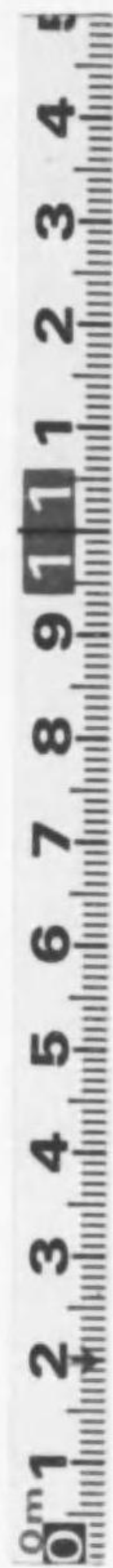


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MAGNETIC OBSERVATIONS

IN
THE YEAR 1905.

MAGNETIC OBSERVATORY.

It is placed within the circle of the Central Meteorological Observatory at the altitude of 21 metres above the mean sea-level. Its geographical co-ordinates are

Longitude 139° 45' E.

Latitude 35° 41' N.

The observatory was first established in 1890. It was rebuilt in July of 1897. The building is constructed of wood, with exclusion of iron, and the supports for instruments are made of marble, placed on the masonry work of white bricks which are free from magnetic ingredients. The observation rooms are put under the ground, and great care is taken to keep off the sudden changes in temperature. There are two rooms, with the stair case running in the N-S direction between them. In the eastern there is a set of Mascart's self-registering magnetograph, and in the western the apparatus for the direct reading.

ABSOLUTE MEASUREMENT OF MAGNETIC ELEMENTS.

Absolute measurement is made twice every month, and in each measurement the horizontal intensity and the dip are generally observed three or four times and the declination in such a manner that it is sufficient to obtain a curve of diurnal variation.

The declination and the horizontal intensity are measured by means of instrument devised by Prof. Tanakadate, which is described in a paper published in the Proceeding of the Royal Society of Edinburgh (1884-6) and also in the Journal of the college of Science, Imperial University, Japan (Vol.II, Part III). It will be sufficient here to give a short description which is chiefly the extraction of the papers.

Declination.—The declinometer is built upon a theodolite which in its ordinary form serves for all the astronomical observations. The magnetometer stage resting on tripods is fitted to the centre of the theodolite base, being able to be fixed either to the base of the theodolite or to the Y's by means of a screw

projected downward from the centre of the base of the stage. A telescope with a mirror and a lamp are fixed to the stage.

The magnetometer case is set upon the stage and can be levelled by four screws at the upper surface of the stage and centered by other four screws at its vertical sides. The magnet is a small hollow cylinder piercing a mirror centrally perpendicular to its plane. Mirror and magnet are fastened to an aluminium stem, whose lower end is broadened, so that it may, when necessary, be securely gripped by means of a vice fitted to the lower part of the case. The suspension is made by means of a spider line.

The peculiar feature of the declinometer is a coil of wire, wound on a flat rectangular frame of brass in two separate parts, a certain portion in the middle being left vacant. Two pivots project from the middle of the sides in a direction perpendicular to the axis of the coil. These pivots are hollow, and are made of the same external diameter as those of the telescope belonging to the theodolite. The upper and lower surfaces are pierced so as to allow the magnetometer to project above the coil.

To bring the coil into adjustment, it is necessary to operate as follows. Place the stage and magnetometer on the theodolite, and mount the coil with its pivots resting on the Y's. Adjust the Y's into an approximate east and west direction by sighting the freely hanging mirror edge-on through the pivot cores. Lay the coil horizontal, so that the ends of the coil now face north and south. Adjust the centering of the magnetometer and place the small telescope with attached scale and lamp-counterpoise in due position. Clamp the stage and all its bearings to the base of theodolite, thus rendering them quite free of the Y's and consequently the coil being able to be turned round independent of every thing else. The magnetometer stage is adjusted until some convenient division on the scale, as reflected from the magnet mirror, is brought to coincidence with the cross-wire of the observing telescope. Thus all things are prepared.

The coil is now in circuit with a small dry battery. This is done by communicating it with the resistance box, whose terminals are joined to the poles of the battery and which enables to change the direction of the current. At the first trial the direction of the current should be such as to make the magnetic field due to the current in the coil have the same (general) direction as that of the earth. This is readily judged of by the quickened movement of the magnet. The reflected image of the scale will in general be seen to move. With the current always on, let the azimuth of the coil be shifted until the originally observed reading of the scale is brought back again to the cross wires. Since the magnetometer and telescope have been absolutely fixed in position during

the whole operation, this gives to the first approximation the direction of the declination. The current is now reversed. In general, the result of this will be that the image of the zero scale reading will slowly move to one or other side of the cross wire. The resistance is then adjusted until the current is such as to cause the time of oscillation of the magnet to be some three or four times as long as that under the earth's force alone. The original division of the scale is again brought back to the cross wire by carefully adjusting the azimuth of the coil. If the current is now broken and the scale image does not shift, it is certain that the magnetic axis of the coil lies in the magnetic meridian. The reading on the theodolite gives its azimuth. An exactly similar observation is made with the coil reversed as regards east and west. Next, two such observations must be made in overturning the coil up and down. The mean of the four readings gives the declination at that instant corresponding to the mean of the two instances of the first and the last adjustments, quite independent of any errors resulting from any slight deviation from perpendicularity between the axis of the pivots and the line of magnetic force at the centre of the coil due to the current in it and from any deviation of the centre of the coil from that of the magnet. A complete observation usually takes four or five minutes.

Horizontal Intensity.—For the determination of the horizontal intensity, the declinometer must be removed and in its place a deflection bar substituted. The bar is made of brass and has a V-groove on its upper surface—or rather two V-grooves extending the one to the east and the other to the west, when the instrument is mounted ready for use. Where the bar rests on the Y's, it is made in the form of the semi-cylinder—the upper surface being flat, the lower having the same curvature as the pivots of the theodolite telescope and the declinometer coil. Between the Y's, the bar swells out into an oblate ring, through which the magnetometer projects. A semi-circular groove is cut in front of the ring, so that the magnet mirror can be sighted by the small telescope. On the V-groove of the bar there are four stops two on each side of the centre. The deflection magnet rests in the groove, and the stops are so placed that the two distances of the magnet from the centre are obtained simply by slipping the magnet along the groove from one stop to the other, without having to lift it out. The stops are placed so as to make the ratio of the two distances the best possible, according to the usual rule.

The instrument is obviously available for use either according to the method of sines or the method of tangents. The former method is the preferable one; and in using it, it is necessary to clamp the stage to the Y's, and free it from the base of the theodolite. The operations are then conducted exactly as with

the Kew instrument. The temperature of the bar is measured by means of two thermometers placed in its opposite sides beyond the further stops. It is advisable to dust with a small brush the surfaces of the magnet and stop just before they are brought together. The chronometer time is taken as the final deflection is adjusted. The beginning of the experiment is given by the first time record in the vibration experiment, which it was found most convenient to make first. The mean of these times is taken as the time corresponding to the value of the horizontal force as finally deduced.

The vibration experiment is made in a vibration box somewhat similar in construction to the one used in the Kew instrument. It is mounted on a second tripod, so that the magnetometer stage need never be removed until the theodolite has to be used for the astronomical observations. The magnet is suspended by two loops of silk from the end of a silk fibre freed from twist in the usual way and its horizontality is well adjusted. A horizontal vibration of about half a degree is given to the magnet, and it is observed by means of a telescope. The observer signals the instant of transit of the middle point of the swing, and these are noted down by recorder at some distance. The temperature is observed at the beginning and the end of the experiment with a thermometer attached to the inside of the glass window of the box, the mean of two readings being taken as the temperature in the vibration experiment.

For determining the horizontal intensity all the necessary corrections are applied. The torsion and arc correction are applied in the usual way; the time correction is applied so as to reduce the time-unit at once to the mean solar second; besides these we may mention the corrections for induction, expansion of steel magnet and of the brass, which constitutes V-groove on which the magnet is to be placed in the deflection experiment, and the correction for the temperature difference in the vibration and the deflection experiments.

The vibration experiment is usually taken before the deflection experiment. From the first recorded swing to the last deflection adjustment the whole experiment generally takes about 20 minutes.

Dip.—The observations of dip are made by means of a dip circle of Casella. The magnetization of the needle is reversed by means of an electro-magnetic coil. A complete observation usually takes 20 minutes.

The astronomical meridian is sometimes determined by observations of circumpolar stars. Thus, the azimuth of the top of a tower of a Cathedral Nicoli at a distance of about 1.5 km. is often tested. The reading of the meridian is usually reduced from that of the object.

PHOTOGRAPHIC RECORDS OF MAGNETIC ELEMENTS.

Photographic records of magnetic elements are made by means of a Mascart's magnetograph. Let us shortly describe the arrangement of the instrument and the method of reduction.

THE ARRANGEMENT OF THE APPARATUS.

Declinometer.—It is contained in a metal case with a tube on its cover. From the upper end of the tube, a magnet with a mirror perpendicular to its direction is freely suspended by means of a fine silk thread. There is a second mirror fixed to the base of the case. Thus, the rays of light falling upon the two mirrors reflect on a photographic paper moving by a clock-work, one tracing the curve of variation of the magnetic needle and other the fixed line.

Bifilar magnetometer.—Its construction is similar to that of declinometer. But, in this case, the magnet with a mirror parallel to its direction is suspended by means of two fine silk threads and put in equilibrium in the direction perpendicular to the magnetic meridian in virtue of the couples due to the horizontal intensity and the torsion. Its sensibility can be adjusted by regulating the distance between the two points of suspension. The light reflected from the mirror traces the variation of the horizontal intensity.

Magnetic balance.—It is a magnetic balance with a hole in its central portion. There is, in the hole, a knife-edge by means of which the magnet rests on an agate plane, and the magnet is placed horizontally by adjusting the position of its centre of gravity by means of a small index attached to it, the couple due to the vertical intensity equilibrating with that due to gravity. The sensibility can be adjusted by means of two weights movable in the horizontal and vertical ones attached to the magnet. The whole is contained in a metal case. There are two horizontal mirrors, one fixed to the case, and the other to the magnet. At the central portion of the cover of the case, there is a hole on which an isosceles rectangular prism is placed, the two faces being put horizontally and vertically. Thus, the light falling upon the vertical face of the prism is refracted towards the mirrors and again reflected and traces the variation of the vertical intensity and the fixed line.

METHOD OF REDUCTION.

The hourly ordinates of the three magnetic curves are at first measured in millimetres and the tenths.

For declination, the ordinate values are then reduced into minutes by multiplication of the factor 1.36 which is the angular value for 1 mm. of the paper. The ordinates measured for the times of the absolute measurements combined with the absolute values of declination, give the values of the base line, from which hourly values of declination are all reduced.

For the horizontal and vertical intensities, the ordinates of the curves are multiplied respectively by the factors ΔH and ΔZ , which are the variations of the horizontal intensity (H) and the vertical intensity (Z) corresponding to 1 mm. of the paper. The mean values of ΔH and ΔZ for each month were as follows:—

	ΔH	ΔZ		ΔH	ΔZ
January	3.66×10^{-2} C.G.S.	3.58×10^{-2} C.G.S.	July	4.08×10^{-2} C.G.S.	4.80×10^{-2} C.G.S.
February	3.72 ..	3.66 ..	August	4.08 ..	4.72 ..
March	3.83 ..	3.80 ..	September	3.96 ..	8.09 ..
April	3.91 ..	4.89 ..	October	3.90 ..	9.93 ..
May	4.00 ..	5.43 ..	November	3.81 ..	6.01 ..
June	4.03 ..	5.69 ..	December	3.76 ..	5.53 ..

TEMPERATURE COEFFICIENTS OF BIFILAR AND BALANCE.

The temperature of the room where the photographic record is always made can not be constant, the range in a day sometimes amounting to nearly 1.5 C. Thus, the temperature coefficients of the bifilar and the balance were determined in June, 1898. The result was as follows:—

	Temperature Coefficient for 1 °C.
Bifilar.....	20.73×10^{-5} C.G.S.
Balance.....	30.45×10^{-5} ..

DIRECT READING SYSTEM.

The system is essentially the same as the self-recording magnetograph. By means of this system, the variations obtained by photographic records are often tested.

HARMONIC ANALYSIS OF DIURNAL VARIATION OF MAGNETIC ELEMENTS.

Expressing the means of hourly values of magnetic elements for every month and the year by the formula.

$$f(t) = p_0 + p_1 \cos t + q_1 \sin t + p_2 \cos 2t + q_2 \sin 2t \\ + p_3 \cos 3t + q_3 \sin 3t + p_4 \cos 4t + q_4 \sin 4t,$$

where t is the Central Standard Mean Time (mean time of the meridian 135° E) converted into arc; and $f(t)$ the mean value of the magnetic element at the time t , the coefficients $p_0, p_1, q_1, p_2, q_2, p_3, q_3, p_4,$ and q_4 , were calculated. The result is given in page 48.

HOURLY VALUES
OF
MAGNETIC ELEMENTS

observed at the Central Meteorological Observatory, Tokio,

1905.

Time is given in the Central Standard Time (the civil mean time of the meridian 135° E.).

The declination is measured in degrees and minutes, the horizontal and vertical intensities in C. G. S. units. For the hourly values, the declination is given to 0.1 minute of arc; the intensities to the fifth decimal of the C. G. S. unit. For the mean values, one more figure is added, i.e. the declination is given to 0.01 and the intensities to 10^{-6} C. G. S. unit.

The mean values are taken only using all days of complete record. The values for intensities are all corrected for temperature.

The characters of the diurnal variation of the magnetic elements are divided into 5 classes:

Calm (C), Agitated (A), Light Storm (S'), Storm (S), and Severe Storm (S').

DECLINATION: 4+ . . . W

Table with 17 columns (1-17) and 31 rows (1-31) of numerical data. Includes a 'Mean' row at the bottom.

DECLINATION: 4+ . . . W

Table with 17 columns (1-17) and 28 rows (1-28) of numerical data. Includes a 'Mean' row at the bottom.

JANUARY, 1905.

Table with 24 columns (18-24, Mean, Maximum, Minimum, Range) and 31 rows (1-31) of numerical data. Includes a 'Remarks' column with 'a. m.' and 'p. m.' sub-columns.

FEBRUARY, 1905.

Table with 24 columns (18-24, Mean, Maximum, Minimum, Range) and 28 rows (1-28) of numerical data. Includes a 'Remarks' column with 'a. m.' and 'p. m.' sub-columns.

DECLINATION: 4° + . . . W

Table with 17 columns (Hour/Day 1-17) and 31 rows (Days 1-31). Contains numerical data for declination measurements.

DECLINATION: 4° + . . . W

Table with 17 columns (Hour/Day 1-17) and 31 rows (Days 1-31). Contains numerical data for declination measurements.

MARCH, 1905.

Table with 24 columns (Days 18-24, Mean, Maximum, Minimum, Range) and 31 rows (Days 1-31). Includes numerical data and 'Remarks' column with 'a. m.' and 'p. m.' sub-columns.

APRIL, 1905.

Table with 24 columns (Days 18-24, Mean, Maximum, Minimum, Range) and 31 rows (Days 1-31). Includes numerical data and 'Remarks' column with 'a. m.' and 'p. m.' sub-columns.

DECLINATION: 4+ . . . W

Table with 17 columns (Day 1-17) and 17 rows (Day 1-17). Values range from approximately 46.0 to 47.0. Includes a 'Mean' row at the bottom.

DECLINATION: 4+ . . . W

Table with 17 columns (Day 1-17) and 17 rows (Day 1-17). Values range from approximately 45.0 to 47.0. Includes a 'Mean' row at the bottom.

MAY, 1905.

Table with 24 columns (Days 18-24, Mean, Maximum, Minimum, Range) and 17 rows (Days 18-24). Includes 'Remarks' column with 'a. m.' and 'p. m.' sub-columns.

JUNE, 1905.

Table with 24 columns (Days 25-31, Mean, Maximum, Minimum, Range) and 17 rows (Days 25-31). Includes 'Remarks' column with 'a. m.' and 'p. m.' sub-columns.

DECLINATION: 4°+ . . . W

Table with 17 columns (1-17) and 31 rows (1-31) of declination data. Includes a 'Mean' row at the bottom.

DECLINATION: 4°+ . . . W

Table with 17 columns (1-17) and 31 rows (1-31) of declination data. Includes a 'Mean' row at the bottom.

JULY, 1905.

Table with 18 columns (18-21, Moon, Maximum, Minimum, Range) and 31 rows (1-31) of July 1905 data. Includes a 'Mean' row at the bottom.

AUGUST, 1905.

Table with 18 columns (18-21, Moon, Maximum, Minimum, Range) and 31 rows (1-31) of August 1905 data. Includes a 'Mean' row at the bottom.

DECLINATION: 4°+ . . . W

Table with 17 columns (Day 1-17) and 17 rows (Day 1-17). Each cell contains a numerical value representing declination. A 'Mean' row is at the bottom.

DECLINATION: 4°+ . . . W

Table with 17 columns (Day 1-17) and 17 rows (Day 1-17). Each cell contains a numerical value representing declination. A 'Mean' row is at the bottom.

SEPTEMBER, 1905.

Table with 24 columns (Days 18-24) and 17 rows (Days 18-24). Includes 'Mean', 'Maximum', 'Minimum', and 'Range' columns. 'Remarks' column contains 'a. m.' and 'p. m.' entries.

OCTOBER, 1905.

Table with 24 columns (Days 25-31) and 17 rows (Days 25-31). Includes 'Mean', 'Maximum', 'Minimum', and 'Range' columns. 'Remarks' column contains 'a. m.' and 'p. m.' entries.

DECLINATION: 4° . . . W

Table with 17 columns (1-17) and 30 rows (1-30) of numerical data. Includes a 'Mean' row at the bottom.

DECLINATION: 4° . . . W

Table with 17 columns (1-17) and 30 rows (1-30) of numerical data. Includes a 'Mean' row at the bottom.

NOVEMBER, 1905.

Table with 24 columns (18-24, Mean, Maximum, Minimum, Range) and 30 rows (1-30) of numerical data. Includes a 'Mean' row at the bottom.

DECEMBER, 1905.

Table with 24 columns (18-24, Mean, Maximum, Minimum, Range) and 30 rows (1-30) of numerical data. Includes a 'Mean' row at the bottom.

HORIZONTAL INTENSITY: 0.29 . . . C.G.S.

Table with 17 columns (1-17) and 31 rows (1-31) of numerical data. Includes a 'Mean' row at the bottom.

HORIZONTAL INTENSITY: 0.29 . . . C.G.S.

Table with 17 columns (1-17) and 28 rows (1-28) of numerical data. Includes a 'Mean' row at the bottom.

JANUARY, 1905.

Table with 24 columns (18-24) and 31 rows (1-31) of numerical data. Includes a 'Mean' row at the bottom.

FEBRUARY, 1905.

Table with 24 columns (18-24) and 28 rows (1-28) of numerical data. Includes a 'Mean' row at the bottom.

HORIZONTAL INTENSITY: 0.29 . . . C.G.S.

Table with 17 columns (1-17) and 31 rows (1-31) of magnetic intensity data. Includes a 'Mean' row at the bottom.

HORIZONTAL INTENSITY: 0.29 . . . C.G.S.

Table with 17 columns (1-17) and 30 rows (1-30) of magnetic intensity data. Includes a 'Mean' row at the bottom.

MARCH, 1905.

Table with 24 columns (18-24, Mean, Maximum, Minimum, Range) and 31 rows (1-31) of magnetic intensity data. Includes a 'Mean' row at the bottom.

APRIL, 1905.

Table with 24 columns (18-24, Mean, Maximum, Minimum, Range) and 30 rows (1-30) of magnetic intensity data. Includes a 'Mean' row at the bottom.

HORIZONTAL INTENSITY: 0-29 . . . C.G.S.

Table with 17 columns (1-17) and 31 rows (1-31) of numerical data. Includes a 'Mean' row at the bottom.

HORIZONTAL INTENSITY: 0.29 . . . C.G.S.

Table with 17 columns (1-17) and 31 rows (1-31) of numerical data. Includes a 'Mean' row at the bottom.

MAY, 1905.

Table with 24 columns (18-24, Mean, Maximum, Minimum, Range) and 31 rows (1-31) of numerical data. Includes a 'Mean' row at the bottom.

JUNE, 1905.

Table with 24 columns (18-24, Mean, Maximum, Minimum, Range) and 31 rows (1-31) of numerical data. Includes a 'Mean' row at the bottom.

HORIZONTAL INTENSITY: 0.29 . . . C.G.S.

Table with 17 columns (1-17) and 31 rows (1-31) of numerical data. Includes a 'Mean' row at the bottom.

HORIZONTAL INTENSITY: 0.29 . . . C.G.S.

Table with 17 columns (1-17) and 31 rows (1-31) of numerical data. Includes a 'Mean' row at the bottom.

JULY, 1905.

Table with 24 columns (18-24, Mean, Maximum, Minimum, Range) and 31 rows (1-31) of numerical data. Includes a 'Mean' row at the bottom.

AUGUST, 1905.

Table with 24 columns (18-24, Mean, Maximum, Minimum, Range) and 31 rows (1-31) of numerical data. Includes a 'Mean' row at the bottom.

HORIZONTAL INTENSITY: 0.29 . . . C.G.S.

Table with 17 columns (1-17) and 31 rows (1-31) of numerical data for September 1905. Includes a 'Mean' row at the bottom.

HORIZONTAL INTENSITY: 0.29 . . . C.G.S.

Table with 17 columns (1-17) and 31 rows (1-31) of numerical data for October 1905. Includes a 'Mean' row at the bottom.

SEPTEMBER, 1905.

Table with 24 columns (18-24) and 31 rows (1-31) of numerical data for September 1905. Includes 'Maximum', 'Minimum', 'Range', and 'Remarks' columns.

OCTOBER, 1905.

Table with 24 columns (18-24) and 31 rows (1-31) of numerical data for October 1905. Includes 'Maximum', 'Minimum', 'Range', and 'Remarks' columns.

HORIZONTAL INTENSITY: 0.29 . . . C.G.S.

Table with 17 columns (1-17) and 31 rows (1-31) of numerical data. Includes a 'Month' row at the bottom with values ranging from 924.3 to 925.0.

HORIZONTAL INTENSITY: 0.29 . . . C.G.S.

Table with 17 columns (1-17) and 31 rows (1-31) of numerical data. Includes a 'Month' row at the bottom with values ranging from 968.2 to 970.9.

NOVEMBER, 1905.

Table with 24 columns (18-24) and 24 rows (937-964) of numerical data. Includes summary statistics like Mean, Maximum, Minimum, Range, and Remarks.

DECEMBER, 1905.

Table with 24 columns (972-970) and 24 rows (972-970) of numerical data. Includes summary statistics like Mean, Maximum, Minimum, Range, and Remarks.

VERTICAL INTENSITY: 0.34 . . . C.G.S.

Table with 17 columns (1-17) and 31 rows (1-31) of vertical intensity data. Includes a 'Mean' row at the bottom.

VERTICAL INTENSITY: 0.34 . . . C.G.S.

Table with 17 columns (1-17) and 31 rows (1-31) of vertical intensity data. Includes a 'Mean' row at the bottom.

JANUARY, 1905.

Table with 24 columns (18-24, Mean, Maximum, Minimum, Range) and 31 rows (1-31) of vertical intensity data. Includes a 'Remarks' column with 'n. m.' and 'p. m.' sub-columns.

FEBRUARY, 1905.

Table with 24 columns (18-24, Mean, Maximum, Minimum, Range) and 31 rows (1-31) of vertical intensity data. Includes a 'Remarks' column with 'n. m.' and 'p. m.' sub-columns.

VERTICAL INTENSITY: 0.34 . . . C.G.S.

Table with 17 columns (Day 1-17) and 31 rows of data. Includes a 'Mean' row at the bottom. Values range from approximately 370 to 425.

VERTICAL INTENSITY: 0.34 . . . C.G.S.

Table with 17 columns (Day 1-17) and 31 rows of data. Includes a 'Mean' row at the bottom. Values range from approximately 370 to 425.

MARCH, 1905.

Table with 24 columns (Days 18-24, Mean, Maximum, Minimum, Range) and 31 rows of data. Includes a 'Mean' row at the bottom. Values range from approximately 370 to 425.

APRIL, 1905.

Table with 24 columns (Days 18-24, Mean, Maximum, Minimum, Range) and 31 rows of data. Includes a 'Mean' row at the bottom. Values range from approximately 370 to 425.

VERTICAL INTENSITY: 0.34 . . . C.G.S.

Table with 17 columns (1-17) and 31 rows (1-31) of vertical intensity data for May 1905. Includes a 'Mean' row at the bottom.

VERTICAL INTENSITY: 0.34 . . . C.G.S.

Table with 17 columns (1-17) and 31 rows (1-31) of vertical intensity data for June 1905. Includes a 'Mean' row at the bottom.

MAY, 1905.

Table with 24 columns (18-24) and 31 rows (1-31) of vertical intensity data for May 1905. Includes a 'Mean' row at the bottom.

JUNE, 1905.

Table with 24 columns (18-24) and 31 rows (1-31) of vertical intensity data for June 1905. Includes a 'Mean' row at the bottom.

VERTICAL INTENSITY: 0.34 . . . C.G.S.

Table with 17 columns (Day 1-17) and 24 rows (Hour 1-24). Contains numerical data for vertical intensity measurements.

VERTICAL INTENSITY: 0.34 . . . C.G.S.

Table with 17 columns (Day 1-17) and 24 rows (Hour 1-24). Contains numerical data for vertical intensity measurements.

JULY, 1905.

Table with 24 columns (Days 18-31) and 24 rows (Hour 1-24). Includes columns for Mean, Maximum, Minimum, Range, and Remarks.

AUGUST, 1905.

Table with 24 columns (Days 1-31) and 24 rows (Hour 1-24). Includes columns for Mean, Maximum, Minimum, Range, and Remarks.

VERTICAL INTENSITY: 0.34 . . . C.G.S.

Table with 17 columns (1-17) and 31 rows (1-31) of vertical intensity data for September 1905. Includes a 'Mean' row at the bottom.

VERTICAL INTENSITY: 0.34 . . . C.G.S.

Table with 17 columns (1-17) and 31 rows (1-31) of vertical intensity data for October 1905. Includes a 'Mean' row at the bottom.

SEPTEMBER, 1905.

Table with 24 columns (18-24, Mean, Maximum, Minimum, Range) and 31 rows (1-31) of vertical intensity data for September 1905. Includes a 'Mean' row at the bottom.

OCTOBER, 1905.

Table with 24 columns (30-34, Mean, Maximum, Minimum, Range) and 31 rows (1-31) of vertical intensity data for October 1905. Includes a 'Mean' row at the bottom.

VERTICAL INTENSITY: 0.34 . . . C.G.S.

Table with 17 columns (1-17) and 31 rows (1-31). Each row contains 17 numerical values representing vertical intensity measurements. A 'Mean' row is at the bottom.

VERTICAL INTENSITY: 0.34 . . . C.G.S.

Table with 17 columns (1-17) and 31 rows (1-31). Each row contains 17 numerical values representing vertical intensity measurements. A 'Mean' row is at the bottom.

NOVEMBER, 1905.

Table with 24 columns (18-24, Mean, Maximum, Minimum, Range) and 31 rows (1-31). Includes numerical data and 'Remarks' column with 'a. m.' and 'p. m.' sub-columns.

DECEMBER, 1905.

Table with 24 columns (18-24, Mean, Maximum, Minimum, Range) and 31 rows (1-31). Includes numerical data and 'Remarks' column with 'a. m.' and 'p. m.' sub-columns.

MEAN VALUES OF

TOKIO

Hour Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
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DECLINATION :

January	45.41	45.43	45.51	45.59	45.74	45.89	45.94	45.23	44.26	44.29	45.26	46.55	47.06	46.92	46.49	45.71
February	45.70	45.80	45.87	46.04	46.22	46.05	45.76	43.99	42.74	43.22	45.22	46.82	47.67	48.00	47.65	47.02
March	45.82	45.76	45.63	45.79	45.86	45.98	45.00	43.53	42.72	43.42	45.23	47.48	48.44	48.53	47.82	46.93
April	45.18	45.11	45.00	45.02	45.23	45.00	44.91	44.94	44.94	44.94	45.94	47.72	48.77	48.81	48.06	47.00
May	46.51	46.28	46.18	46.12	45.77	44.83	44.09	43.75	44.46	46.05	47.86	48.87	49.60	49.54	48.92	48.06
June	46.02	45.75	45.59	45.47	44.87	43.62	42.99	43.24	44.13	45.68	47.19	48.30	48.77	48.81	48.37	47.63
July	45.27	45.12	44.96	44.91	44.26	42.80	41.82	42.21	42.90	44.63	46.56	47.88	48.39	48.32	48.08	47.00
August	45.49	45.19	45.06	44.85	44.25	42.57	41.68	42.11	43.83	46.35	47.95	49.28	49.65	49.97	47.68	46.45
September	45.60	45.49	45.36	45.28	44.96	43.98	43.25	43.44	44.80	47.43	49.30	49.84	49.41	48.91	46.75	45.82
October	46.10	45.91	45.98	45.94	45.97	46.01	44.95	44.18	44.24	45.49	47.39	48.84	49.27	48.55	47.49	46.39
November	47.02	46.82	46.78	47.01	47.28	47.26	46.96	45.97	45.54	46.05	47.21	48.34	48.96	48.68	48.01	47.61
December	47.55	47.60	47.57	47.62	47.61	47.78	47.84	47.08	46.47	45.84	48.12	49.01	49.19	48.87	48.39	47.66
Year	45.97	45.85	45.79	45.80	45.67	45.15	44.51	43.97	44.06	45.29	46.94	48.25	48.76	48.52	47.80	46.96

HORIZONTAL INTENSITY :

January	973.0	975.2	974.6	975.8	976.1	979.2	980.9	983.7	981.6	974.4	968.8	971.5	972.2	974.1	977.8	980.0
February	962.6	963.5	964.8	964.5	964.4	967.5	971.9	973.6	969.8	959.8	951.0	953.7	957.6	961.5	965.8	968.4
March	961.2	962.9	962.7	961.9	962.8	964.0	967.3	962.2	954.9	948.6	949.4	960.5	967.3	974.4	978.5	974.1
April	952.8	952.5	953.7	954.7	953.3	955.6	954.1	947.9	939.0	936.5	944.0	956.6	966.7	971.1	968.6	963.8
May	958.2	956.1	955.1	955.1	957.5	958.0	953.9	947.0	943.4	944.8	951.2	959.3	968.0	972.7	973.8	972.9
June	930.9	930.3	930.3	929.5	931.9	932.4	925.8	920.4	920.0	924.5	934.2	936.6	942.9	944.9	942.4	938.4
July	938.1	936.3	935.9	935.5	935.4	934.4	926.8	920.4	921.9	926.6	933.4	935.8	943.0	946.2	947.4	944.5
August	942.7	943.9	943.1	943.7	944.6	941.5	933.0	923.2	923.2	930.3	938.6	945.6	952.3	954.0	953.9	949.8
September	955.7	954.4	956.1	955.6	955.5	952.4	943.3	933.1	928.6	933.8	943.0	955.7	965.4	969.8	967.7	962.7
October	947.1	949.2	947.8	948.1	947.3	948.5	945.0	934.5	926.2	925.6	933.2	947.5	958.4	964.0	962.9	957.2
November	924.3	923.6	922.8	924.6	925.4	929.1	939.9	927.6	922.6	918.6	921.1	930.6	932.1	933.6	934.0	930.4
December	969.2	967.3	966.6	967.9	969.2	968.9	971.9	972.3	968.4	962.9	961.5	967.8	970.3	973.1	975.8	975.3
Year	951.3	951.3	951.1	951.4	951.9	952.6	950.3	945.5	941.6	940.5	944.1	951.8	958.0	961.6	962.4	959.7

VERTICAL INTENSITY :

January	400.8	399.9	397.3	395.9	393.3	392.0	389.4	386.4	381.2	374.2	382.6	390.5	397.5	403.9	406.8	
February	382.3	379.8	378.2	375.4	371.6	371.6	369.0	365.0	356.8	344.0	342.2	354.7	364.5	373.0	382.2	387.9
March	428.3	427.1	425.2	424.1	423.4	422.0	421.3	416.3	407.4	397.6	396.0	406.0	412.9	420.1	425.4	427.8
April	408.6	408.9	409.4	408.9	408.8	408.8	406.9	403.8	396.1	389.8	392.7	399.9	403.0	404.5	405.0	406.1
May	367.4	367.1	367.7	369.1	371.4	370.7	365.8	358.5	353.7	350.9	351.9	351.4	351.3	354.8	354.2	356.6
June	359.3	359.0	360.4	360.0	363.8	360.6	355.0	349.5	346.3	345.7	349.4	354.8	354.3	354.8	354.2	356.6
July	370.5	369.1	368.7	368.6	368.3	367.1	363.1	358.0	356.3	355.9	359.2	364.3	366.6	370.3	372.4	373.1
August	358.5	357.9	356.8	356.5	356.2	353.3	347.6	341.3	339.4	341.7	346.6	352.8	355.4	357.5	358.9	357.2
September	320.9	322.3	323.3	323.3	323.0	319.8	310.9	302.0	295.7	299.5	310.8	320.3	335.5	333.0	327.7	317.6
October	363.7	365.5	364.2	364.2	363.3	363.5	362.0	356.7	351.7	349.8	351.7	359.1	364.3	366.5	365.3	361.7
November	385.3	384.8	383.5	383.7	382.5	381.8	380.2	376.7	371.0	364.8	365.4	374.7	377.7	383.9	386.5	386.9
December	415.6	413.9	412.4	412.1	411.2	409.2	408.8	406.1	400.4	395.6	396.7	403.3	409.2	413.6	417.3	417.8
Year	380.1	379.6	378.9	378.5	378.1	376.7	373.3	368.4	362.9	359.2	361.3	370.3	374.6	378.1	380.2	380.2

MAGNETIC ELEMENTS

YEAR 1905.

17	18	19	20	21	22	23	24	Mean	Mean			Absolute		
									Max.	Min.	Range	Max.	Day	Min.

4° + . . . W

45.29	45.35	45.41	45.56	45.51	45.34	45.33	45.96	45.00	47.57	43.62	3.95	50.3	6	41.9	17	8.4
46.25	46.05	46.19	45.77	45.90	45.70	45.78	45.00	45.87	48.54	42.34	6.20	52.2	3	40.7	11	11.5
46.07	46.09	46.37	46.05	45.85	45.83	45.89	45.79	45.91	48.96	42.19	6.77	50.7	2, 3, 7	39.8	2	10.9
46.00	45.54	45.86	45.80	45.67	45.74	45.65	45.63	45.68	49.24	42.11	7.13	52.0	3	40.2	26	11.8
47.09	46.69	46.82	46.84	46.82	46.93	46.81	46.90	46.73	49.92	43.29	6.63	51.8	21	39.4	19	12.4
46.81	46.03	45.85	46.03	46.19	46.28	46.17	46.22	46.08	49.15	42.53	6.62	51.1	23	39.8	23	11.3
46.01	45.37	45.22	45.41	45.38	45.46	45.57	45.43	45.39	49.00	41.26	7.74	51.1	6	39.1	19	12.0
45.45	45.25	45.29	45.24	45.31	45.65	45.59	45.67	45.62	49.97	41.29	8.67	52.0	30	40.1	11.9	11.9
45.47	46.05	45.93	46.03	46.07	46.02	45.96	45.65	46.08	50.11	42.75	7.36	53.4	2	41.2	15	12.2
46.41	46.47	46.55	46.58	46.56	46.47	46.35	46.25	46.44	49.51	43.96	5.85	50.7	29	41.9	30	8.8
47.89	47.84	47.75	47.75	47.57	47.35	47.26	47.22	47.34	49.44	44.82	4.63	52.1	15, 16	42.1	3	9.7
47.63	47.69	48.18	47.76	47.70	47.65	47.60	47.61	47.78	49.50	45.20	3.31	50.7	13	45.9	2	5.7
46.36	46.20	46.28	46.24	46.21	46.20	46.16	46.04	46.21	49.24	43.00	6.24	51.51		40.96		10.55

0.29 . . . C. G. S.

978.9	975.5	973.5	970.0	969.7	971.8	973.1	972.4	975.2	992.6	956.7	35.9	1023	21	936	6	87
967.4	964.1	960.8	959.0	958.3	958.2	960.1	960.7	962.9	982.5	939.0	49.5	1009	3	859	3	150
971.2	966.5	964.8	963.7	963.8	964.4	965.1	962.9	963.9	985.9	937.4	49.5	1026	29	863	2	163
960.6	957.5	956.0	953.0	955.5	954.1	955.3	955.6	954.8	980.1	929.7	50.4	1058	1	913	2, 20	145
968.1	962.9	961.9	960.5	960.2	959.4	958.5	959.1	959.0	979.3	938.0	41.2	986	17	909	1	87
934.2	933.8	933.2	933.4	933.6	934.6	934.0	934.7	932.7	959.9	913.1	37.7	1008	4	859	23	149
939.3	937.3	938.1	938.5	941.1	941.0	940.3	938.8	936.5	957.6	913.0	44.6	1043	16	868	6	135
944.1	941.4	942.9	943.9	944.4	944.3	945.8	945.8	942.3	963.4	917.6	45.8	996	2	819	2	177
956.5	951.3	950.1	950.2	952.4	951.5	955.5	957.1	952.5	976.8	922.2	54.7	1011	18	867	1	144
952.2	949.9	947.9	945.2	942.8	943.7	945.2	945.4	946.4	969.7	919.7	46.9	991	8	877	6	114
925.0	922.3	921.5	918.9	920.5	921.0	921.0	922.4	925.2	941.3	904.7	36.6	980	30	822	13	158
970.9	968.7	966.8	967.5	968.0	967.9	967.9	967.7	968.9	982.3	953.2	29.9	1024	12	911	13	113
955.7	952.6	951.5	950.3	950.9	951.2	951.8	951.5	951.7	971.7	928.7	43.0	1010.4		875.2		135.2

0.34 . . . C. G. S.

406.4	406.1	405.4	404.2	404.1	404.2	403.0	409.7	395.8	411.9	371.5	40.3	442	23	320	26	116
380.8	380.2	380.1	380.4	388.4	386.6	385.9	383.6	375.1	395.3	339.9	55.3					

VALUES OF THE COEFFICIENTS IN THE PERIODICAL EXPRESSION

$$f(t) = p_0 + p_1 \cos t + q_1 \sin t + p_2 \cos 2t + q_2 \sin 2t + p_3 \cos 3t + q_3 \sin 3t + p_4 \cos 4t + q_4 \sin 4t,$$

in which t is the Central Standard Mean Time (mean time of the meridian 135°E) converted into arc, and $f(t)$ the mean value of the magnetic element at the time t for each month and for the year.

The values of the coefficients for declination are given in degrees and minutes and those for horizontal and vertical intensities in 10⁻⁴C. G.S. unit.

1905,

Month	p_0	p_1	q_1	p_2	q_2	p_3	q_3	p_4	q_4
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

DECLINATION.

January	45.60	-0.24	-0.18	+0.10	+0.48	-0.22	-0.49	+0.17	+0.32
February	45.87	-0.12	-0.70	-0.03	+1.12	-0.41	-0.80	+0.28	+0.25
March	45.91	-0.11	-1.00	+0.30	+1.15	-0.50	-0.83	+0.39	+0.33
April	45.68	-0.57	-1.27	+0.68	+1.09	-0.54	-0.81	+0.31	+0.14
May	46.73	-0.64	-1.36	+1.00	+0.92	-0.59	-0.37	+0.09	-0.09
June	46.08	-0.65	-1.42	+1.13	-0.95	-0.52	-0.21	-0.12	-0.19
July	45.39	-0.68	-1.56	+1.21	+1.16	-0.60	-0.30	+0.01	-0.18
August	45.62	-1.10	-1.37	+1.76	+0.93	-0.89	-0.10	+0.09	-2.03
September	46.08	-1.09	-0.86	+1.49	+0.26	-1.06	-0.07	+0.30	-0.22
October	46.44	-0.53	-0.84	+0.73	+0.63	-0.73	-0.49	+0.42	+0.11
November	47.34	-0.15	-0.70	+0.10	+0.44	-0.36	-0.44	+0.36	+0.16
December	47.78	-0.27	-0.22	+0.22	+0.33	-0.34	-0.35	+0.27	+0.24
Year	46.21	-0.51	-0.96	+0.72	+0.79	-0.56	-0.44	+0.22	+0.06

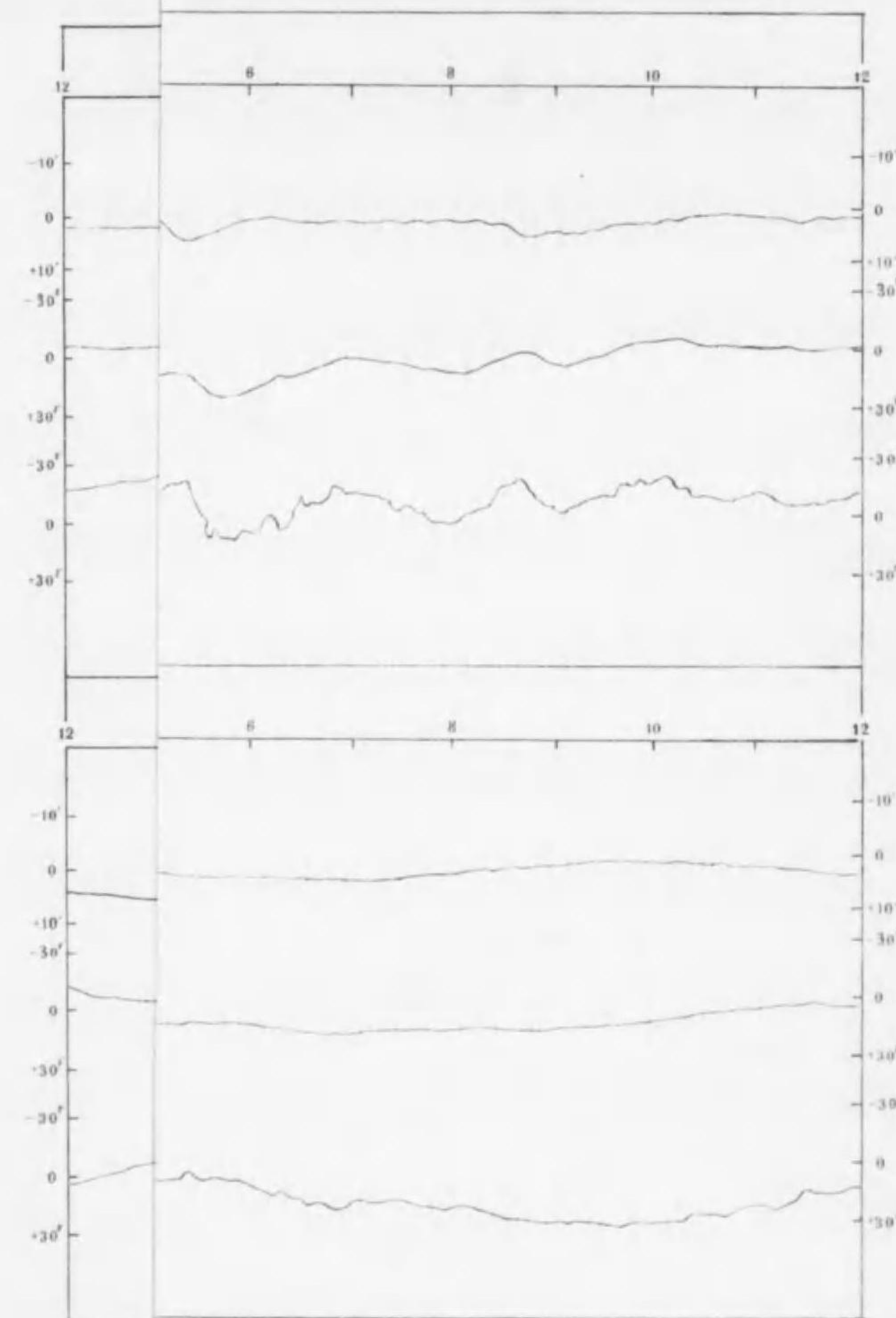
HORIZONTAL INTENSITY.

January	29975.2	-1.48	+1.96	-3.09	+0.63	+3.36	+0.04	-0.78	+0.27
February	962.9	-0.04	+2.25	-4.73	+1.11	+4.47	-0.01	-1.60	+1.14
March	963.9	+0.24	-4.66	-2.70	+4.95	+2.62	-4.46	-0.58	+1.97
April	954.8	-0.70	-6.63	-0.76	+6.84	+0.10	-5.59	+0.88	+2.22
May	959.0	-0.71	-7.87	-0.66	+6.46	+0.38	-4.24	+0.88	+0.78
June	932.7	-1.35	-5.28	+1.92	+4.30	-1.86	-3.58	+1.14	+0.04
July	936.5	+1.73	-6.50	+1.81	+5.01	-1.30	-3.59	+0.22	-0.62
August	942.3	+1.94	-5.93	+2.27	+7.01	-2.57	-4.34	+1.26	-0.38
September	952.5	+1.99	-6.35	+2.24	+10.40	-1.61	-6.03	+1.43	+0.35
October	946.4	-0.23	-5.91	-1.18	+10.03	-0.24	-5.41	+1.33	+2.80
November	925.2	-3.45	+0.35	-0.37	+3.54	+1.37	-3.17	+0.50	+1.83
December	968.9	-0.86	-1.03	-1.38	+1.92	+2.25	-2.08	-0.75	+1.07
Year	951.7	-0.24	-3.76	-0.55	+5.18	+0.58	-3.52	+0.33	+0.96

VERTICAL INTENSITY.

January	34895.8	+8.29	-8.87	-3.82	+4.35	+2.09	-2.23	-0.67	+1.15
February	375.1	+13.09	-11.44	-6.63	+4.01	+3.30	-2.80	-0.18	+2.07
March	421.6	+10.60	-5.74	-4.72	+3.49	+2.45	-3.56	-0.67	+1.93
April	405.3	+5.67	-1.10	-2.18	+2.16	+0.28	-2.86	+0.20	+1.45
May	362.0	+3.60	+2.42	-1.53	+4.60	-0.66	-3.30	+0.80	-0.92
June	356.4	+4.83	-0.67	-1.20	+2.54	-1.26	-2.09	+1.63	-0.47
July	367.8	+4.32	-4.85	-0.95	+3.00	-0.40	-2.09	-0.45	+0.12
August	354.6	+5.45	-4.92	+0.49	+3.68	-1.74	-2.61	+0.82	+0.17
September	317.9	+2.11	-2.43	+4.86	+8.49	-4.72	-7.17	+1.88	+2.29
October	361.4	-3.32	-1.40	-0.39	+3.48	-0.49	-3.10	+0.32	+1.94
November	382.3	+6.70	-5.06	-2.63	+2.65	+0.96	-2.94	-0.12	+1.39
December	411.6	+5.82	-5.56	-2.44	+3.00	+1.12	-2.52	-0.48	+1.39
Year	376.0	+6.14	-4.13	-1.76	+3.79	+0.07	-3.11	+0.26	+1.19

PLATE I.



into arc, and
year.
for horizontal

P_1 Q_1

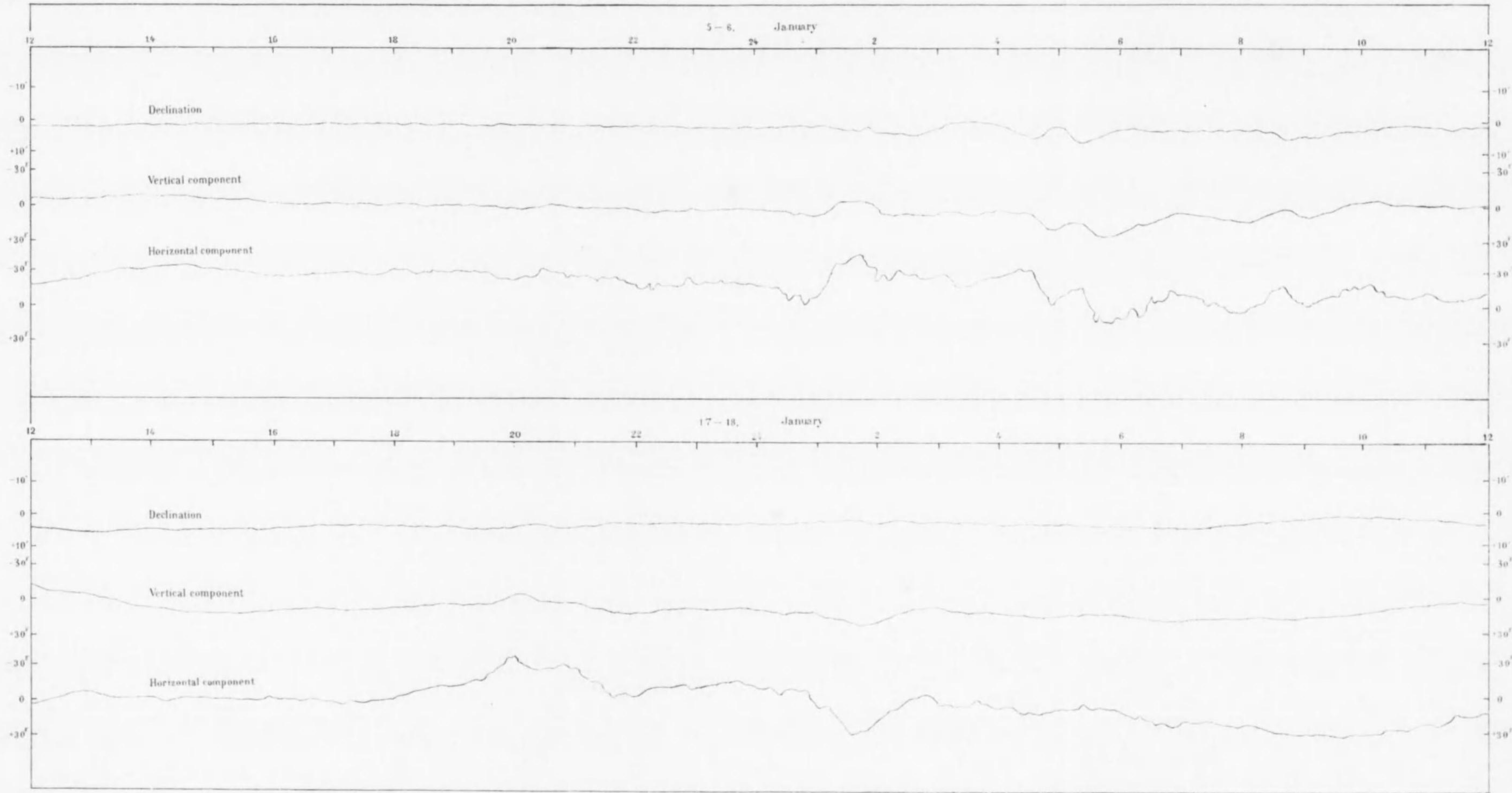
+0.17	+0.32
+0.28	+0.25
+0.39	+0.33
+0.31	+0.14
-0.09	-0.09
-0.12	-0.19
-0.01	-0.18
-0.09	-2.03
-0.30	-0.22
+0.42	+0.11
-0.36	+0.16
+0.27	+0.24
+0.22	+0.06

-0.78	+0.27
-1.60	+1.14
-0.58	+1.97
+0.88	+2.22
+0.88	+0.78
+1.14	+0.04
+0.22	-0.62
+1.26	-0.38
+1.43	+0.35
-1.33	+2.80
-0.50	+1.83
-0.75	+1.07
-0.33	+0.96

-0.67	+1.15
-0.18	+2.07
-0.67	+1.93
+0.20	+1.45
+0.80	+0.92
+1.63	-0.47
-0.45	+0.12
+0.82	+0.17
+1.88	+2.29
+0.32	+1.94
-0.12	+1.39
-0.48	+1.39
+0.26	+1.19

PRINCIPAL MAGNETIC DISTURBANCES
RECORDED AT THE CENTRAL METEOROLOGICAL OBSERVATORY, TOKIO, 1905.

PLATE I.

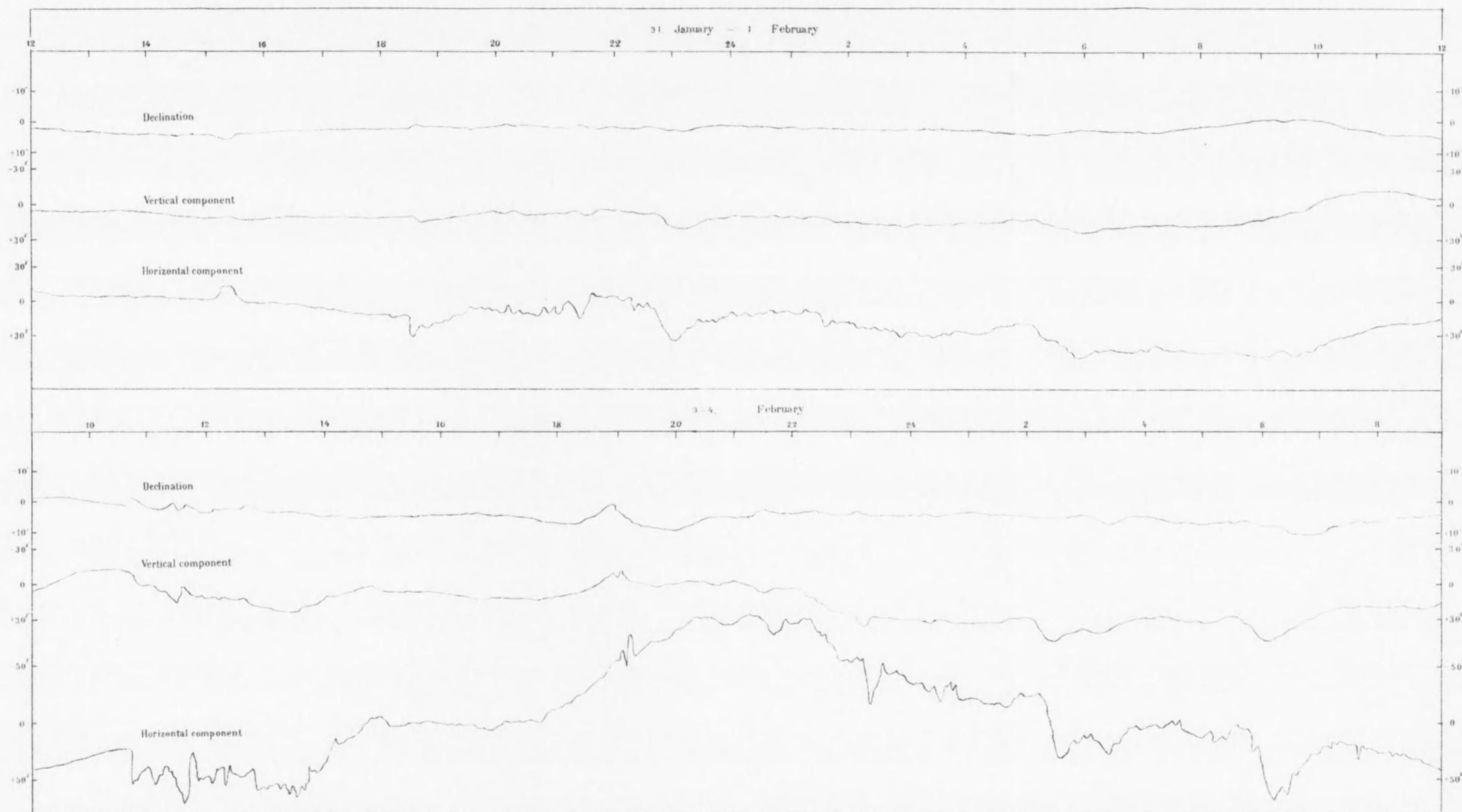


$\gamma = 10^{-5}$ C.G.S.

PRINCIPAL MAGNETIC DISTURBANCES

RECORDED AT THE CENTRAL METEOROLOGICAL OBSERVATORY, TOKIO, 1905.

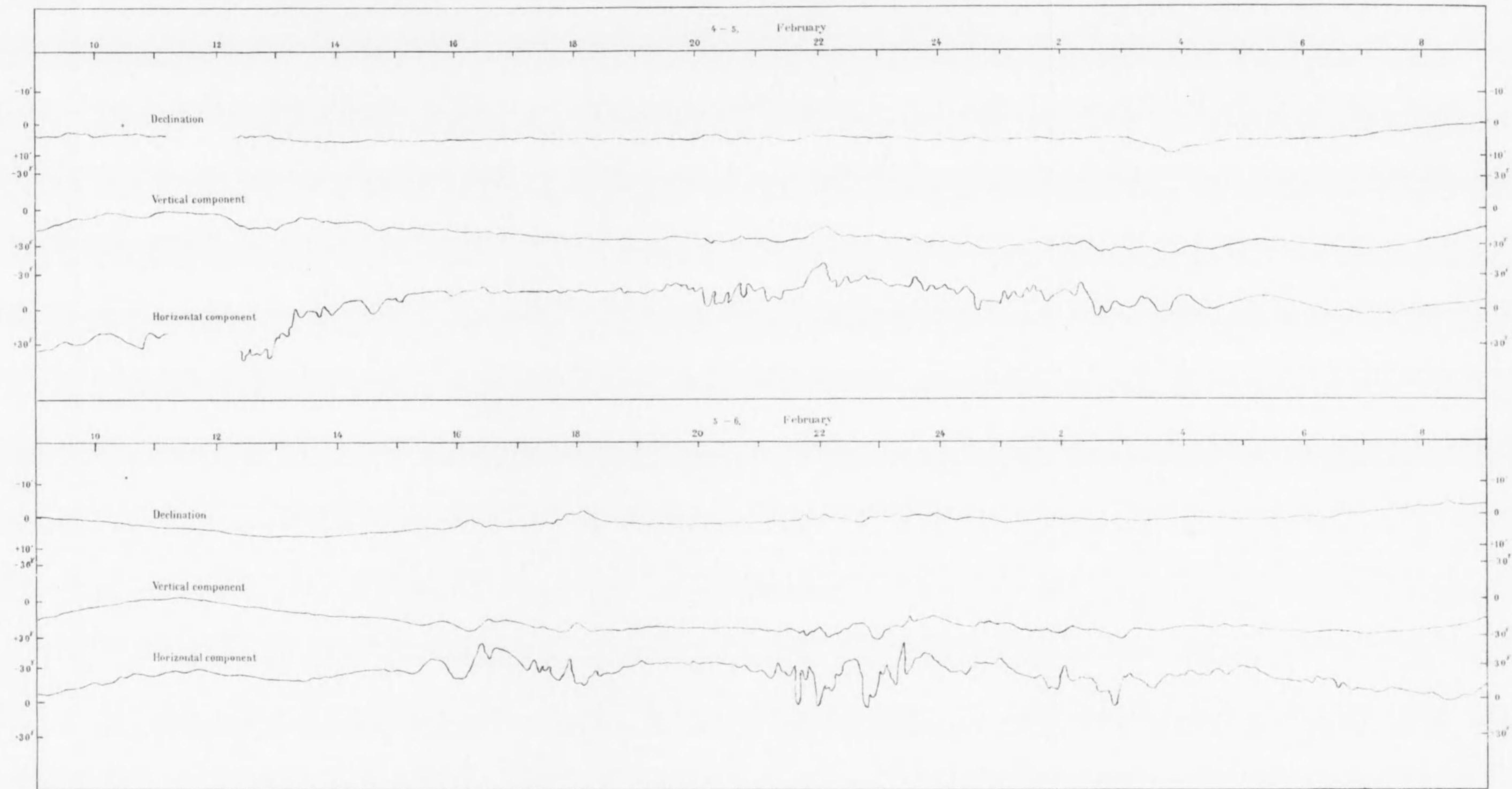
PLATE II.



$\delta = 10^{-3}$ C.G.S.

PRINCIPAL MAGNETIC DISTURBANCES
RECORDED AT THE CENTRAL METEOROLOGICAL OBSERVATORY, TOKIO, 1905.

PLATE III.

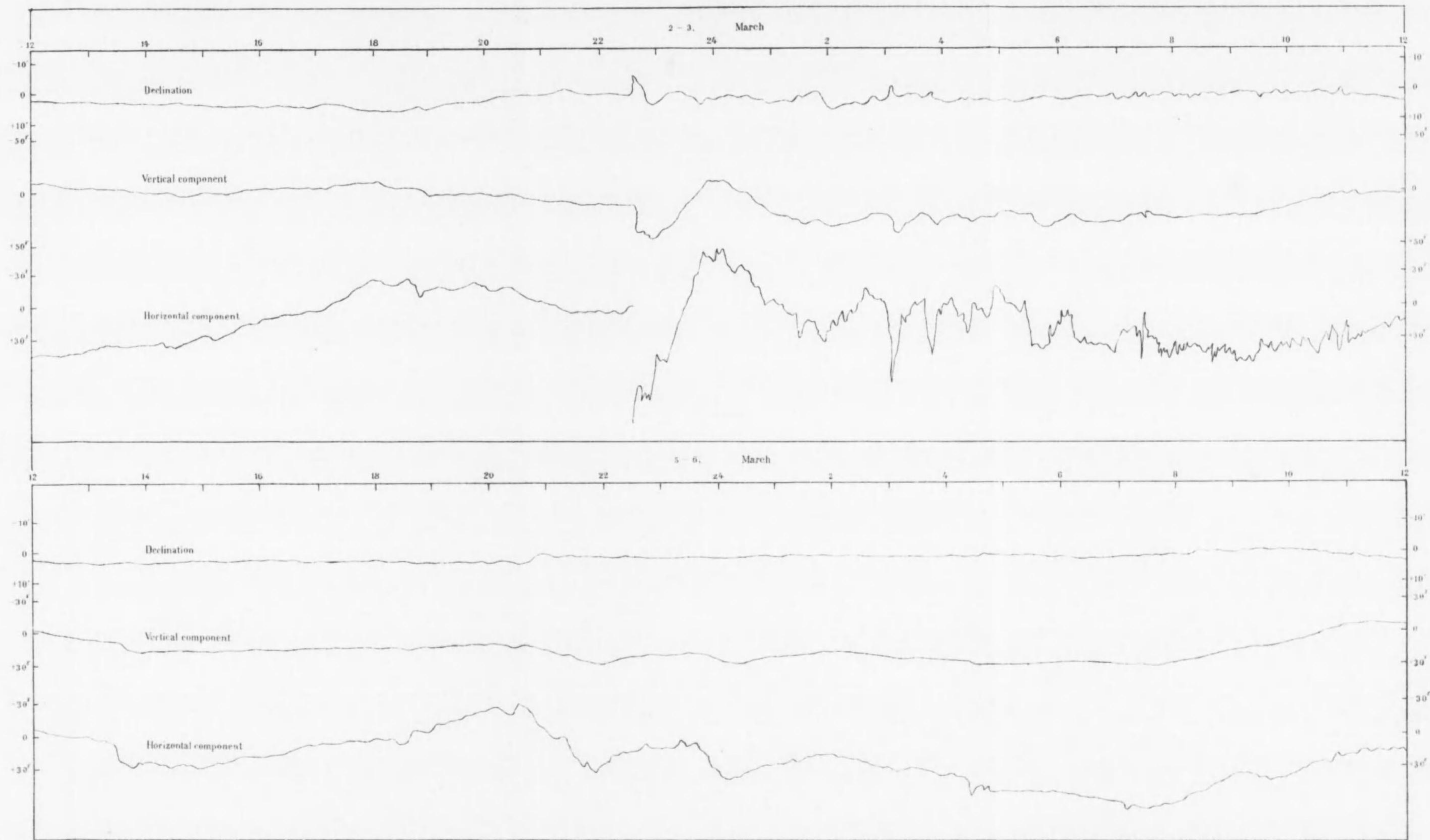


$\gamma = 10^{-5}$ C.G.S.

PRINCIPAL MAGNETIC DISTURBANCES

RECORDED AT THE CENTRAL METEOROLOGICAL OBSERVATORY, TOKIO, 1905.

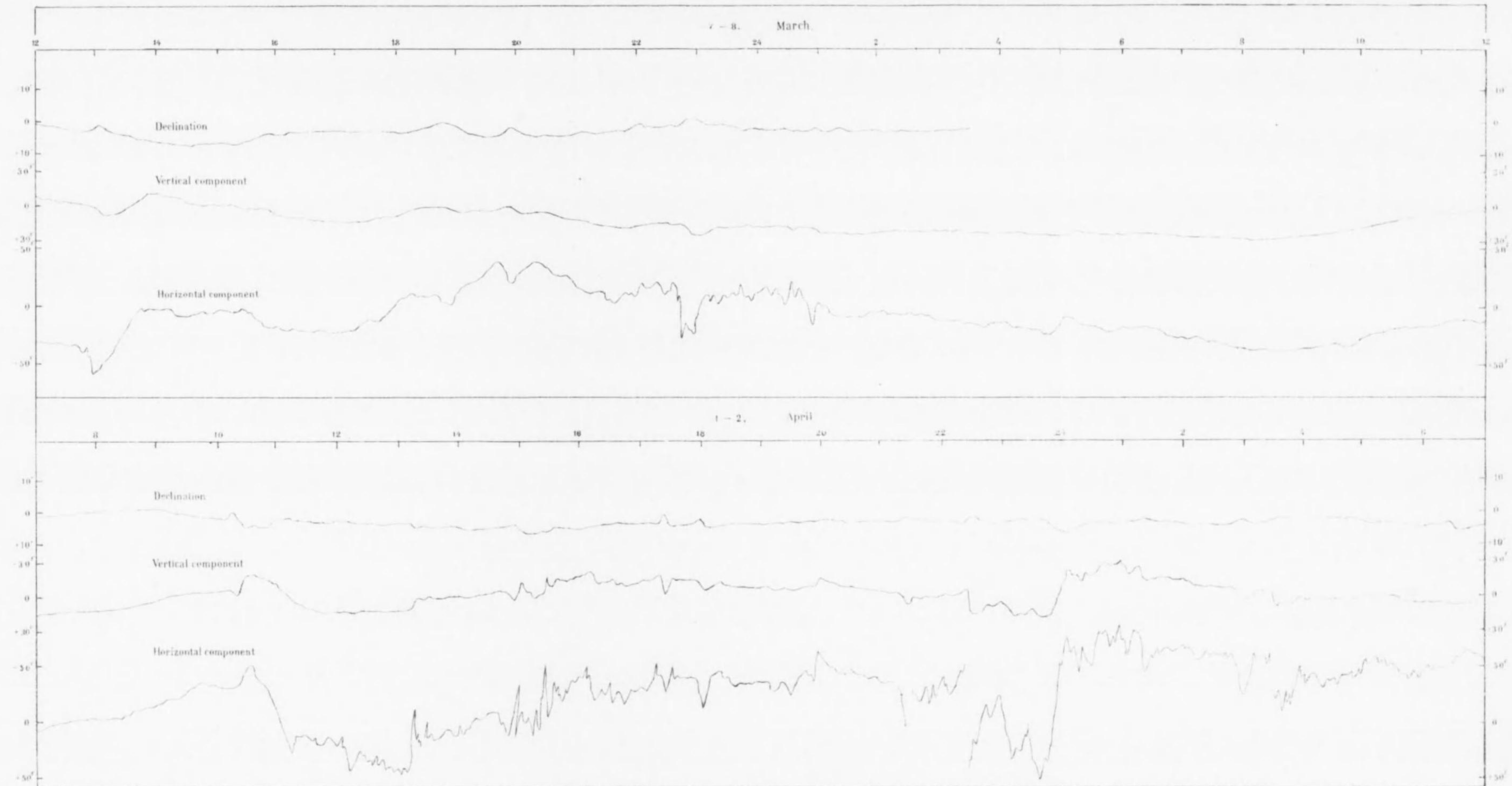
PLATE IV.



PRINCIPAL MAGNETIC DISTURBANCES

RECORDED AT THE CENTRAL METEOROLOGICAL OBSERVATORY, TOKIO, 1905.

PLATE V.

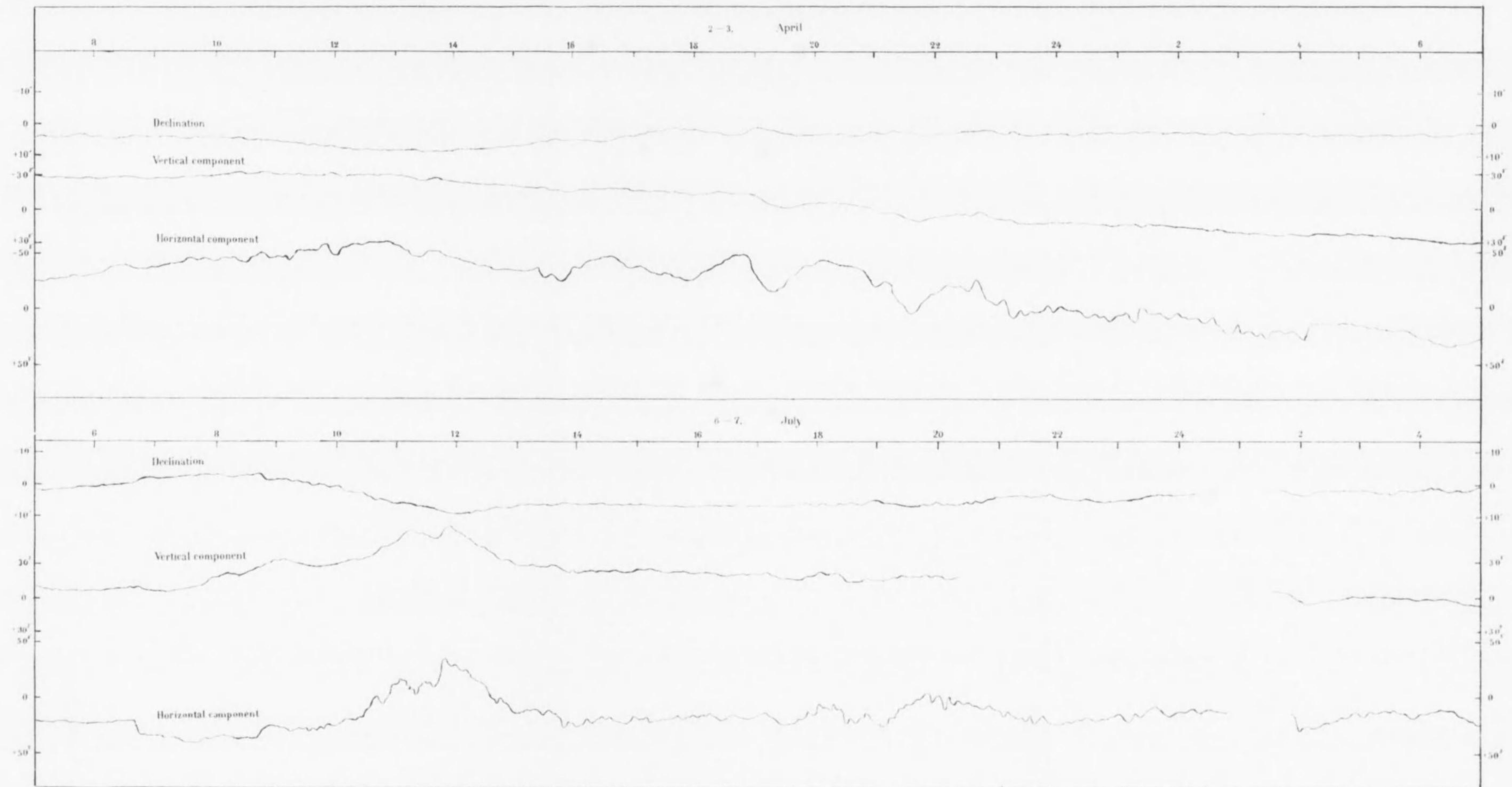


$\lambda = 10^{-3}$ C.G.S.

PRINCIPAL MAGNETIC DISTURBANCES

RECORDED AT THE CENTRAL METEOROLOGICAL OBSERVATORY, TOKIO, 1905.

PLATE VI.

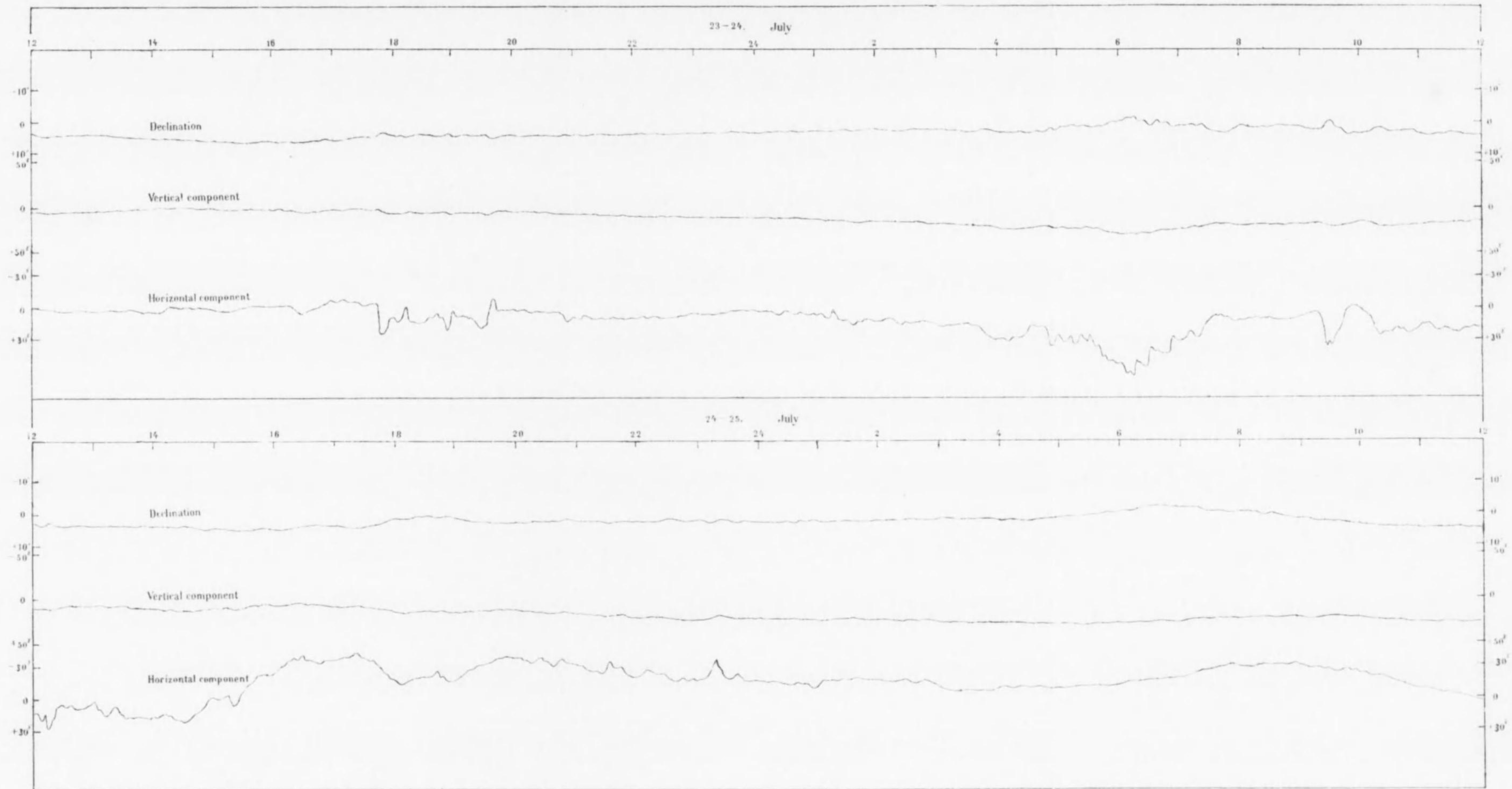


$\times 10^{-5}$ C.G.S.

PRINCIPAL MAGNETIC DISTURBANCES

RECORDED AT THE CENTRAL METEOROLOGICAL OBSERVATORY, TOKIO, 1905.

PLATE VII.

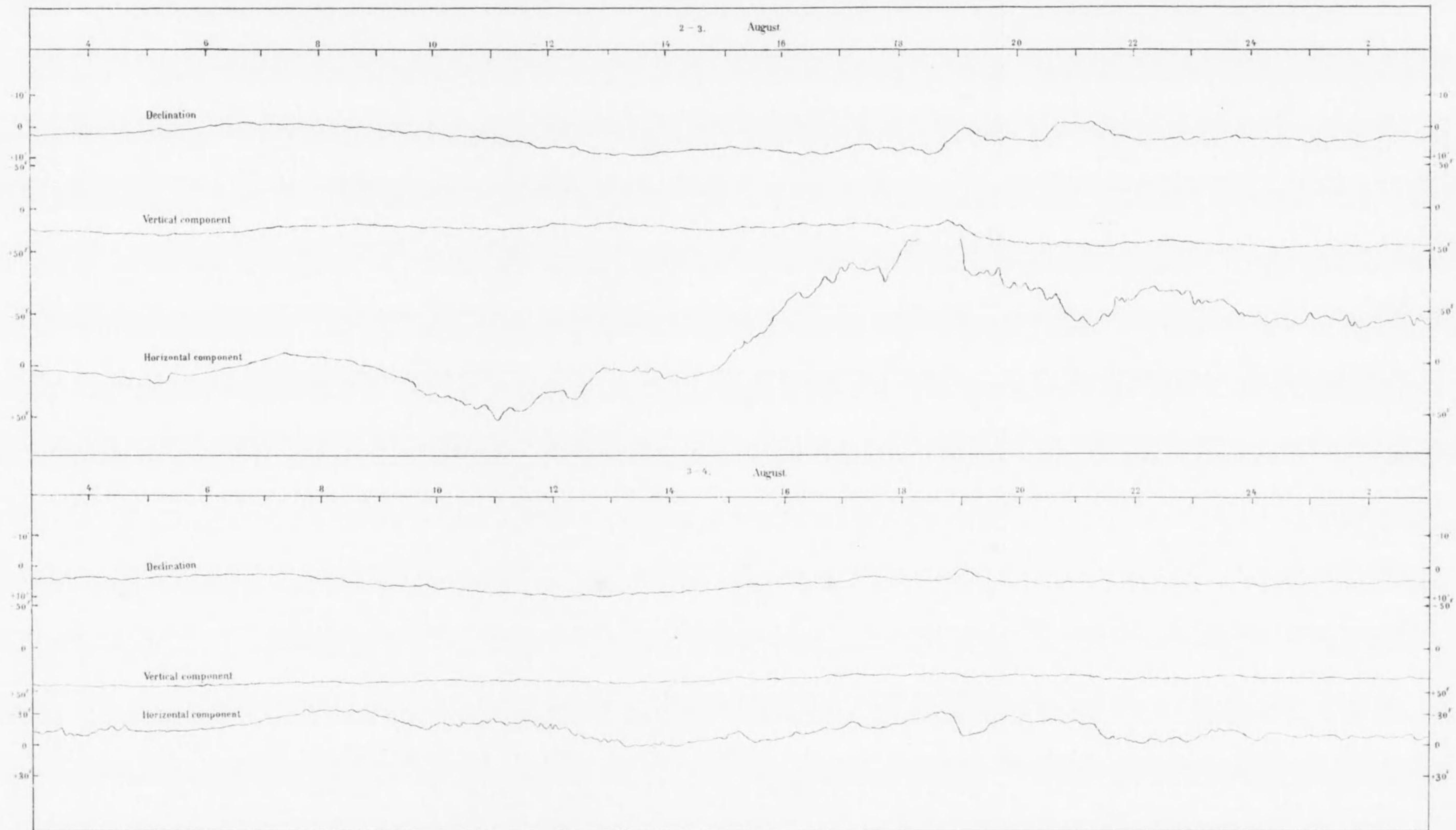


$1 = 10^{-5}$ C.G.S.

PRINCIPAL MAGNETIC DISTURBANCES

RECORDED AT THE CENTRAL METEOROLOGICAL OBSERVATORY, TOKIO, 1905.

PLATE VIII.

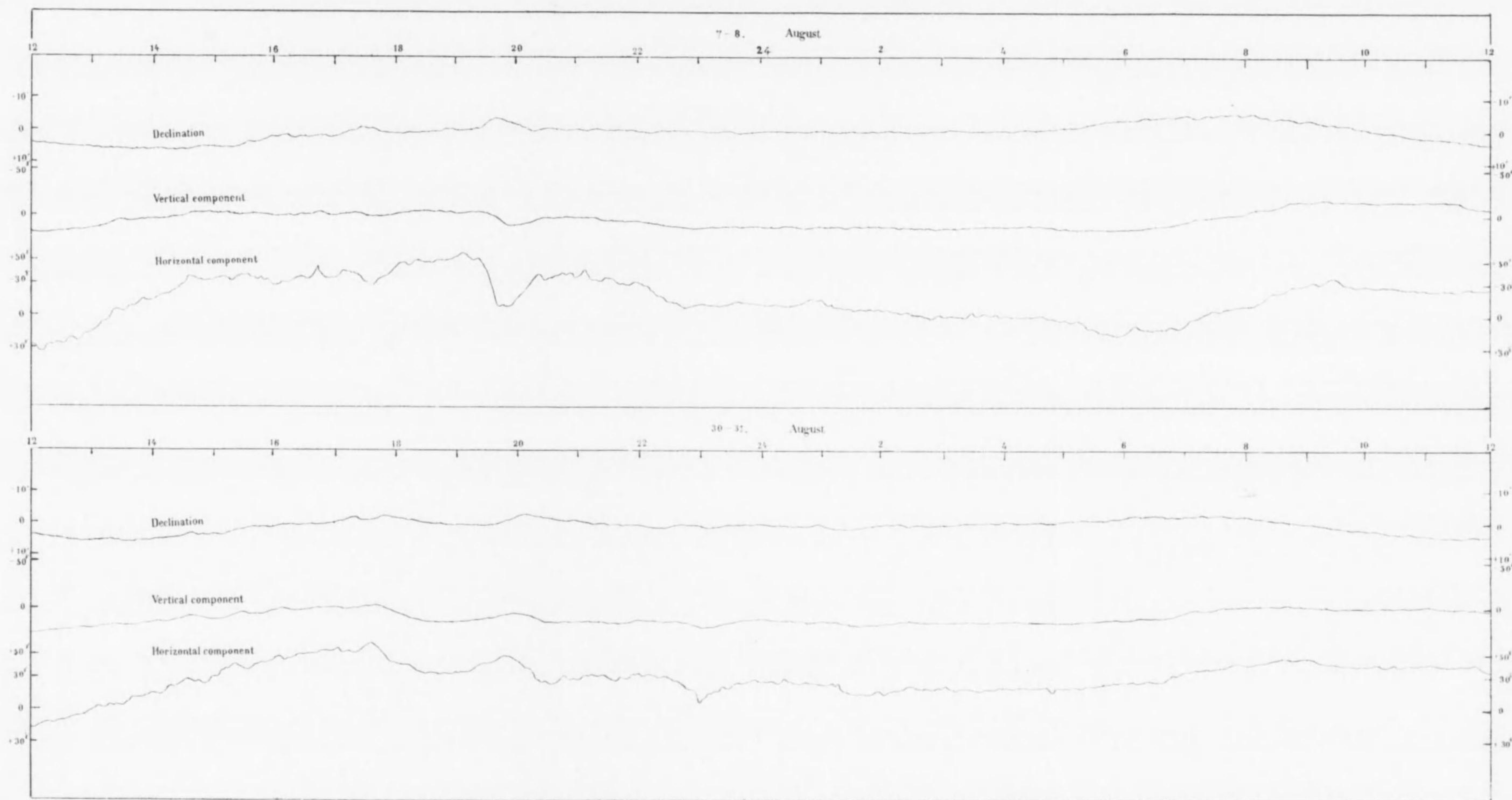


$\gamma = 10^{-5}$ C.G.S.

PRINCIPAL MAGNETIC DISTURBANCES

RECORDED AT THE CENTRAL METEOROLOGICAL OBSERVATORY, TOKIO, 1905.

PLATE IX.

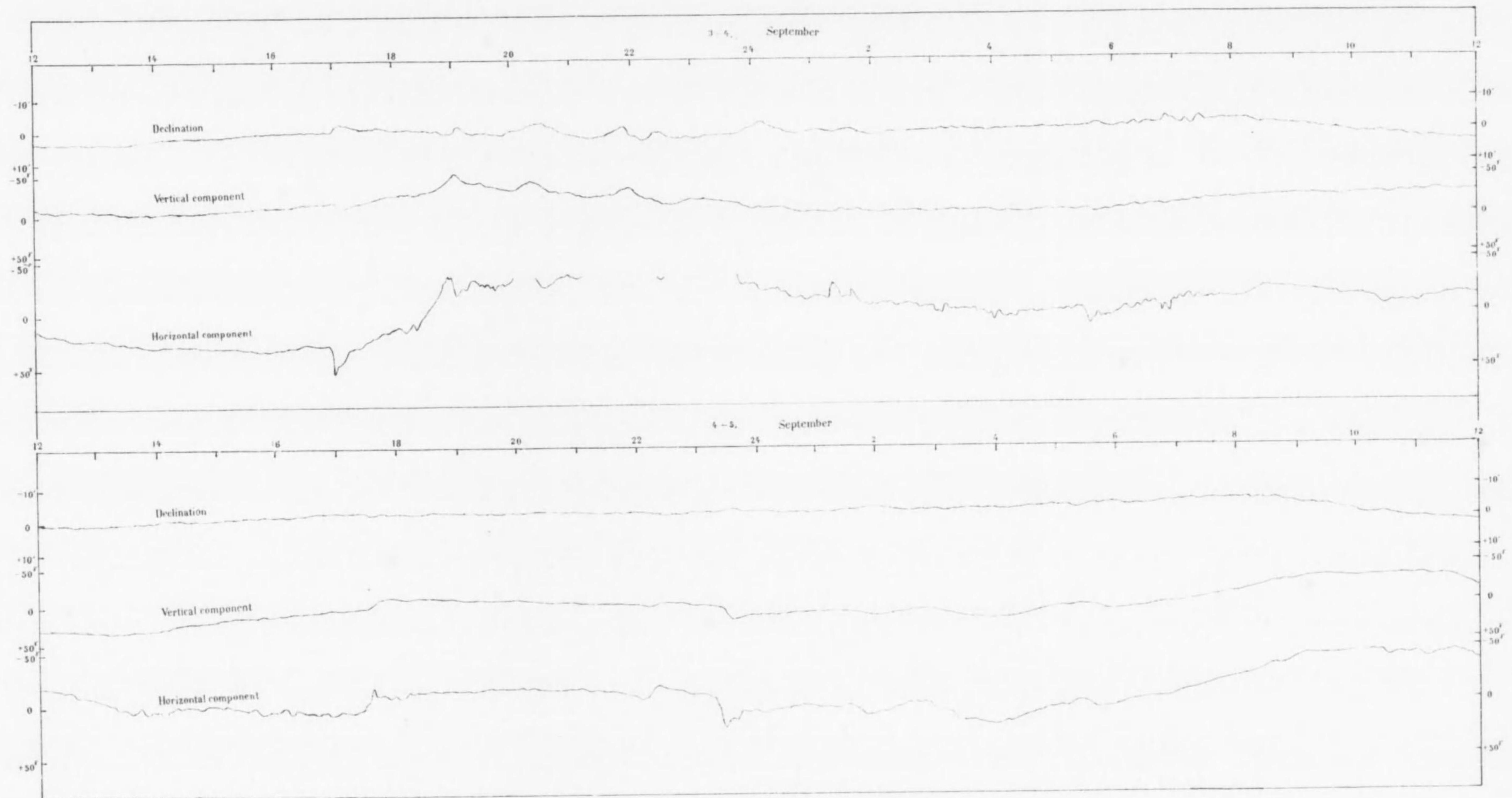


$\gamma = 10^{-5}$ C.G.S.

PRINCIPAL MAGNETIC DISTURBANCES

RECORDED AT THE CENTRAL METEOROLOGICAL OBSERVATORY, TOKIO, 1905.

PLATE X.

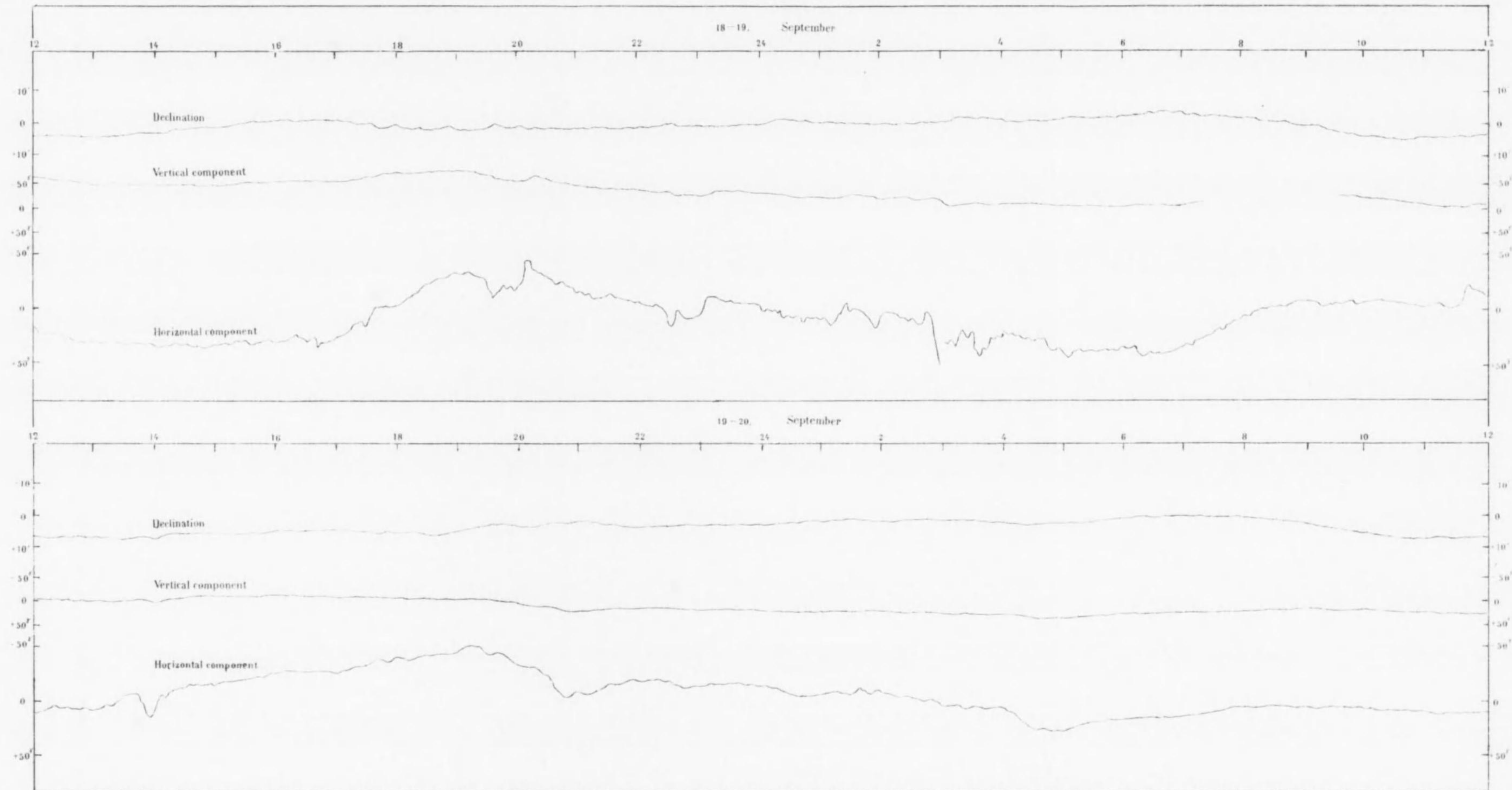


$\gamma = 10^5$ C.G.S.

PRINCIPAL MAGNETIC DISTURBANCES

RECORDED AT THE CENTRAL METEOROLOGICAL OBSERVATORY, TOKIO, 1905.

PLATE XI.

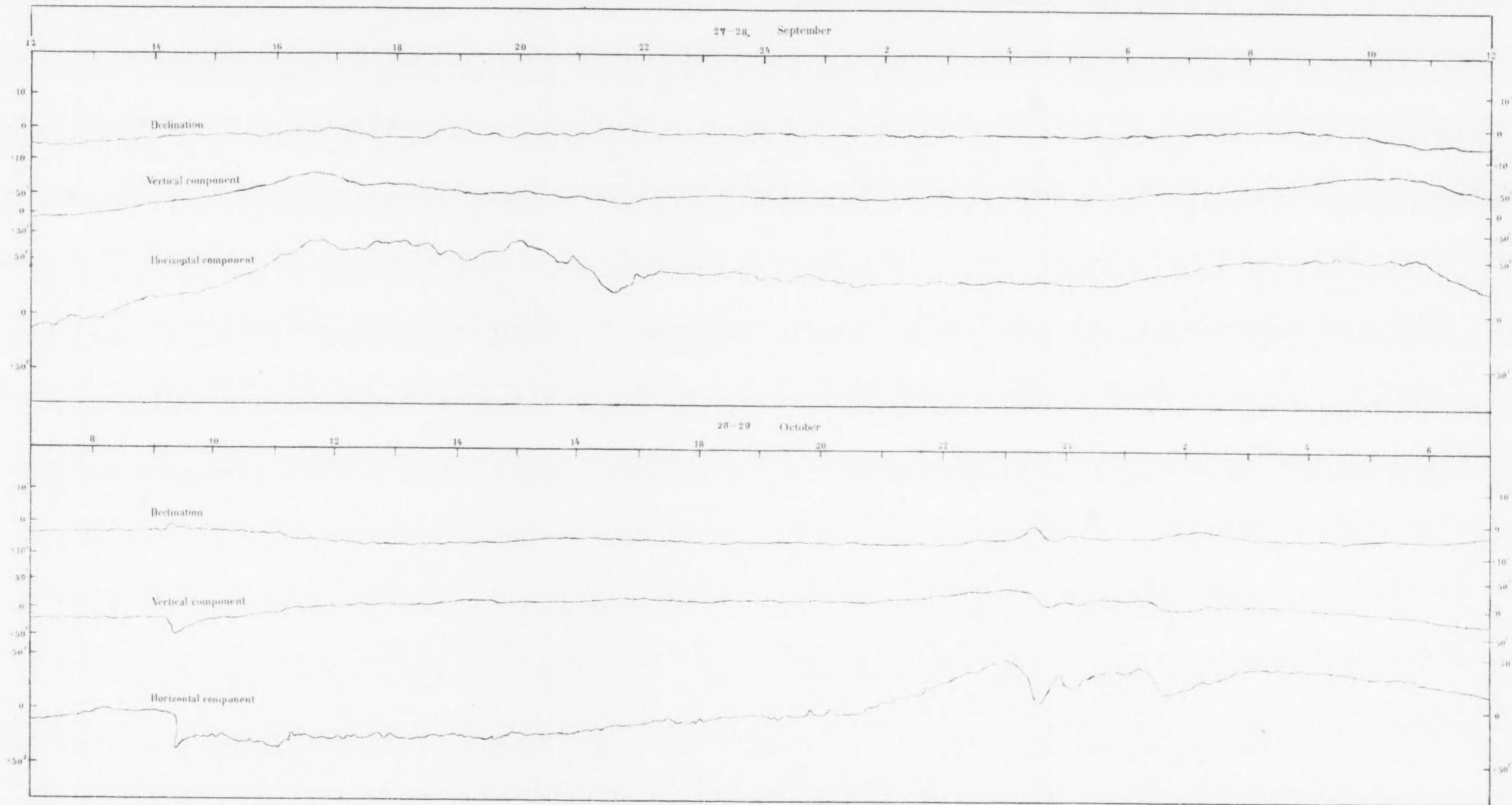


$i = 10^3$ C.G.S.

PRINCIPAL MAGNETIC DISTURBANCES

RECORDED AT THE CENTRAL METEOROLOGICAL OBSERVATORY, TOKIO, 1905.

PLATE XII.

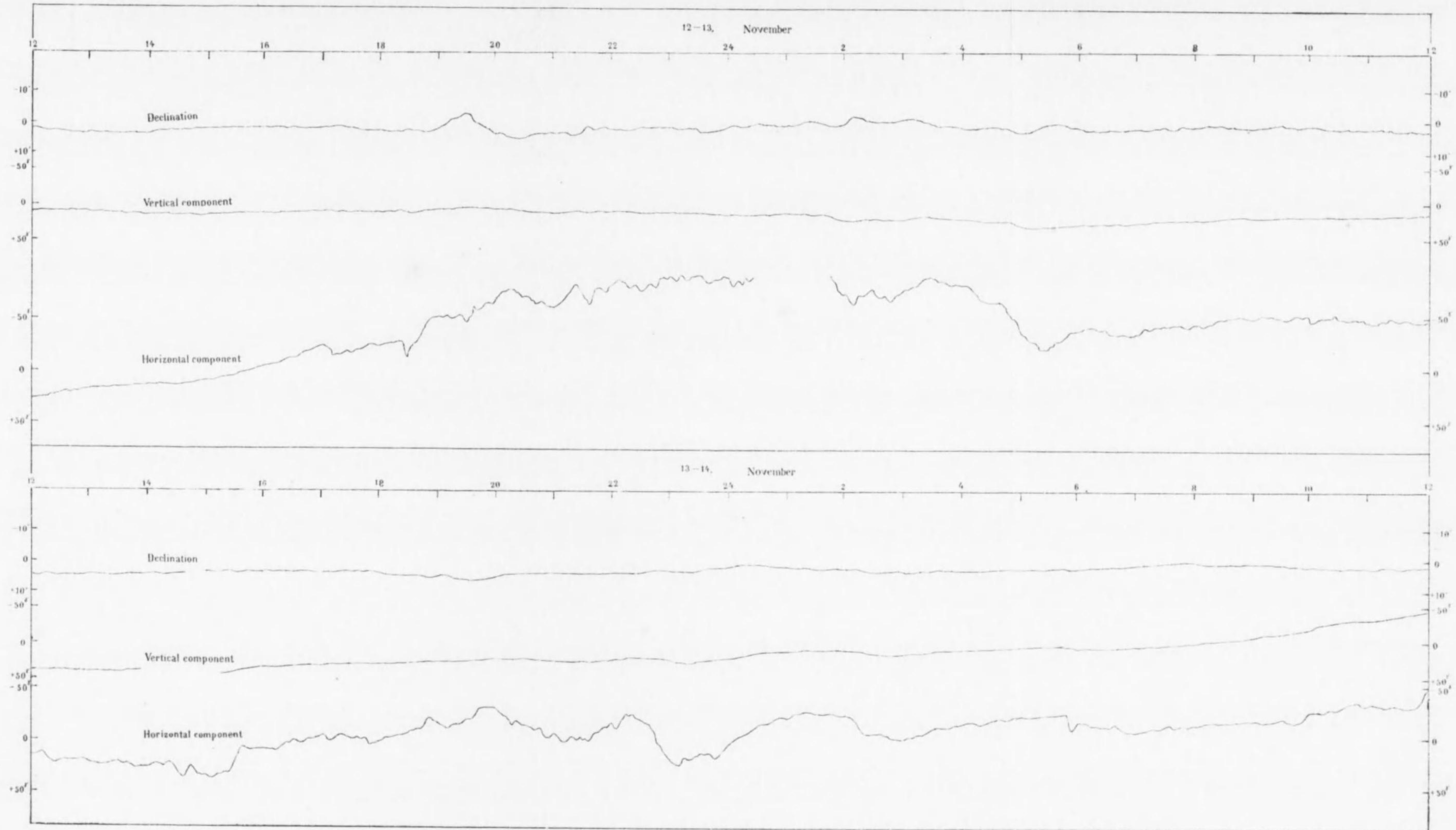


$\gamma = 10^2$ C.G.S.

PRINCIPAL MAGNETIC DISTURBANCES

RECORDED AT THE CENTRAL METEOROLOGICAL OBSERVATORY, TOKIO, 1905.

PLATE XIII.

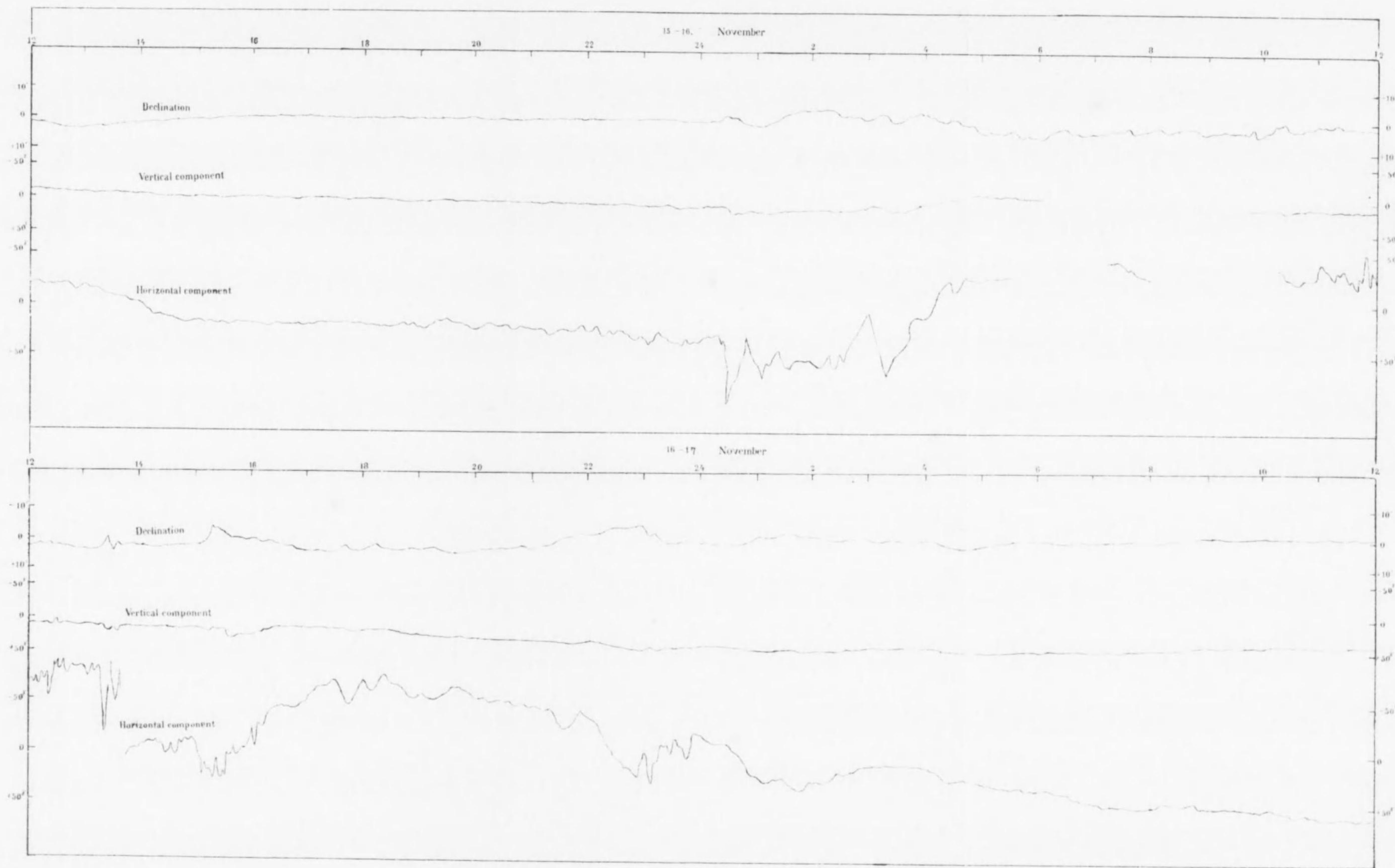


$\gamma = 10^{-5}$ C.G.S.

PRINCIPAL MAGNETIC DISTURBANCES

RECORDED AT THE CENTRAL METEOROLOGICAL OBSERVATORY, TOKIO, 1905.

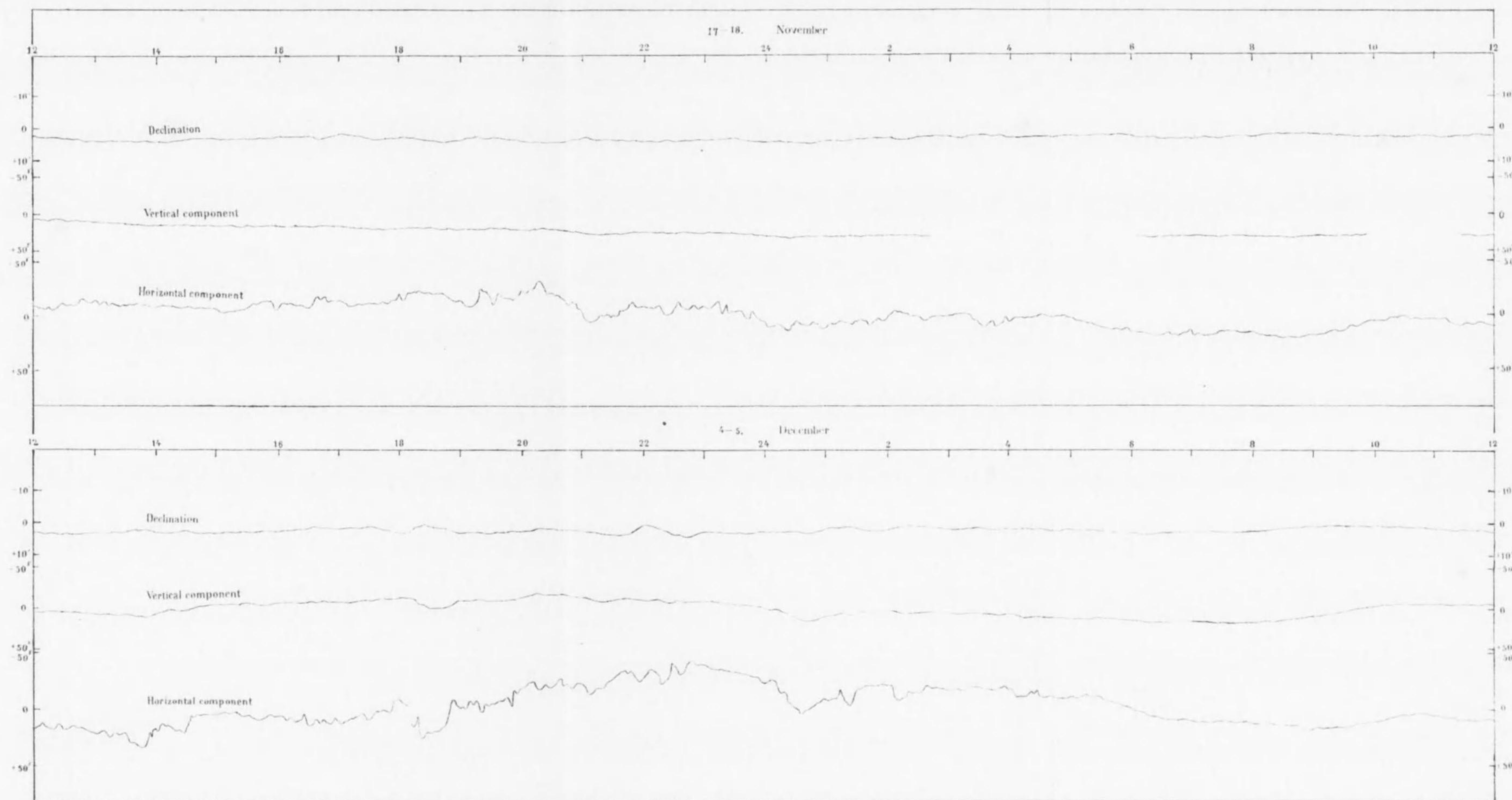
PLATE XIV.



$\gamma = 10^{-3}$ C.G.S.

PRINCIPAL MAGNETIC DISTURBANCES
RECORDED AT THE CENTRAL METEOROLOGICAL OBSERVATORY, TOKIO, 1905

PLATE XV.

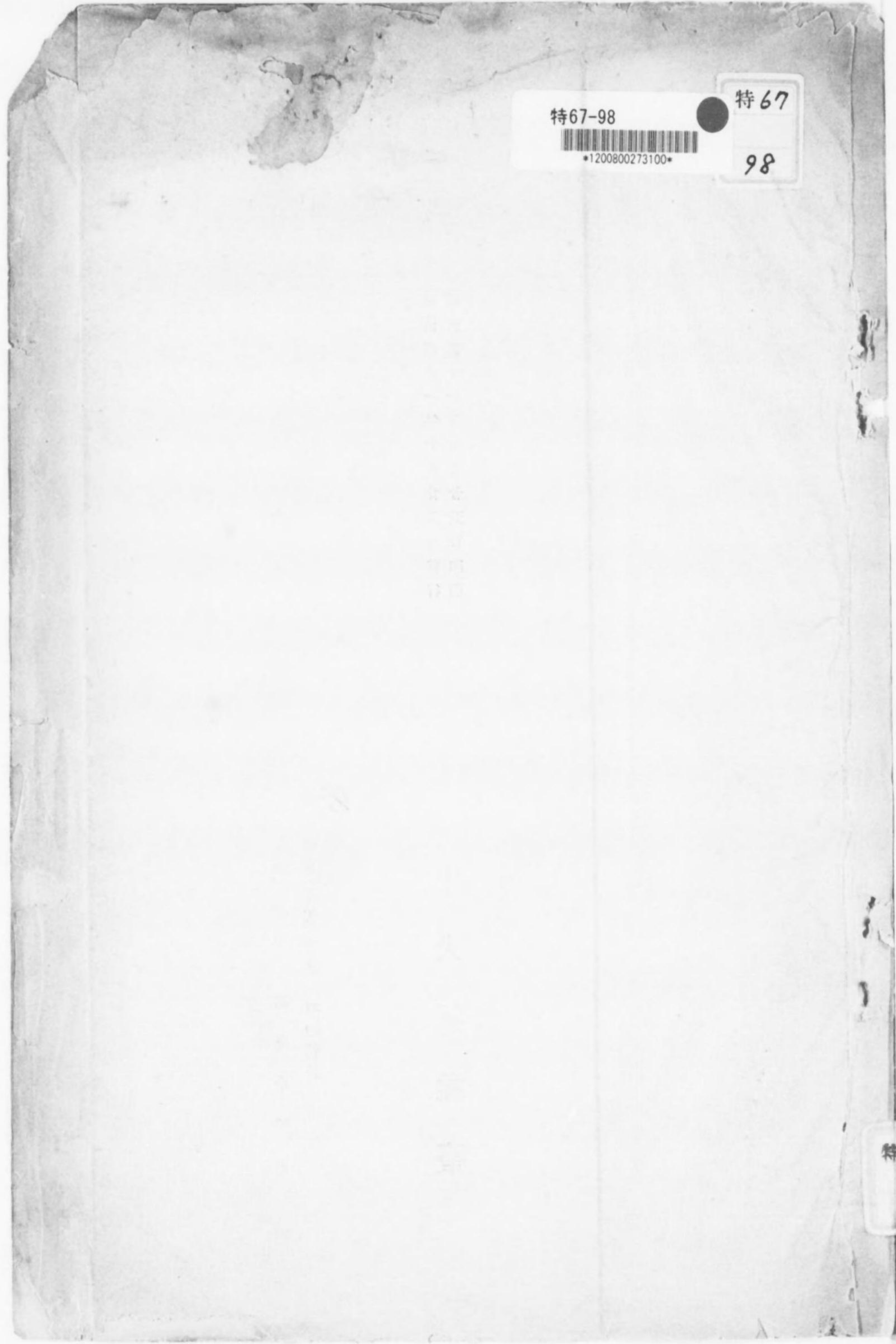


$1 = 10^{-5}$ C.G.S.

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