On the Changes of the Earth-Current and the Earth's Magnetic Field Accompanying the Fukui Earthquake.

ON THE CHANGES OF THE EARTH-CURRENT AND THE EARTH'S MAGNETIC FIELD ACCOMPANYING THE FUKUI EARTHQUAKE

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On June 28, 1948, there occurred a great earthquake in the region of Fukui. The epicentre of the earthquake was situated at the position of 136°15′ E, 36°07′ N, by the announce of the Central Meteorological Observatory.

The writers observed the earth's magnetic field and the earth-current near the epicentre of the earthquake and report here that results.

§ 1. On the Change of the Magnetic Dip Accompanying the Fukui Earthquake.

After the Fukui Earthquake, the writers made a survey of the magnetic dip at Shioya-machi near the epicentre of the earthquake. As at Shioya-machi, the magnetic survey had been made since 1893, we repeated the survey at the same place. The survey was carried out on July 16 and July 21, and this interval, on July 18~19, the Kakioka Magnetic Observatory also made a survey at the same place. Next, on August 11, the third measuring was carried out, and after this, on August 20~22, the Hydrographic Department of the Maritime Safety Agency also made a survey at the same place. These values are shown in the following table and Fig. 1.

Besides at Shioya, the writers made a survey also at Itoigawa and Takefu. As it is considered that the effect owing to this earthquake is not recognized at Itoigawa, we assume that the change at Itoigawa from 1943 to 1948 is the secular variation of dip of this region in this interval, and we corrected this value of secular variation to the observed value of Shioya.

The value at Shioya, which was considered

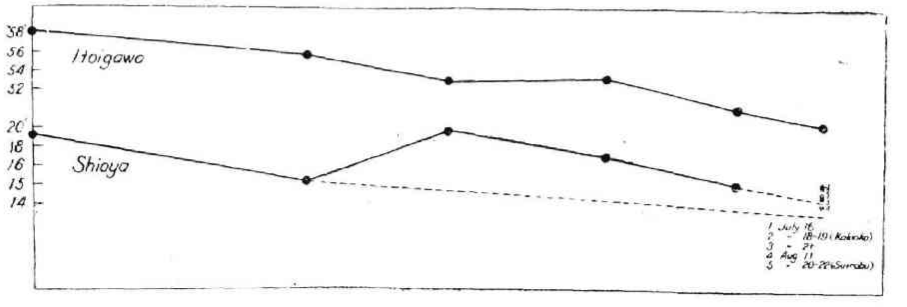

Fig. 1

Table 1

Shioya	1893	50° 19'.3	
	1912	50 14.3	
	1922	50 19.7	
	1933	50 16.7	
	1942	50 13.9	
	1948 July 16	50 13.0	
	〃 〃 18~19	50 13.8	(Kakioka)
	〃 〃 21	50 14.0	
	〃 Aug. 11	50 11.8	
	〃 〃 20~22	50 12.7	(Hydrographic Department)
Itoigawa	1893	50° 58'.2	
	1912	50 55.7	
	1922	50 52.9	
	1933	50 53.1	
	1942	50 49.9	
	1948	50 48.3	
Takefu	1893	49° 29'.7	
	1913	49 24.1	
	1948 July 23	49 20.5	
	〃 Aug. 9	49 20.9	
Nagahama	1896	49° 07'.0	
	1913	49 01.7	
	1922	49 01.0	
	1948 Aug. 9	48 57.8	

to have changed with the same secular variation at Itoigawa since 1943, is shown with the dotted line in the figure. As the figure shows, immediately after the earthquake, the value is somewhat (about 2') larger than that expected. Though, this amount is very small, it may be considered to be the effect of the earthquake. And in August, it became nearly to the expected value.

After all, the changes of the earth's magnetic field accompanying the Fukui Earthquake was not so large notwithstanding the position of Shioya is very near the epicentre of the earthquake, and gradually returned to the expected value.

§ 2. On the Changes in the Earth-Current Accompanying the After-Shocks of the Fukui Eathquake.

In order to survey the changes of the earth-current at the aftershocks of the Fukui Earthquake, the writers took photographic record on the earthen-floor of the Shioya Primary School.

The methods of the survey are as follows: one of them is self recording of the electric potential difference by quadrant electrometer, and the other is self-recording of the time-variation of the earth-current, induced the secondary coil transmitting the earth-current in the primary coil of the transformer which is made piling three endless circular plates of Sendust (its diameter 8cm, thickness 3mm, and each of them $\mu = 13{,}300 \sim 13{,}800$) and the oscillation of 1 cm on the records corresponds to 0.044 mV/sec. For each of the electrodes electrolytic copper (20 cm × 80 cm) is used, and the distance between two electrodes is 100 metres. In each ease, eastwest component only was surveyed. The nature of the soil in the neighbourhood where electrodes are buried is quite uniform sand and is not comparaitvely moist.

About 10 km apart from the place the survey was carried out, there was passing the electric car of Daishoji and Awara, so the

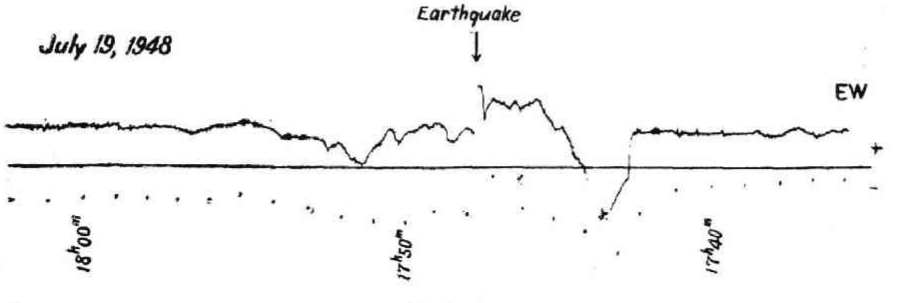

Fig. 2

condition was tolerably difficult to survey the earth-current, and the writers observed mainly at night.

Fig. 2 shows one of the records of electric potential difference by the quadrant electrometer. On the original record, the oscillation of 1 mm corresponds to 0.76 mV. As evidently shown in the records, electric potential difference had changed from 2~3 minutes before the after-shock began and increased more suddenly just a little before the shock and after that still some change was produced and then after several minutes it returned entirely calm. This cange of the electric potential difference is considered to be that evidently accompanied this after-shock.

Next, Fig. 3 is the record of the time-variation of the earth-current. First, the time-variations of the earth-current accompanying the first after-shock of 5^h10^m on July 19 and great one of 3^h48^m on July 19 suddenly increased eastwards at the same time of the shock and after about one minute it returned to the former value respectively. In these cases, mechanical vibration of the galvanometer owing to the shock is superposing, but like this vibrating to one side is impossible so long as the moment of rotation does not act particulary. It means namely, that the earth-current ran temporarily at the time of these after-shocks.

On the change due to the contact electric pontential difference of electrodes owing to vibration, no change was produced when the artificial vibration was given near the electrode beforehand, so there is no need of consideration.

From these results, after all, the writers found that at the same time of some after-shocks earth-current may run temporarily.

At the time of the after-shock of 3^h31^m, July 19 in Fig. 3, there was no change. Before this after-shock, at about 3^h 15^m, and after it, about 3^h 34^m, small change was recognized. This occurred at night, so this was not absolutely an effect by the electric car. And also there was no cange in the record of $\frac{dH}{dt}$ observed at the same time at Onagawa, Miyagi Prefecture, so it is not change of earth-current owing to the earth's magnetic field.

It is considered, therefore, to be concerned with this after-shock. Another small changes before and after the after-shock of 13^h48^m, 19th occurred in the daytime, and

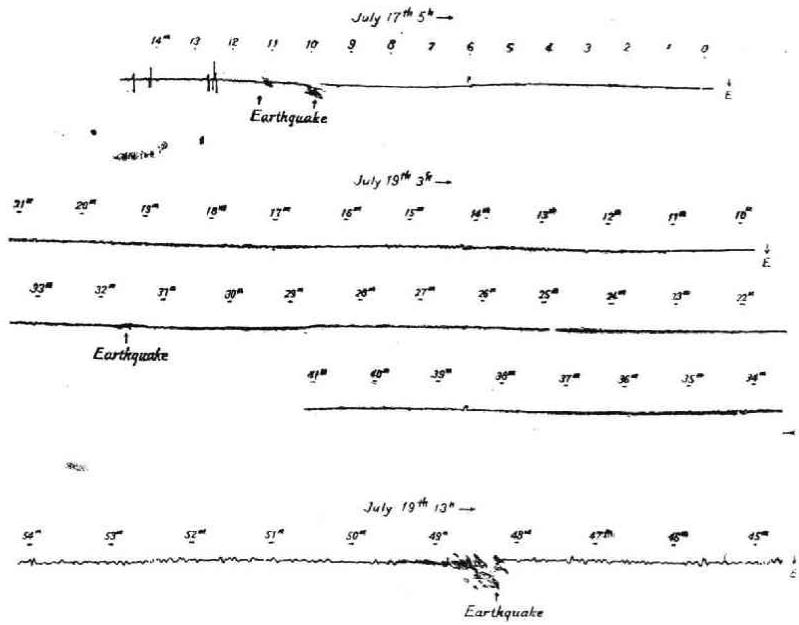

Fig. 3

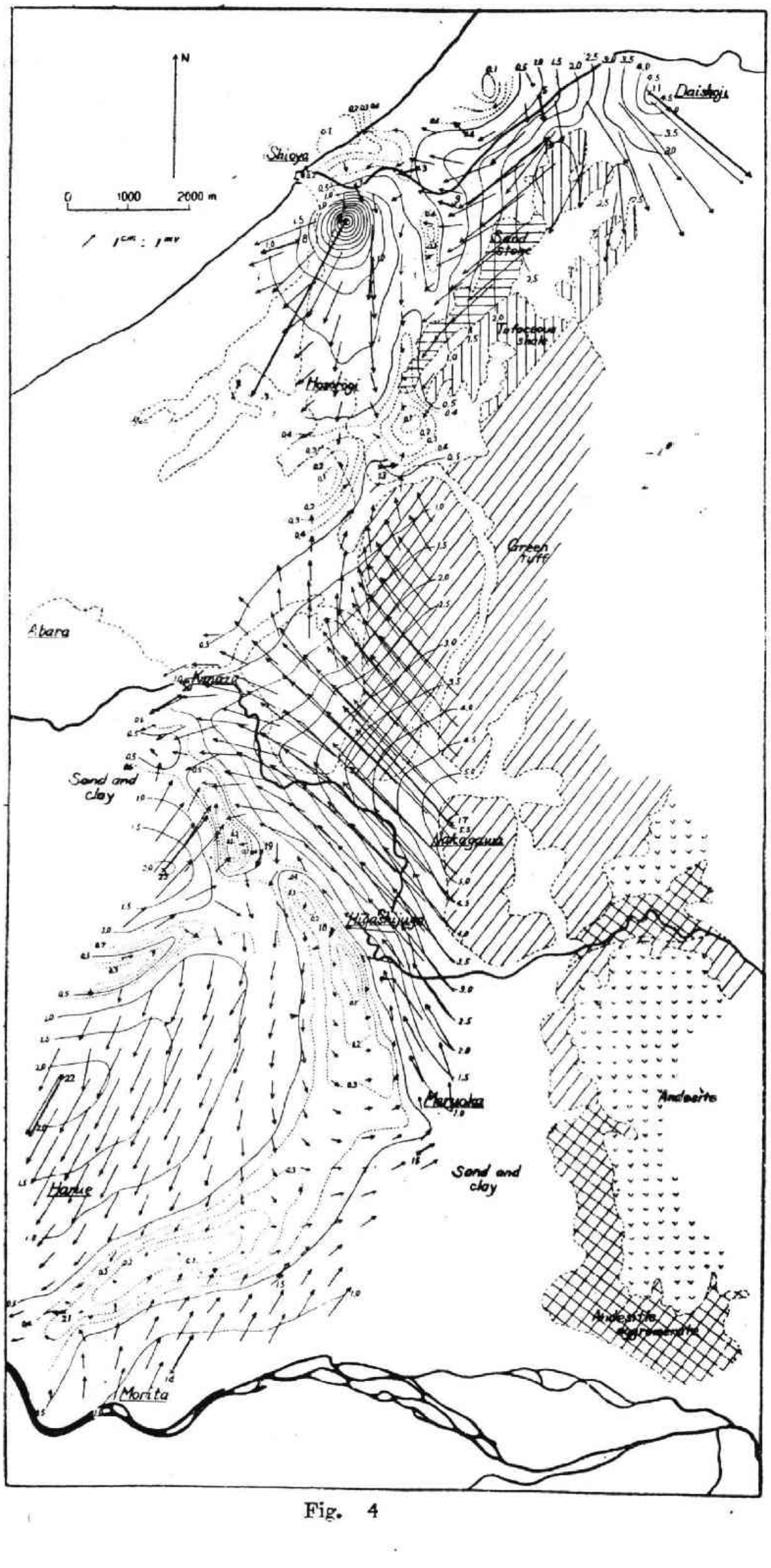
N
0 1000 2000 m
Shioya
Daishoji
Sand stone
Tufaceous shale
Hosogi
Green tuff
Abara
Sand and clay
Nakagawa
Higashijuku
Maruyoka
Sand and clay
Andesite
Harue
Andesite agglomerate
Morita

Fig. 4

an effect by the electric car is also considered, but the period of the change is moderate and the change occurs continuously. After all, though not definite, it seems that such a change of the earth-current occurred accompanying the after-shock too.

As mentioned above, the writers stated on the changes of the earth-current accompanying the after-shocks.

§ 3. On the Distribution of the Electric Potential Differene near the Epicentre of the Fukui Earthquake.

The writers surveyed the distribution of the earth's electric potential defference with the non-polarized electrode and millivoltmeter near the epicentre of the Fukui Earthquake. The electrode of non-polarization is made putting saturated solution of the copper-sulphate in an unglazed tube, and the electrolytic copper was put in this solution as the electrode. In order to exclude the error owing to the different condition of the electrode, the survey was carried out each time changing the electrode. The distance between the electrodes was 30 m, and east-west and north-south components were observed and the vector of the electric difference was obtained. The electric pctential difference was observed directly by the millivoltmeter.

In Fig. 4, the marks of arrow show this vector. Among the arrows, thick ones show the measured values, and those of calculated interpolatedly among those values are shown with thin ones. As clearly shown in the figure, the distribution of the vector of the electric potential difference is very systematic. The survey was carried out at the Alluvium zone, and there was no very local difference of the nature of the soil or clay. Therefore, though the number of the measuring point is small, it may be considered that the distribution of the vector of the electric potential difference near this district is shown in the figure.

First, this figure shows that the discontinuous parts of these vectors are considered to be the boundary of the earth-block. They shows, namely, the geological block on the whole. In the Alluvium zone near the north-western part of Morita latent block is preferable to be considered. This part is nearly coincided with the diagram of deviation of the vertical component of the earth's magnetic field measured by Mr. YUMURA of the Kakioka Magnetic Observatory and it seems very remarkable fact.

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