, for the accuracy of the agreement of the results is such that any variation in this arrangement interferes with the degree of accuracy of the conclusions which may be drawn as to the character or the cause of magnetic disturbances.

First Report of the Committee, consisting of Professor A. Leith Adams, the Rev. Professor Haughton, Professor W. Boyd Dawkins, *and* Dr. John Evans, *appointed for the purpose of exploring the Caves of the South of Ireland.*

The following is a preliminary Report on the Bone Caverns, near Middleton, in the county of Cork, lately explored, in part, by R. J. Ussher and J. J. Smyth, Esqrs. The work has been restricted to a few days'