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29. *Seismicity of Taiwan (Formosa).**

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1. Historical sketch of seismological observation

Taiwan is located in the Circum-Pacific Seismic Zone, and has suffered great damage from a number of destructive earthquakes throughout her history. Seismological observation was first recorded in Taiwan at Anping. Many weather stations were established in 1896. Later, seismographs of the Gray-Milne type were set up at Taipei, Tainan and Penghu, and instrumental observations began. A complete network for making seismic observations was then formed. In 1928, Wiechert type seismometers were installed at Taipei.

The most destructive earthquake recorded by scientific instruments occurred in Taiwan on April 21st of 1935. After this earthquake, seismological observation was strengthened and the Hsinchu seismological station was then established. During the decade of 1928 to 1938, a Wiechert's seismometer and other seismographs were installed at other seismological stations on the islands. Seismological observation made remarkable progress during these years. Before World War II, a seismic network of 17 stations had been established throughout the Taiwan Islands. At the end of the war, many seismic stations were destroyed by airraids and seismological observation had almost ceased.

After the year 1945, six seismic stations were reestablished at Taipei, Ilan, Hwalien, Alishan, Tainan and Taitung. Seismometers have been continuously in operation since then.

On October 22nd of 1951, a severe earthquake occurred at Hwalien and Taitung. A toll of 856 wounded and 68 persons dead was reported in this earthquake. About 2,382 houses were damaged. Close to the Hwalien Earthquake another big earthquake occurred around Taitung on November 25th of the same year. Twenty persons were killed, 326 persons were hurt and more than 1,500 houses were damaged.

* Communicated by T. Hagiwara.

Table 1. List of the Seismological Stations, Taiwan, China

Station	φ; N	λ; E	φ'	Altitude	Subsoil	a	b	c	Seismographs	Year of Establishment
Alishan (阿里山)	23°31′	120°48′	23°22′	2,406.1m	Miocene Sandstone	−0.4700	+0.7885	+0.3966	$W(H, V)$, O, S_1	1933
Hengchun (恒春)	22 00	120 45	21 52	22.3	Alluvium	4745	7976	3724	$W(H, V)$, S_1	1907
Hsinkong (新港)	23 06	121 22	22 58	36.5	Alluvium	4793	7862	3901	$W(H, V)$, S_1	1941
Hsinchu (新竹)	24 48	120 58	24 39	32.8	Alluvium	4677	7793	4171	P_1, S_2	1938
Hwalien (花蓮)	23 58	121 37	23 49	17.6	Diluvium	4796	7791	4038	$W(H, V)$, P_1, S_2, A_2	1914
Ilan (宜蘭)	24 46	121 45	24 37	7.4	Alluvium	4781	7731	4165	$W(H, V)$, P_1, S_1	1936
Kaohsiung (高雄)	22 37	120 16	22 29	33.1	Limestone	4657	7981	3824	P_1, S_1	1931
Lanyu (蘭嶼)	22 02	121 33	21 54	332.2	Basalt	4881	7950	3730	P_2	1961
Penghu (澎湖)	23 32	119 33	23 23	9.4	Basalt	4527	7985	3969	P_1	1900
Taipei (台北)	25 02	121 31	24 53	8.0	Alluvium	4742	7733	4208	$W(H, V)$, O, P_3, S_1, A_1	1896
Tawu (大武)	22 21	120 54	22 13	7.6	Alluvium	4754	7944	3781	$W(H, V)$, S_1	1942
Taitung (台東)	22 45	121 09	22 37	8.9	Alluvium	4775	7900	3846	$W(H, V)$, S_2	1906
Tainan (台南)	23 00	120 13	22 52	12.7	Alluvium	4637	7962	3886	$W(H, V)$, P_1, S_1, A_1	1898
Taichung (台中)	24 09	120 41	24 00	77.1	Alluvium	4662	7856	4067	$W(H, V)$, P_1, S_2	1902
Yushan (玉山)	23 29	120 57	23 21	3,850.0	Miocene Sandstone	4722	7873	3964	P_1	1944

Notation

λ: Longitude
φ: Geographical Latitude
φ': Geocentric Latitude
$W(H)$: Wiechert's horizontal seismograph
$W(V)$: Wiechert's vertical seismograph
O: Omori's horizontal seismograph
P_1: Portable horizontal seismograph
P_2: Three component portable seismograph
P_3: Higuti's portable horizontal seismograph
S_1: C.M.O type three component strong motion seismograph
S_2: Higuti's three component strong motion seismograph
A_1: Ishimoto's three component acceleration seismograph
A_2: Higuti's three component strong motion asseleration seismograph

$a=\cos\varphi'\cos\lambda$, $b=\cos\varphi'\sin\lambda$, $c=\sin\varphi'$

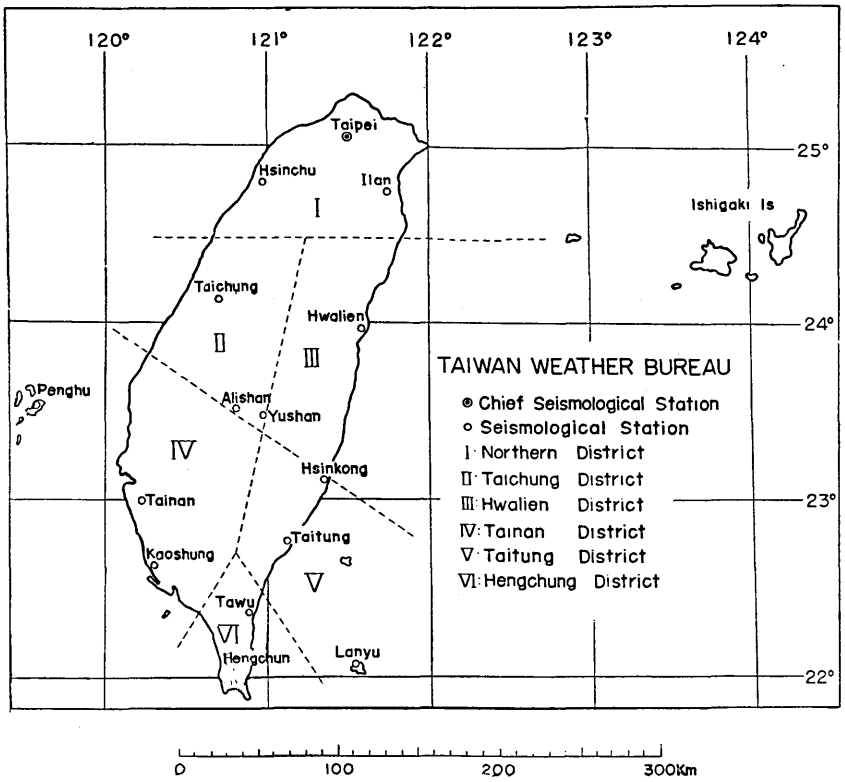

Fig. 1. The network of seismological station in Taiwan.

For the purpose of solving earthquake engineering problems, some new types of strong motion seismographs and acceleration seismographs were introduced. From 1955 to 1957, new type seismographs such as Higuti's three component strong motion seismograph, Higuti's portable horizontal seismograph, Ishimoto's three component acceleration seismograph were installed at important stations.

Since 1954, the quarterly Seismological Bulletin of the Taiwan Weather Bureau has been published. More than 150 observatories have their names on its mailing list.

The Taiwan Weather Bureau is now maintaning a network of 15 seismological stations in a satisfactory manner. The geographic coordinates of these stations and the seismographs in use are indicated in Table 1, and a map also showing the distribution of location is given in Fig. 1. The coefficients of seismographs are listed in Table 2.

The scale of seismic intensity of 0–VI in Table 3 is customarily adopted for use in Taiwan.

Table 2. The Constants of Seismographs

Seismograph	Component	M kg	V	v	r mm	T_0 sec
$W(H)$	E-W	200	77	9	0.10	5.1
	N-S	200	78	9	0.13	5.1
$W(V)$	U-D	80	75	8	0.08	5.1
P_1	E-W	18	40	8	0.13	5.1
	N-S	18	40	8	0.13	5.1
P_2	E-W	10	20	2	0.24	4.0
	N-S	10	20	2	0.41	4.0
	U-D	7.5	20	2	0.29	4.0
P_3	E-W	20	49	10	0.08	2.2
	N-S	20	49	10	0.08	2.3
0	E-W	15	20	3	0.05	15.7
	N-S	15	20	3	0.08	15.1
S_1	E-W	2	2	4	0.06	3.8
	N-S	2	2	4	0.06	3.8
	U-D	1.5	2	8	0.06	3.5
S_2	E-W	4	1	8	0.04	6.0
	N-S	4	1	8	0.04	6.0
	U-D	2	1	8	0.03	5.0
A_1	E-W	16	220	10	0.005	0.10
	N-S	16	220	10	0.009	0.10
	U-D	16	170	10	0.006	0.08
A_2	E-W	1	16	10	0.01	0.11
	N-S	1	16	10	0.02	0.10
	U-D	1	16	10	0.01	0.11

Notation

M: Mass
V: Magnification
v: Damping ratio
r: Friction
T_0: Proper period

Table 3. Scales of Seismic Intensity

0; No Feeling: Shocks too weak to cause human feelings, registered only by seismographs. (Acceleration smaller than 0.8 gal)

I; Slight: Extremely feeble shocks only felt by persons at rest or by those who are observant of earthquakes. (0.8-2.5 gal)

II; Weak: Shocks felt by most persons, slight shaking of doors. (2.5-8.0 gal)

III; Rather Strong: Slight shaking of houses and buildings, rattling of doors, swinging of hanging objects such as electric lamps, moving of liquids in vessels. (8.0-25.0 gal)

IV; Strong shaking of houses and buildings, overturning of unstable objects, spilling of liquids out of vessels. (25.0-80.0 gal)

V; Very Strong: Cracks in the walls, overturning of gravestones, stone lanterns etc., damaging of chimneys and stone walls. (80.0-250 gal)

VI; Disastrous: Demolition of houses, landslides, faults, fissures on the ground. (larger than 250 gal)

2. The topography of Taiwan

A central mountain range runs in NNE to SSW direction, the north edge begins at the northeast coast and ends at the Hengchun peninsula. There are 62 peaks with height higher than 3,000 meters. The distance from north to south is about 400 kilometers, and the widest distance from east to west is about 160 kilometers. Due to the central mountain range that leans to the east side, there is but a small local plane because most parts of the east seaside are steep cliffs. Owing to many high mountains, the rivers generally are very short, and are shaped by rapid currents. The rivers on the west side are rather long and the longest one is the Choshichi river which is located at the central part of the island and is about 165 kilometers long. The rivers on the east side are shorter and the longest one, which is named Hsiukuluanchi, is about 90 kilometers long and is also located in the central part of the island. The sea off the east coast is the Pacific Ocean, and its depth is more than 2,000 meters. The sea off the west coast is the Taiwan Channel, its depth is shallow and forms the shape of continental shelf.

3. Geographical distribution

Taiwan stands at the outskirts of the asiatic continent and lies right on the Circum-Pacific Seismic Zone where earthquakes are frequently felt. Taiwan experienced earthquakes about 1,265 times in an average year as calculated from 1930 to 1960. Among them 1,037 times were unfelt earthquake and 238 times were felt earthquake. The number changed considerebly from year to year as in Fig. 2. The maximum number occurred in 1922 amounting to 3,224 times, while the minimum in 1910 was only 264 times. The fomer was caused by an earthquake swarm which occurred near Suau, on northeastern coast of Taiwan.

The geographical distribution of the number which could be felt by persons is shown in Fig. 3 which was made on the basis of data from 1933 to 1958.

For the sake of convenience we divided Taiwan into six districts as in Fig. 1, and the annual monthly mean numbers of felt and unfelt earthquake are shown in Table 4 and Table 5 respectively. The number of earthquakes counted in the tables occurred within 300 kms from the coast of Taiwan. As the number of unfelt earthquakes increases with the magnification of the seismagraphs, so the number of unfelt earth-

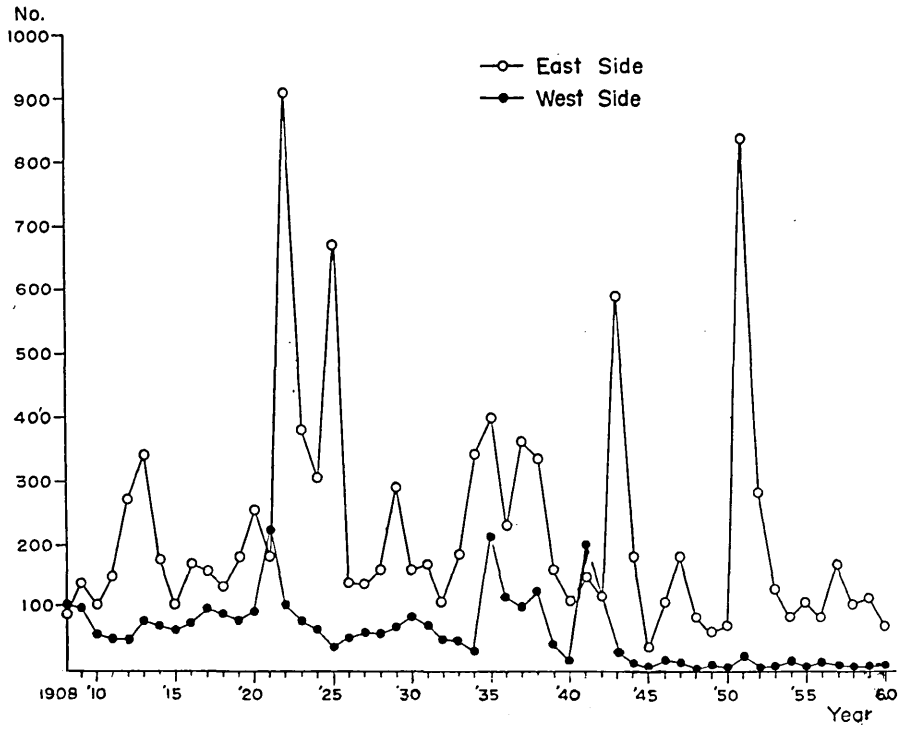

Fig. 2. The secular change of the number of earthquakes in Taiwan in the years from 1909 to 1960.

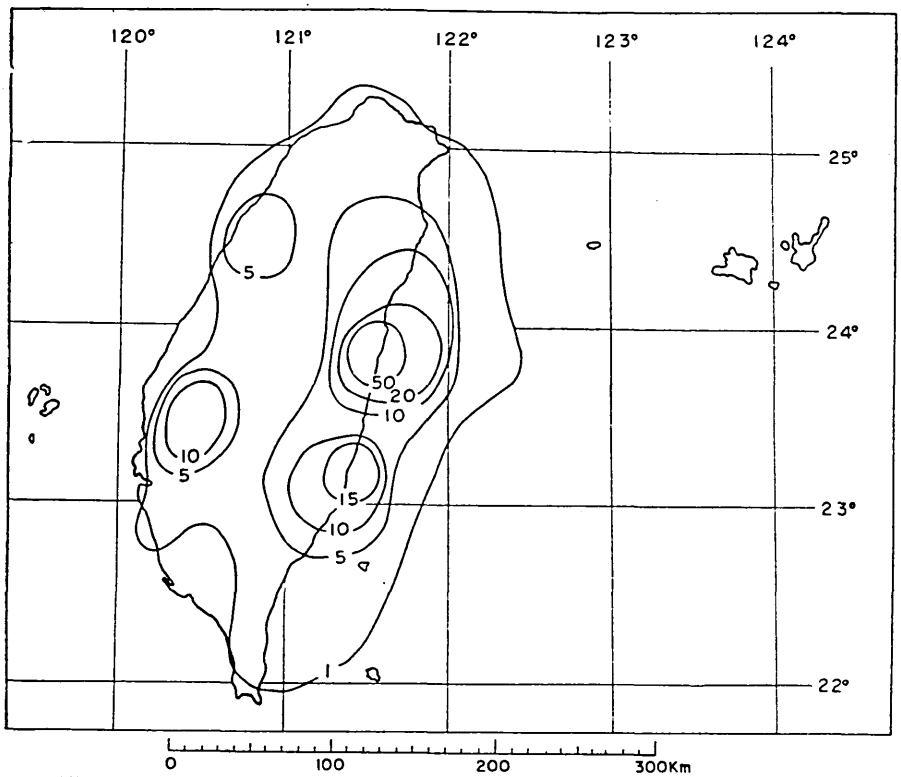

Fig. 3. The distribution of the number of felt earthquakes in the average year from 1933 to 1958.

Table 4. Number of Annual Monthly Mean Felt Earthquakes from 1913 to 1958.

District	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Year	Monthly Mean	Ratio of District per Total Area. %
Northern	4.0	3.3	3.4	4.0	3.4	2.9	3.7	4.7	12.6	5.7	5.3	4.0	57.3	4.8	19.8
Taichung	2.1	1.5	1.2	1.4	1.0	1.2	3.5	1.5	1.4	1.4	1.9	0.8	18.7	1.5	6.2
Hwalien	10.5	8.8	12.2	8.0	8.5	17.4	6.0	7.0	8.8	17.7	15.4	7.7	128.1	10.7	44.0
Tainan	4.5	2.5	2.5	2.8	2.1	2.6	1.6	2.5	3.0	2.6	1.8	7.3	35.8	3.0	12.3
Taitung	4.6	2.5	3.1	3.3	2.8	4.2	2.7	3.5	4.1	3.4	4.1	7.3	45.7	3.8	15.6
Hengchun	0.5	0.4	0.6	1.3	0.6	0.3	0.8	0.6	0.3	0.2	0.3	0.3	5.9	0.5	2.1
Total Taiwan	26.2	19.0	23.0	20.8	18.4	28.6	18.0	19.8	30.2	31.0	28.8	27.4	291.5	24.3	100.0

Table 5. Number of Annual Monthly Mean Unfelt Earthquakes from 1930 to 1958.

District	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Year	Monthly Mean	Ratio of District per Total Area. %
Northern	13.1	11.7	10.3	13.6	15.2	13.3	15.2	20.5	31.3	22.2	13.6	13.3	193.3	16.1	18.6
Taichung	4.0	3.7	3.7	4.8	3.5	3.8	3.8	3.5	6.7	5.1	3.8	3.8	50.2	4.2	4.9
Hwalien	23.5	40.5	31.2	24.3	23.4	22.9	18.4	21.3	36.7	71.7	48.8	29.2	391.9	32.7	37.8
Tainan	20.4	8.2	8.1	10.1	4.4	3.3	3.4	4.9	6.2	4.1	5.8	18.0	96.9	8.1	9.4
Taitung	15.5	16.1	15.1	14.6	17.3	14.8	14.7	15.8	20.0	18.0	22.1	44.8	228.8	19.1	22.0
Hengchun	3.9	6.5	6.5	8.7	7.0	4.4	5.0	9.8	8.7	5.2	5.1	5.2	76.0	6.3	7.3
Total Taiwan	80.4	86.7	74.9	76.1	70.8	62.5	60.5	75.8	109.6	126.3	99.2	114.3	1037.1	86.5	100.0

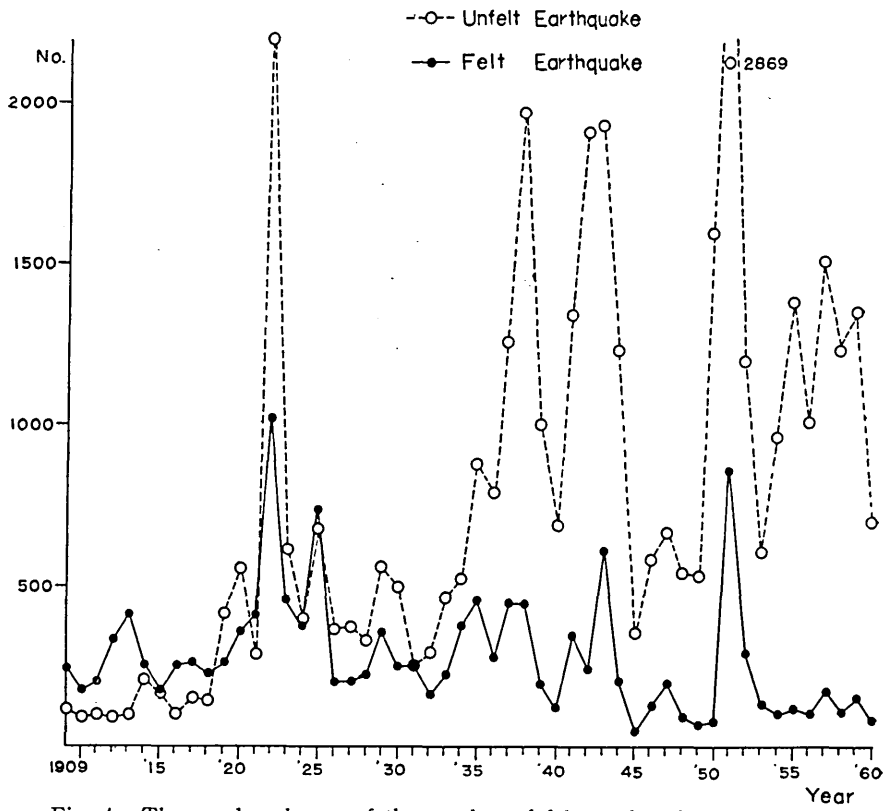

Fig. 4. The secular change of the number of felt earthquakes in Eastside Seismic Zone and the Westside Seismic Zone from 1908 to 1960.

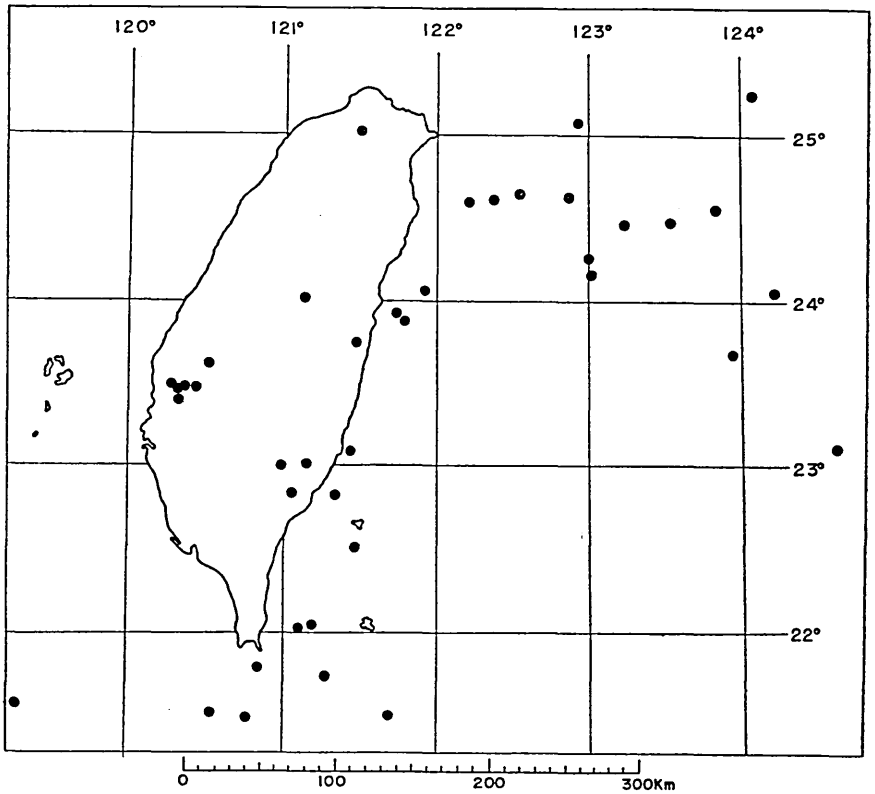

Fig. 5. The distribution of the epicentres of remarkable earthquake which occurred during the years from 1900 to 1960.

quakes were counted from the year 1930 when the Wiechert's seismographs were installed at main seismological stations. These figures and tables indicate that the most frequently affected region is that along the east coast of Taiwan, and the quietest is the southwestern part of Taiwan. The largest number of felt earthquakes was observed at the Hwalien District which ammount to 128 times per year as the mean value from 1913 to 1958. This value is equal to 44% of the total felt earthquakes in Taiwan.

As mentioned above, the region most frequently affected lies along the east coast of Taiwan suggesting that there is a seismic zone in this area. We called it the Eastside Seismic Zone. On the other hand, in the west plane near Hsinchu and Chai area earthquakes also frequently occurred. We called it the Westside Seismic Zone.

In the case of earthquake occurring in the Eastside Zone. in case

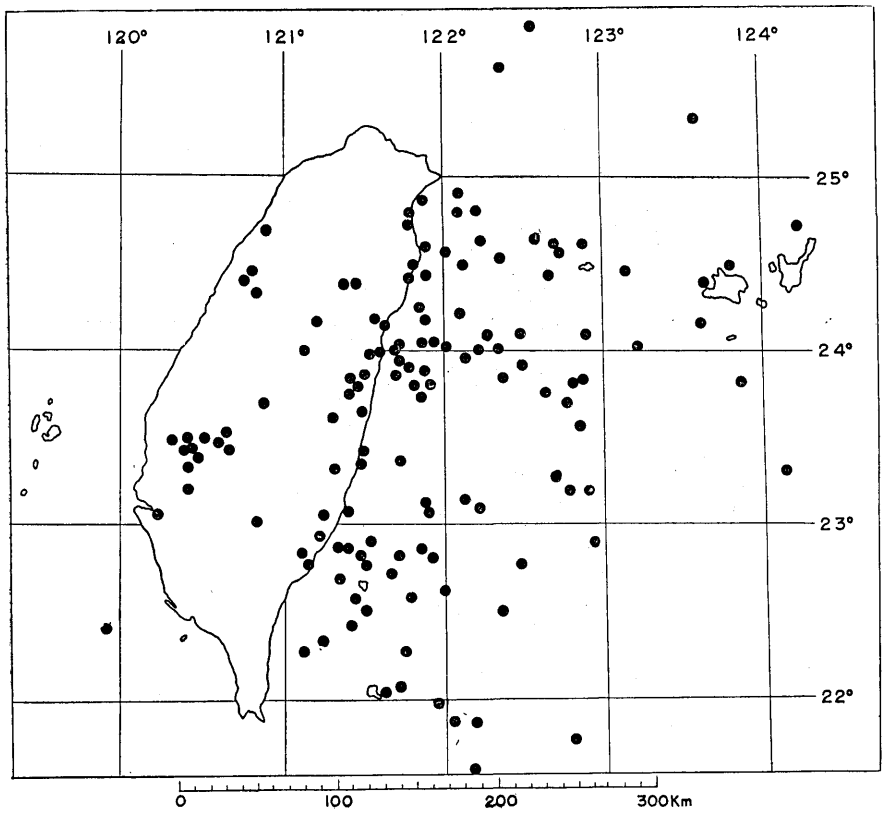

Fig. 6. The distribution of the epicentres of moderate earthquake which occurred during the years from 1900 to 1960.

the epicentre is located on land its magnitude is small and the depth of the hypocentre is about 10 to 30 km but they occur frequently and continuously. In case the epicentre located at sea, its magnitude is larger and the depth of the hypocentre is deeper, namely 40 to 100 km, so that little damage and crustal deformation occurs on land.

In the Westside Zone many destructive earthquakes have occurred throughout history. Owing to the depth of the hypocentres being very shallow, that is 0 to 10 km, great damage and accompaning remarkable crustal deformation such as fault, fissure and landslide occurs.

The number of felt earthquakes which have occurred in the East and West sides Seismic Zones are shown in Fig. 4. The seismic activety was vigourous in the years 1913, 1922, 1925, 1929, 1935, 1937, 1943, and 1951 in the eastside and 1908, 1913, 1917, 1921, 1930, 1935, 1938

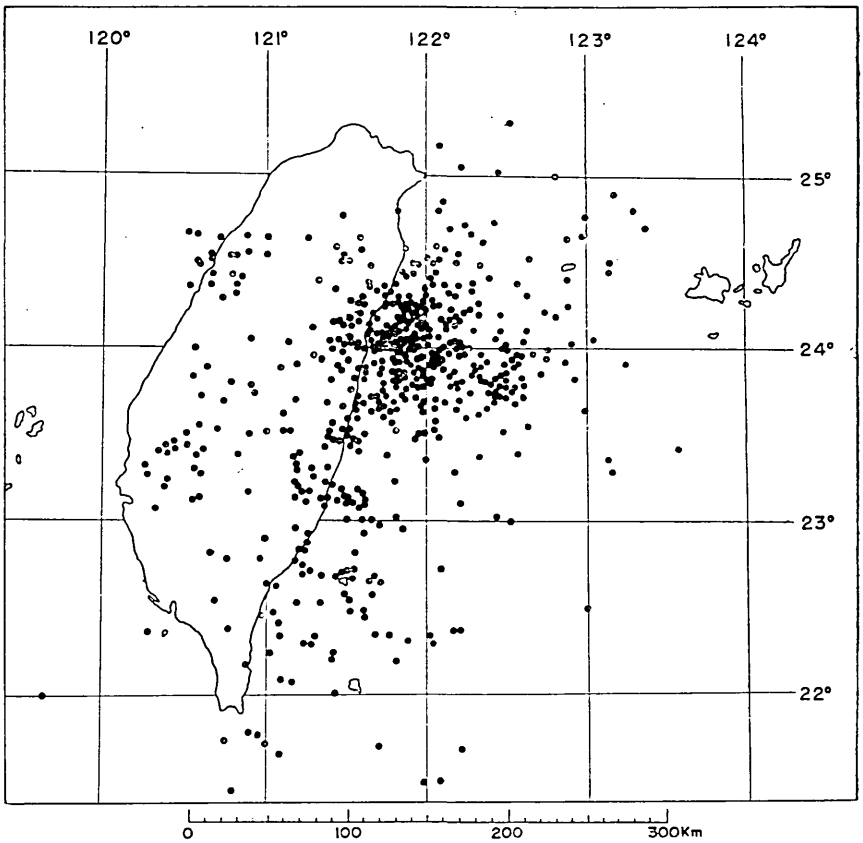

Fig. 7. The distribution of the epicentres of earthquakes of limited felt area which occurred during the years from 1931 to 1960.

and 1941, in the westside. It is very difficult to find periodicity in both sides.

The magnitude of an earthquake is classified according to the radius of the felt area under the assumption of a circle as follows:

i) Remarkable earthquake; The radius of the felt area is greater than 300 km. (M is larger than 6.4)

ii) Moderate earthquake: The radius is smaller than 300 km but greater than 200 km. (M=6.4–5.7)

iii) Earthquake of limited felt area: The radius is smaller than 200 km but greater than 100 km. (M=5.7–4.8)

iv) Local earthquake: The radius is smaller than 100 km. (M is smaller than 4.8)

According to the "Guide of Seismometry" (Zishin Kansokuho) published

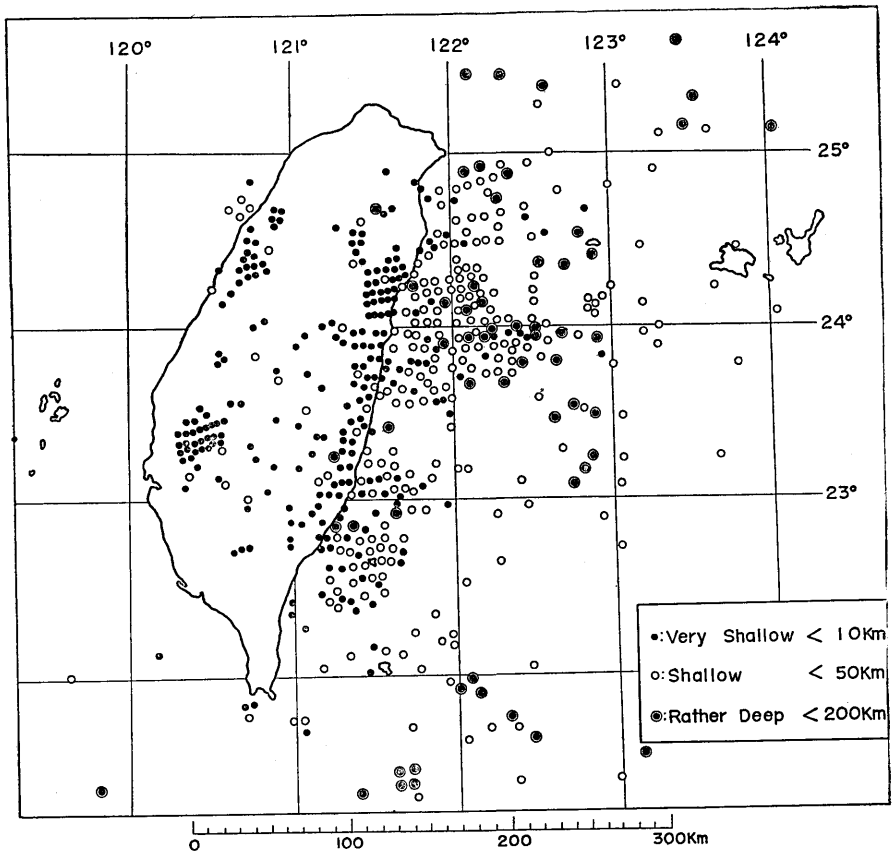

Fig. 8. The distribution of earthquakes of magnitude larger than local earthquakes, classified by the depth of the hypocentre (1909–1958).

Table 6. List of Disastrous

No.	Origin Time					Location of epicentre		
	Year	Month	Day	Hour	Minute	Place	Lat. (*N*)	Long. (*E*)
1	1901	6	7	8	05	Near Ilan (宜蘭)		
2	1904	4	24	14	39	Upper part of Pachang-Chi (八奎溪)	120°5	23°5
3	1904	11	6	4	25	Lower part of Peikang-Chi (北港溪)	120°3	23°5
4	1906	3	17	6	42	Near Minhsung (民雄)	120°5	23°6
5	1906	3	26	11	29	Near Touliu (斗六)	120°5	23°7
6	1906	4	5	0	52	Near Tian-tze Kou (店仔口)	120°4	23°4
7	1906	4	8	6	40	Near Tian-tze Kou (〃)	〃	〃
8	1906	4	14	3	18	Near Tian-tze Kou (〃)	〃	〃
9	1906	4	14	7	52	Near Tian.ize Kou (〃)	〃	〃
10	1908	1	11	11	35	Near Patzai (拔子)	121°4	23°7
11	1909	4	15	3	54	Southern part of Taipei (台北)	121°5	25°0
12	1909	5	23	6	44	Western part of Puli (埔里)	120°9	24°0
13	1909	11	21	15	36	South of Tanan-Ao (大南澳)	121°8	24°4
14	1910	3	26	2	38	Near Hwalien (花蓮)		
15	1910	4	12	8	23	South of Chilung (基隆)	122°9	25°1
16	1910	6	17	13	28	Far south off Taiwan		
17	1915	1	6	7	27	East of Yonakuni Is.	123°2	24°4
18	1916	8	28	15	27	Upper part of Choshui-Chi (濁水溪)	120°9	23°7
19	1916	11	15	6	31	Near Taichung (台中)	120°7	24°1
20	1917	1	5	0	55	Near Puli (埔里)	120°9	23°9
21	1917	1	7	2	08	Near Puli (〃)	〃	〃
22	1918	3	27	11	52	Off Suao (蘇澳)	121°9	24°6
23	1920	6	5	12	22	Off Hwalien (花蓮)	122°0	24°0
24	1922	9	2	3	16	Off Suao (蘇澳)	122°2	24°6
25	1922	9	15	3	32	Off Suao (〃)	122°3	24°6
26	1922	9	17	6	44	Off Hwalien (花蓮)	122°5	23°9
27	1922	10	15	7	47	Off Suao (蘇澳)	122°3	24°6
28	1922	12	2	11	46	Off Suao (〃)	122°0	24°6
29	1922	12	13	19	26	Off Suao (〃)	122°1	24°6
30	1923	9	29	14	51	Near Taitung (台東)	121°1	22°8
31	1925	4	17	3	53	Bashi Channel	120°2	20°4
32	1925	6	24	13	38	Off Takkili River (立霧溪)	120°8	24°1
33	1927	8	25	2	09	Near Hsinyin (新營)	120°3	23°3
34	1930	8	8	7	49	South of Hwalien (花蓮)	121°3	23°2
35	1930	12	8	14	20	Near Hsinyin (新營)	120°4	23°3
36	1930	12	8	16	10	Near Hsinyin (〃)	〃	〃
37	1930	12	22	7	52	Near Hsinyin (〃)	〃	〃
38	1930	12	22	8	08	Near Hsinyin (〃)	〃	〃
39	1930	12	22	12	19	Near Hsinyin (〃)	〃	〃
40	1931	1	24	23	02	Middle part of Pachiang Chi (八奎溪)	120°4	23°4
41	1934	8	11	16	18	Ilan Cho Shui Chi (宜蘭濁水溪)	121°8	24°8
42	1935	4	21	6	02	Near Mt. Kwan-Tao (関刀山)	120°8	24°3
43	1935	4	21	6	26	Chung-Kang-Chi, near Sanwan (中港溪, 三灣)	120°9	24°7
44	1935	5	5	7	02	Houlung-Chi (後竜溪), near Kung Kwan (公館)	120°8	24°5
45	1935	5	30	3	43	Middle part of Tatu-Chi (大肚溪)	120°8	24°1

Earthquakes in Taiwan (1900–1960).

Magnitude	Depth of Hypocentre	Damage				
		No. of lives lost	No. of wounded	No. of houses totally destroyed	No. of houses damaged	Crustal deformation
m				1	57	
m		3	10	66	840	
m		145	158	661	3,197	Fissure, sand-crater
r		1,258	2,385	6,769	14,218	Fault, fissure and sand crater
l		1	5	29	529	
m		1	6	63	283	Landslide
m						
r		15	84	1,794	10,037	Fissure, sand-crater landslide
r						
m		2		3	5	Fissure, landslide
r		9	51	122	1,050	
s			6	10	32	
m			4	14	39	
s				Slight	damages	
r				13	59	
r				Slight	damages	
r				〃	〃	
m		16	159	614	4,885	
s		1	20	97	972	
s		54	85	130	625	
s			21	187	498	
m			3		6	
r		5	20	273	1,275	
r		5	7	14	161	
r			5	24	389	
m			1	6	197	
m		6	2		14	
m		1	2	1	33	
s			1		13	
s			1	1	80	
r				Slight	damages	
s			1		339	
r		11	63	439	984	
s				Slight	damages	
m		4	25	214	449	
r						
r			14	545	2,295	
r						
s					698	
s						
m	S		3	7	11	
m	5	3,276	12,053	17,907	36,781	Fault, landslide, collapse of ground
m	S					
s	S		38	28	571	
s	S			2	24	

(to be continued)

No.	Origin Time					Location of spicentre		
	Year	Month	Day	Hour	Minute	Piace	Lat. (*N*)	Long. (*E*)
46	1935	6	7	10	51	Near Wuchi (梧棲)	120°5	24°2
47	1935	7	17	0	19	Near Houlung-Chi (後壠溪)	120°7	24°6
48	1935	9	4	9	38	50 km E of Taitung (台東)	121°5	22°5
49	1936	8	22	14	51	45 km E of Hengchun (恒春)	121°1	22°0
50	1937	12	8	16	32	Near Hsing-Kong (新港)	121°4	23°1
51	1938	9	7	12	03	30 km SE of Hwalien (花蓮)	121°8	23°8
52	1938	11	2	14	40	S of Mt. Hohuan 20 km (合歡山)	121°2	24°1
53	1939	11	7	11	53	Near Cholan, Hsinchu (卓蘭, 新竹)	120°8	24°4
54	1942	12	17	3	19	SE of Chiayi (嘉義), near Chung Pu (中埔)	120°4	23°4
55	1943	10	23	0	01	15 km SW of Hwalien (花蓮)	121°5	23°8
56	1943	10	23	0	15	15 km SW of Hwalien (〃)	〃	〃
57	1943	11	3	0	51	30 km E of Hwalien (〃)	121°8	24°0
58	1943	11	24	5	51	5 km ENE of Hwalien (花蓮)	119°3	21°6
59	1943	12	2	13	09	20 km S of Lutao (綠島, former 火燒島)	121°5	22°5
60	1944	2	6	1	20	25 km SW of Hwalien (花蓮)	121°4	23°8
61	1946	12	5	6	47	Near Hsin-Hwa (新化)	120°1	23°1
62	1951	10	22	5	34	15 km ESE of Hwalien (花蓮)	121°7	23°8
63	1951	10	22	11	29	30 km E of Hwalien (花蓮)	121°8	24°1
64	1951	11	25	2	47	35 km NW of Taitung (台東)	120°9	23°0
65	1955	4	4	12	11	30 km SSE of Hengchung (恒春)	120°9	21°8
66	1959	4	27	4	41	145 km ENE of Hwalien (花蓮)	123°0	24°1
67	1959	8	15	16	57	67 km ESE of Hengchun (恒春)	121°2	21°5
68	1959	8	17	16	25	35 km E of Tawu (大武)	121°2	22°3
69	1959	8	18	8	34	98 km E of Hengchun (恒春)	121°7	22°1
70	1959	9	25	10	37	50 km E of Hengchun (〃)	121°2	22°1

Notation:
r : remarkable earthquake
m : moderate earthquake
s : earthquake of limited felt area
l : local earthquake
S : shallow earthquake
Note: 120° E.M.T. is used

by the Japan Meteorological Agency, there is a relation between the radius of a felt earthquake (r) and the Richter and Gutenberg magnitend (M) in the form, $r=2.3(M-1.3)^3-1.7$

The distribution of the epicentre of remarkable earthquakes is shown in Fig. 5. The number amounts to 41 times during the year from 1900 to 1960. It indicates that remarkable earthquake frequently occurred along the east coast and the Chai district. The distribution of the epicentre of moderate earthquakes is shown in Fig. 6. The number amounts to 136 times. This also shows that the district of their frequent occurrence is along the east coast and Chai district. The distribution

(continued)

Magnitude	Depth of Hypocentre	Damage				
		No. of lives lost	No. of wounded	No. of houses totally destroyed	No. of houses damaged	Crustal deformation
s	S		2	5	190	
m	30	44	391	1,754	6,167	
m	S				114	
r			3	Slight	damages	
r				Slight	damages	Landslide
m				Slight	damages	
m				Slight	damages	
s	S			4	20	
m	10	358	733	4,520	11,086	Landslide
m	5	1	1	1	148	Road collapse
m						
s					87	
m					479	
r	40	3	11	139	284	Landslide
m	5			2	388	Fissure
s	0	74	482	1,954	2,084	Landslide
r	0	68	856		2,382	Landslide, fissure
r	20					Damage was confusedly included in (62)
r	5	20	326	1,016	582	Landslide, fissure
r	5	5	7	22	171	
r	30		1	9	4	
r	20	16	63	789	752	
m	40		3			
m	15			32	5	
r	10		3	3	65	

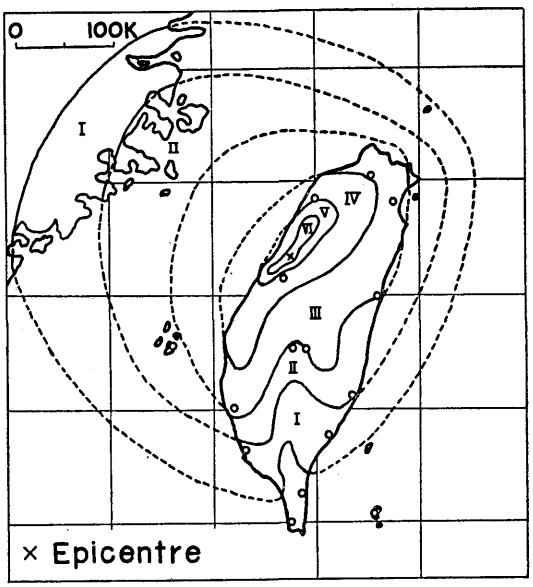

Fig. 9. The intensity distribution owing to the Hsinchu-Taichung Earthquake of 1935.

of earthquakes of limited felt area is shown in Fig. 7. The number amounts to 581 times during the years from 1931 to 1960. The area of their most frequent occurrence is off the coast of Hwalien.

The distribution of earthquakes of magnitude larger than local earthquakes, classified by the depth of the hypocentre is shown in Fig. 8. It shows that the depth of the hypocentres in the westside is shallower than those occurring in the eastside.

The earthquakes which caused damage in Taiwan since 1900 have amounted to 70 in number (see Table 6). The earthquake which caused the greatest number of casualties in Taiwan was the Hsinch-Taichung earthquake of 1935 in which 54,688 houses were destroyed and 15,329 persons where either killed or hurt. It's intensity scale is shown in Fig. 9. The next is the Chai earthquake of 1906 in which 20,987 houses were destroyed and 3,643 persons were killed or hurt. These two earthquakes were accompanied by very remarkable crustal deformation such as fault, fissure, landslide, sand-crator and collapse of the ground.

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29. 台湾の地震活動

中華民国 台湾省気象所 徐 明 同

第2次世界戦争前，台湾にはウィヘルト地震計を備えた17の地震観測があつたが，戦争のとき空襲によつてその多くを失い，地震観測はほとんど中断した．1945年には6カ所の地震観測所(台北，宜蘭，花蓮，阿里山，台南，台中)が復活した．

1951年10月22日花蓮，台中地方に地震が起こり，破壊家屋 2,382，死者 68，負傷者 856 を生じた．同年11月25日これに近い地域に再び地震が起こり，破壊家屋 1,500，死者 20，負傷者 326，を生じた．これに刺激されて，地震工学上の目的から重要な観測所に加速度地震計や強震計が付加えられるようになつた．

1954年以後，台湾省気象所から地震報告が発行され，現在では同省は15の地震観測所の維持に当つている．これらの観測所の位置は第1表及び第1図に示してある．第2表は地震計の常数を示す．

台湾は 1930～1960 年の間に，平均年間有感地震 238 回，無感地震 1,037 回を経験した．年間回数は年により大いに異り，最大は有感無感合せて，1922 年の 3,224 回，最小は 1910 年の 264 回である．第3図に 1933～1958 年の有感地震の震央分布を示す．

便宜上，台湾を6箇の地区に分け(第1図)，区域別の有感，無感地震の月別年平均を示した(第3，第4図)．地震は台湾の海岸から 300 km 以内に起こつたものを採つてある．1930年後無感地震回数が増加しているのは，ウィヘルト地震計が主要な観測所に置かれたためである．この表から分るように，地震回数の最も多いのは，台湾の東海岸に沿つた地域であり，少いのは台湾の西南地域である．1913年～1958年の期間に，花蓮(元の花蓮港)地方では平均年間 128 回の有感地震があつたが，これは全島有感地震回数の 44% に当る．

東海岸に沿う地震の多く起こる地帯を「東側地震帯」，これに対して新竹及び嘉義付近の平地の地震頻発地帯を「西側地震帯」と名付けた．東側地震帯では，震央が陸地の場合は，magnitude は小さく，深さは 10～30 km，時間に対し連続的に起こつている．この地震帯で，震央が海の場合は，magnitude が比較的大きいが，深さは 40～100 km より深く，災害や地形変動を起こすことは稀である．西側地震帯では有史以来多くの破壊地震が起こつている．震源の深さは 0～10 km で，大きな災害と断層，地割，山崩れなど地形変動を生じることが多い．

第4図に，両地震帯の有感回数の時間的変化を示すが，周期性を見出すことは困難である．

第5図に顕著地震の震央分布を示す．顕著地震の多くは，台湾の東海岸と嘉義地方に起こつている。

第6図に稍顕著地震の震央分布を示す．顕著地震と同じ地域に多く起こつている．

第7図に小区域の地震の震央分布を示す．この多くは花蓮の沖に起こつている．

第8図に，局発地震以上の大きい地震の深さ別の分布を示してある．震央の深さは，西側の方が東側より浅い．

1900年以後の破壊地震の数は70である(第6表)．最も大きい被害を生じたのは 1935 年の新竹台中地震である．これに次ぐものは 1906 年の嘉義地震である．両地震とも顕著な地形変動を伴つた．