CANADA
DEPARTMENT OF MINES AND TECHNICAL SURVEYS
Dominion Observatories

PUBLICATIONS

of the

DOMINION OBSERVATORY

OTTAWA

Volume XXVI · No. 6

DIRECTION OF FAULTING IN SOME OF THE LARGER EARTHQUAKES OF 1958

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Price 25 cents

ROGER DUHAMEL, F.R.S.C.
QUEEN'S PRINTER AND CONTROLLER OF STATIONERY
OTTAWA, 1962

Direction of Faulting in Some of the Larger Earthquakes in 1958

ABSTRACT:—Fault-plane solutions are presented for twelve of the larger earthquakes of 1958; the results are summarized in tabular form.

J. H. Hodgson and M. E. Metzger

Introduction

In a paper published very recently (Hodgson et al., 1961) it was announced that this Observatory would continue to publish P-nodal solutions for the larger earthquakes, although it is recognized that the ultimate interpretation placed on these solutions may not be in terms of faulting. This paper continues the program, bringing it up to the end of 1958.

The data for this paper derived from parts of two questionnaires, one circulated in August, 1958, under the title "Fault-Plane Project, 1957-1958," and one circulated in August, 1959 under the title "Fault-Plane Project, 1958-1959." Data from the second questionnaire for earthquakes of 1959 will be used in a later paper.

For the year 1958 data were collected for 24 earth-

TABLE I—LIST OF EARTHQUAKES CONSIDERED

Date	H (G.M.T.)	Epicentre Q	Epicentre λ	Focal Depth	Magnitude	Remarks
Earthquakes for which solutions have not been obtained						
January 19, 1958	14:07:27	1½° N	79½° W	0.01R	7½	Confusion of data. Possibly a double shock.
January 19, 1958	14:43:24	1½° N	79° W	0.01R	6¾	Too few data.
March 11, 1958	00:25:56	25½° N	125° E	0.01R	7	Confusion of data.
April 7, 1958	15:30:38	66½° N	157° W	0.00R	7	Confusion of data. *See* text.
April 13, 1958	09:07:24	66° N	156° W	0.00R	6¾	Too few data.
April 14, 1958	22:48:33	1° N	79½° W	0.00R	6½–6¾	Too few data.
April 15, 1958	03:52:39	9° N	84° W	0.00R	6¾	Too few and confused data.
May 9, 1958	04:40:20	31° S	65½° W	0.01R	6¾	To few and confused data.
May 31, 1958	19:32:30	15° S	169° E	0.00R	7½	Confusion of data at large distances.
September 4, 1958	21:51:08	33½° S	69½° W	0.00R	6¾–7	Too few and poorly distributed data.
November 15, 1958	09:00:45	44° N	149° E	0.00R	6½–6¾	Too few and confused data.
December 10, 1958	07:02:59	37° S	176½° E	0.04R	6¾	Confusion of data.
Earthquakes for which solutions have been obtained						
January 15, 1958	19:14:29	16½° S	71½° W	0.01R	7	
February 1A, 1958	16:10:15	2° N	79° W	0.00R	6¾–7	
February 1B, 1958	18:02:39	2° N	79° W	0.00R	—	
February 1C, 1958	20:45:45	1½° N	79° W	0.00R	6¾	
February 22, 1958	10:50:23	50½° N	175° W	0.00R	6¾	
April 14, 1958	21:32:28	1° N	79½° W	0.00R	6 ¾–7	
April 15, 1958	01:30:43	1° N	79½° W	0.00R	—	
July 26, 1958	17:37:09	13½° S	69° W	0.10R	7–7¼	
August 15, 1958	22:29:17	1½° N	125° E	0.03R	6¾–7	
October 12, 1958	15:18:42	27½° N	125½° E	0.03R	6¾	
November 6, 1958	22:58:06	44½° N	148½° E	0.01R	8–8¼	
November 12, 1958	20:23:26	44½° N	148½° E	0.01R	6¾–7	

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quakes, of which 8 were aftershocks. Solutions or partial solutions have been obtained for 12 of these.

Presentation of the Data

Table I lists the earthquakes for which solutions have been attempted; the listing is in two groups—those for which a solution has been obtained and those for which it has not. In the latter case the reason for the failure is given. Three earthquakes occurred on the same day (February 1st); these have been designated as *a*, *b*, *c* for ease of reference in subsequent tables.

The data on which the solutions are based are listed in Table II, following the notation used in earlier papers of this series.

TABLE II—DATA ON WHICH THE SOLUTIONS ARE BASED

Stations	Jan. 15, 1958	Feb. 1A, 1958	Feb. 1B, 1958	Feb. 1C, 1958	Feb. 22, 1958	Apr. 14, 1958	Apr. 15, 1958	July 26, 1958	Aug. 15, 1958	Oct. 12, 1958	Nov. 6, 1958	Nov. 12, 1958
Abashiri											D	D
Aberdeen	C	C		(D)	D	(D)	(D)	(C)	(D)		C	C
Adelaide										D	C	C
Akita								D_1'	C		D	
Alberni								D			C	
Alger University	C					C						
Alicante	C	C	C	C	(C)	C	(D)	(C)			C	C
Alishan										C		
Almeria	C	C	C	C	(C)	C			C_1'		C	(D)
Angra Do Herosimo	(D)					C		D				
Ann Arbor	C			C	D	C	C	D				
Antigua					C							
Antofagasta				C								
Aomori									C		D	C
Arcata						D	(D)					
Asahikawa											D	D
Astrida	D				C_1'			D	C			
Athens								D		(C)	C	C
Balboa Heights	C	C	C	C		D	D	C	(C_1')			
Bandong						(D_1')	C_1'	D_1'				
Banff	C			C	D						C	
Barbados						(D)		C			C	
Barcelona								(C)				
Basel	C		C	C	D	C	C	D				
Belgrade	C	C	(D)		D	(D)		(C)	(C)		C	(D)
Bensberg	C	C	C	C	D			D				
Berkeley	C	D	D		D	D	C	D		D	C	C
Bogota	C	D	D	C		D		C				
Bokaro									C		C	C
Bologna											C	(D)
Bombay	(C_1')	C_1'	C_1'	C_1'	C	C_1'	C_1'	D_1'				
Boulder City	C		D	C	D	D		D	(C)	D		C
Bozeman	C	C	C	(D)	D	D				D	C	(D)
Bratislavia	(D)	C	C	C	D	C	C		(D)	(C)	(D)	(D)
Bucarest									C	D	C	
Buenos Aires		D	D	(D)								
Butte	C	C		C	D			D		D	(D)	C
Byrd	(C)	D			(D_1')							
Bytom								D				
Calcutta	C_2'	C_1'			(C)	(D_1')						
Canberra									(C)	D		(D)
Canton		C_1'						D_1'				
Cartuja	(D)	(D)	(D)	(C)	(C)	(D)	C	D			C	C
Chatra							(D)			C		(C)
Chichibu											C	
Chihuahua								D			C	
China Lake										D	C	
Chinchina	D	(D)	(D)	D		D	D	(D)			(D)	
Chur										D	C	C

TABLE II—DATA ON WHICH THE SOLUTIONS ARE BASED—*Continued*

Stations	Jan. 15, 1958	Feb. 1A, 1958	Feb. 1B, 1958	Feb. 1C, 1958	Feb. 22, 1958	Apr. 14, 1958	Apr. 15, 1958	July 26, 1958	Aug. 15, 1958	Oct. 12, 1958	Nov. 6, 1958	Nov. 12, 1958
Cine	.....	.....	.....	.....	.....	.....	.....	.....	.....	D	.....	C
Clermont	C	C	C	C	D	C	C	D	.....	.....	.....	.....
Cleveland	C	C	C	(D)	D	(D)	C	D	D_1'	.....	C	C
Coimbra	C	(D)	(D)	(D)	.....	.....	(D)	D	.....	.....	(D)	.....
College	C	C	C	C	(C)	(D)	.....	(C)	C	D	D	C
Cologne	.....	.....	.....	.....	.....	.....	.....	.....	.....	D	C	.....
Colombo	.....	.....	.....	.....	.....	.....	.....	D_1'	(D)	C	(D)	C
Columbia	C	C	C	C	D	C	.....	(C)	.....	.....	C	C
Comitan	.....	.....	.....	.....	.....	D	D	.....	.....	.....	.....	.....
Concepcion	D	.....	.....	.....	.....	.....	.....	C	.....	.....	.....	.....
Copenhagen	C	.....	.....	.....	D	(D)	C	D	C	D	C	C
Corvallis	C	D	.....	C	D	D	C	D	.....	.....	.....	.....
De Bilt	C	C	.....	.....	.....	.....	C	D	.....	.....	C	.....
Dehra Dun	D_1'	(D_1')	.....	.....	D	(D_1')	.....	.....	.....	.....	C	C
Djakarta	.....	C_2'	.....	.....	.....	(D_1')	.....	.....	.....	.....	C	C
Durham	C	C	C	C	(C)	C	C	D	C	.....	.....	C
Edinburgh	.....	.....	.....	.....	.....	.....	.....	D	C	.....	C	(D)
Erevan	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	C	C
Eureka	C	(C)	.....	C	D	(C)	.....	D	D	D	C	C
Fanatsu	.....	.....	.....	.....	.....	.....	.....	.....	C	.....	.....	.....
Fayetteville	C	C	C	C	(C)	.....	.....	.....	.....	.....	.....	C
Florence	C	C	C	.....	.....	.....	.....	D	C	.....	.....	.....
Florissant	.....	.....	C	C	D	.....	.....	.....	.....	.....	C	C
Fresno	C	D	D	C	D	.....	.....	D	.....	.....	.....	.....
Fukui	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	(D)	.....
Fukuoko	.....	.....	.....	.....	.....	.....	.....	.....	.....	C	C	C
Fukushima	.....	.....	.....	.....	.....	.....	.....	.....	C	.....	C	C
Funatsu	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	C	.....
Galerazamba	.....	.....	.....	.....	.....	.....	.....	C	.....	.....	.....	.....
Gifu	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	C	C
Goteborg	.....	.....	.....	.....	.....	.....	.....	.....	.....	D	.....	.....
Grahamstown	.....	.....	.....	.....	.....	.....	.....	D	.....	.....	.....	.....
Grenada	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	C	.....
Guadalajara	.....	.....	.....	.....	.....	.....	.....	D	.....	.....	C	.....
Guam	D	.....	.....	.....	.....	.....	.....	D_1'	.....	.....	.....	.....
Hachinohe	.....	.....	.....	.....	.....	.....	.....	.....	C	.....	.....	C
Hakodate	.....	.....	.....	.....	.....	.....	.....	.....	(D)	.....	D	C
Halifax	C	C	C	C	D	.....	C	D	D_1'	.....	C	.....
Hamada	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	(D)	(D)
Hawaii	D	D	.....	.....	C	C	.....	(D)	.....	.....	.....	.....
Helwan	.....	.....	.....	.....	(D)	.....	.....	.....	C	D	C	C
Hengchun	.....	.....	.....	.....	.....	.....	.....	.....	C	C	(D)	.....
Hermanus	(C)	D	.....	.....	.....	C	.....	.....	.....	.....	.....	.....
Hikone	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	C	C
Hiroo	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	C
Hiroshima	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	C	.....
Hong Kong	.....	.....	.....	.....	D	.....	.....	D_1'	C	C	C	C
Hongo	.....	.....	.....	.....	.....	.....	.....	D_1'	C	.....	C	C
Honolulu	.....	.....	.....	.....	C	.....	.....	C	D	.....	C	C
Horseshoe Bay	C	.....	.....	.....	.....	C	.....	(C)	.....	D	C	.....
Huancayo	(C)	C	C	.....	.....	(D)	C	C	.....	D_1'	C_1'	.....
Hungry Horse	C	C	C	C	D	D	.....	D	.....	D	C	C
Hurbanova	.....	.....	.....	.....	.....	.....	.....	.....	(D)	.....	(D)	(D)
Hyderabad	D_1'	(D_1')	.....	.....	C	C_1'	C_1'	(C_1')	C	.....	C	C
Iasi	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	C
Ilan	.....	.....	.....	.....	.....	.....	.....	.....	C	C	.....	.....
Isabella	.....	.....	.....	.....	.....	.....	.....	.....	.....	D	.....	C
Ishinomaki	.....	.....	.....	.....	.....	.....	.....	.....	(D)	.....	C	.....
Istanbul	D_1'	C	.....	.....	.....	.....	.....	.....	.....	C	C	.....

TABLE II—DATA ON WHICH THE SOLUTIONS ARE BASED—*Continued*

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Jena	C	.....	C	C	D	.....	.....	D (C)	.....	.....	.....	.....
Jersey	.....	.....	.....	.....	.....	.....	.....	.....	(D)	(C)	(D)	.....
Jerusalem	.....	.....	.....	.....	.....	.....	.....	.....	.....	C	C	C
Kagoshima	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	C	.....
Kakioka	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	C	.....
Kameyama	.....	.....	.....	.....	.....	.....	.....	.....	.....	D	C	C
Karachi	.....	.....	.....	.....	.....	.....	.....	.....	D	.....	C	C
Karapiro	.....	C	.....	C	D	C	C	D	.....	.....	.....	.....
Karlsruhe	C	C	C	C	D	C	C	D	.....	D	C	.....
Kew	.....	.....	.....	.....	(D_1')	.....	.....	.....	.....	.....	.....	.....
Kimberley	.....	.....	.....	.....	.....	.....	.....	C	.....	D	C	D
Kipapa	.....	.....	.....	.....	D	.....	.....	.....	C	D	C	.....
Kiruna	.....	.....	.....	.....	.....	.....	.....	.....	C	C	.....	.....
Kochi	.....	.....	.....	.....	.....	.....	.....	.....	C	.....	C	(D)
Kodaikanal	D_1'	(D_1')	.....	.....	.....	.....	.....	.....	.....	.....	C	D
Kofu	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	C	C
Koror	.....	.....	.....	.....	D	.....	.....	.....	C	D	C	.....
Krakow	.....	.....	.....	.....	D	C	C	D	.....	.....	.....	.....
Ksara	D_1'	C	.....	.....	C	.....	.....	D	C	D	C	C
Kumamoto	.....	.....	.....	.....	.....	.....	.....	.....	.....	C	C	.....
Kunming	D_1'	C_1'	C_1'	.....	D	.....	.....	.....	.....	.....	.....	.....
Kushiro	.....	.....	.....	.....	.....	.....	.....	.....	C	.....	D	C
Kyoto	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	C	.....
Lahore	.....	.....	.....	.....	.....	.....	.....	.....	.....	D	.....	.....
Lanchow	.....	.....	.....	.....	D	.....	.....	.....	.....	.....	.....	.....
La Paz	.....	.....	.....	C	.....	.....	C	.....	D_1'	D_1'	(D_1')	C_1'
La Plata	D	(C)	.....	.....	.....	C	C	C	.....	.....	.....	.....
Lembang	.....	(D_1')	C_1'	(D_1') C_2'	.....	.....	C_1'	D_1'	C	D	.....	C
Lisbon	C	C	C	C	D	C	C	D	(D_1')	.....	C	(D)
Lubbock	.....	.....	.....	.....	.....	.....	.....	.....	D_1'	.....	C	C
Lwiro	C	.....	.....	.....	(D_1')	.....	.....	D	C	(C)	C	C
MacQuarie	.....	.....	.....	.....	.....	.....	.....	.....	D	.....	C	.....
Madras	.....	.....	.....	.....	C	.....	.....	.....	.....	.....	.....	C
Maizuru	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	C
Maebashi	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	C	.....
Malaga	.....	.....	.....	.....	.....	.....	.....	.....	(D_1')	.....	C	C
Manzanillo	.....	.....	.....	.....	.....	.....	.....	D	.....	.....	C	.....
Matsue	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	C	.....
Matsushiro	.....	.....	.....	.....	D	.....	.....	D	C	C	.....	C
Matsuyama	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	C	.....
Mazatlan	.....	.....	.....	.....	.....	.....	.....	D	.....	.....	.....	.....
M'Bour	C	C	C	C	C_1'	C	C	D	C_1'	.....	C	.....
Medan	D_1'	(D_1')	C_1'	(D_1')	C	(D_1')	.....	(C_1')	C	.....	.....	C
Melbourne	.....	.....	.....	.....	.....	.....	.....	.....	D	D	C	C
Merida	C	D	D	D	.....	D	D	D	.....	.....	C	.....
Meszstetten	C	C	C	C	D	.....	.....	D	.....	.....	C	C
Mineral	C	D	D	C	D	D	.....	D	.....	.....	.....	.....
Mishima	.....	.....	.....	.....	.....	.....	.....	.....	C	.....	C	.....
Miyako	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	C	.....
Miyazaki	.....	.....	.....	.....	.....	.....	.....	.....	C	C	C	C
Montreal	C	C	C	C	D	C	C	D	D_1'	.....	C	.....
Morgantown	.....	C	(D)	(D)	D	(D)	C	.....	.....	.....	C	(D)
Mori	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	D	.....
Morioka	.....	.....	.....	.....	.....	.....	.....	.....	C	.....	C	.....
Morne des Cadets	C	C	C	C	.....	(D)	(D)	D	.....	.....	.....	.....
Moscow	.....	.....	.....	.....	D	.....	.....	.....	C	D	.....	C
Mount Hamilton	C	D	D	C	D	(C)	C	D	.....	D	C	C
Muroran	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	C

TABLE II—DATA ON WHICH THE SOLUTIONS ARE BASED—*Continued*

Stations	Jan. 15, 1958	Feb. 1A, 1958	Feb. 1B, 1958	Feb. 1C, 1958	Feb. 22, 1958	Apr. 14, 1958	Apr. 15, 1958	July 26, 1958	Aug. 15, 1958	Oct. 12, 1958	Nov. 6, 1958	Nov. 12, 1958
Murotomisaki											C	
Nagano											C	C
Nagasaki										C	C	
Nagoya												C
Nanking					D							
Nemuro											D	
Neuchatel	C	C	C	C	D	C	C	D		(C)		
Niigata											C	C
Noumea	D_1'	D_1'	D_1'		(D)			D_1'				
Oaxaca								D				
Obihiro											D	
Oita										C	C	C
Oiwake											C	
Onahama											C	
Onerahi									D			
Oropa											C	C
Osaka											C	C
Oshima											C	
Ottawa		C	C		D	C	C	D			C	
Owase											C	
Owashi										C		
Palisades	C	C	C	C	D	C	C	D			C	C
Palomar											C	
Palo Alta	C		D	D	D	D						
Parc St. Maur									C	D	C	C
Pasadena	C							D		D	C	C
Pavia	C	C				C		(C)			C	(D)
Peking					D							
Perth		C_1'	C_1'			C_1'	D				C	C
Pietermaritzburg	D											
Pittsburg	C				D						C	(D)
Poona											C	C
Ponta Delgada						(D)		(C)			C	
Port Blair											C	C
Port Moresby									D	D	C	C
Prague	C	C			D			(C)	C		C	
Pruhonice										(C)	C	C
Pulkovo											C	
Quetta		C_1'	C_1'	C_1'	D					D	C	C
Raciborz	C	C	C	C	D	C		(C)				C
Rapid City	C	C			D	(C)		D	(C_1')	D	C	C
Rathfarnham	C	C	(D)	C	D	C		D			C	C
Ravensburg								D			C	
Reggio Calabria											C	
Relizane	C	C	C	C							C	
Reno	C	D	D	C	D	D	C	D				
Resolute	C		C	C	D	C	C	D	C	D	C	C
Reykjavik	C	C	C					D			C	
Riverside										D	C	
Riverview		C_1'			C	C_1'		D_1'	D	D	C	C
Rome	C	C	C				C	D			C	
Roxburgh									D		C	C
Rumangabo								D			C	
Saga												C
Saigo											(D)	
St. Louis	C	(D)	C	C		C	C	D			C	C
St. Vincent	C	(D)									(D_1')	
Sakata											C	
Salt Lake City	C	D	(C)	C	D	D		D	(C)	D	C	C

TABLE II—DATA ON WHICH THE SOLUTIONS ARE BASED—*Continued*

Stations	Jan. 15, 1958	Feb. 1A, 1958	Feb. 1B, 1958	Feb. 1C, 1958	Feb. 22, 1958	Apr. 14, 1958	Apr. 15, 1958	July 26, 1958	Aug. 15, 1958	Oct. 12, 1958	Nov. 6, 1958	Nov. 12, 1958
San Juan	C	C	C	C	.....	C	.....	D	.....	.....	(D)	.....
Santa Clara	C	D	(C)	C	.....	.....	.....	.....	.....	.....	.....	.....
Santa Lucia	(C)	D	.....	.....	.....	C	.....	C	.....	.....	.....	.....
Sapporo	.....	.....	.....	.....	.....	.....	.....	.....	C	.....	D	C
Scoresby Sund	(D)	.....	(D)	.....	D	(D)	.....	.....	.....	(C)	C	(D)
Seattle	C	D	.....	C	.....	D	C	D	D	D	C	(D)
Serra do Pilar	.....	.....	.....	.....	.....	.....	.....	.....	C_1'	(C)	(D)	C
Sendai	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	C	.....
Seven Falls	C	C	C	C	D	.....	C	D	.....	.....	C	.....
Shasta	C	.....	.....	.....	.....	.....	.....	D	.....	D	C	C
Shawinigan Falls	C	.....	C	C	D	C	C	D	.....	.....	C	.....
Shillong	D_1'	C_1'	C_1'	.....	D	C_1'	C_1'	(C_1')	C	D	C	C
Shimizu	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	C	.....
Shimonoseki	.....	.....	.....	.....	.....	.....	.....	.....	.....	C	.....	.....
Shionomisaki	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	C	.....
Shirakawa	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	C	.....
Shizuoka	.....	.....	.....	.....	.....	.....	.....	.....	C	C	C	.....
Sida	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	C	.....
Simferopol	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	C	C
Sitka	(D)	.....	C	C	(C)	.....	.....	C	C	(C)	D	.....
Skalnate Pleso	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	(D)	(D)
Skalstugan	.....	.....	.....	C	D	.....	.....	.....	C	.....	C	.....
Skopje	C	C	.....	.....	C	C	.....	D	(D)	.....	(D)	C
Sodankyla	.....	.....	.....	.....	.....	.....	.....	.....	(D)	(C)	(D)	.....
South Pole	D	.....	.....	.....	.....	.....	.....	(C)	D	.....	.....	.....
State College	C	C	.....	.....	(C)	C	C	D	.....	.....	C	(D)
Strasbourg	C	C	C	C	D	C	C	D	.....	(C)	C	C
Stuttgart	C	C	C	C	D	C	C	D	.....	D	C	.....
Sumoto	.....	.....	.....	.....	.....	.....	.....	.....	.....	C	C	C
Tacubaya	D	D	D	D	.....	D	D	D	.....	.....	C	(D)
Taipei	.....	.....	.....	.....	.....	.....	.....	.....	C	C	C	C
Taitung	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	C	.....
Tala Pozo	.....	.....	.....	.....	.....	C	C	.....	.....	.....	C_1'	.....
Tamanrasset	.....	.....	.....	.....	.....	C	C	D	.....	.....	C	.....
Tananarive	.....	D_1'	C_1'	.....	.....	.....	.....	.....	D	(C)	.....	.....
Tawu	.....	.....	.....	.....	.....	.....	.....	.....	C	.....	C	.....
Thule	.....	.....	.....	.....	.....	.....	.....	.....	(D)	.....	.....	.....
Tinemaha	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	C	.....
Tokushima	.....	.....	.....	.....	.....	.....	.....	.....	C	C	C	C
Tokyo	.....	.....	.....	.....	.....	.....	.....	.....	(D)	C	C	C
Toledo	C	C	C	C	D	C	(D_1')	.....	.....	.....	C	C
Tomakomai	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	D	.....
Tomie	.....	.....	.....	.....	.....	.....	.....	.....	.....	C	C	C
Toyooka	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	C	C
Tomisaki	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	C	.....
Tongariro	.....	.....	.....	.....	.....	.....	.....	.....	D	.....	.....	.....
Toyama	.....	.....	.....	.....	.....	.....	.....	.....	C	.....	(D)	.....
Toyooka	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	C	C
Trieste	.....	C	C	.....	D	.....	(D)	D	.....	D	C	C
Trinidad	.....	.....	.....	.....	.....	.....	.....	.....	.....	D	C	.....
Truk	(C_1')	.....	.....	.....	C	.....	.....	D_1'	.....	D	(D)	.....
Tsu	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	C	.....
Tsukuba	D_1'	(D_1')	C_1'	.....	D	C_1'	.....	D_1'	C	C	C	C
Tsuruga	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	C	.....
Tubingen	.....	.....	C	C	D	.....	.....	D	.....	.....	C	.....
Tucson	C	D	(C)	D	D	D	.....	D	D_1'	D	C	C
Uccle	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	C	C
Ukiah	C	D	.....	.....	D	D	.....	D	.....	D	C	C
Unzendaki	.....	.....	.....	.....	.....	.....	.....	.....	C	C	.....	.....

TABLE II—DATA ON WHICH THE SOLUTIONS ARE BASED—*Concluded*

Stations	Jan. 15, 1958	Feb. 1A, 1958	Feb. 1B, 1958	Feb. 1C, 1958	Feb. 22, 1958	Apr. 14, 1958	Apr. 15, 1958	July 26, 1958	Aug. 15, 1958	Oct. 12, 1958	Nov. 6, 1958	Nov. 12, 1958
Uppsala	.....	.....	.....	.....	D	.....	.....	.....	C	D	C	C
Urakawa	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	D	C
Utsunomiya	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	(D)	.....
Uvira	.....	.....	.....	.....	(D_1')	.....	.....	.....	.....	.....	C	.....
Veracruz	.....	D	.....	.....	.....	.....	.....	.....	.....	.....	C	.....
Victoria	C	D	D	.....	D	C	.....	D	C	D	C	C
Vienna	.....	.....	.....	.....	(C)	.....	.....	D	C	D	C	C
Wajima	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	C
Wakayama	.....	.....	.....	.....	.....	.....	.....	.....	C	.....	C	.....
Wakkani	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	(C)	.....
Warsaw	.....	.....	.....	.....	.....	.....	.....	.....	C	(C)	C	.....
Washington	(D)	C	.....	.....	(C)	(D)	.....	(C)	(C_1')	.....	(D)	.....
Wellington	D	.....	.....	.....	.....	.....	.....	.....	D	.....	C	.....
Weston	C	C	C	.....	.....	.....	.....	.....	.....	.....	.....	.....
Witteveen	.....	C	C	C	.....	.....	.....	.....	.....	(C)	C	.....
Woody	.....	.....	.....	.....	.....	.....	.....	.....	.....	D	.....	C
Yakushima	.....	.....	.....	.....	.....	.....	.....	.....	C	C	C	C
Yamagata	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	C	C
Yokohama	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	C	.....
Zabrze	.....	.....	.....	.....	.....	.....	.....	D	.....	.....	.....	.....
Zagreb	.....	(D)	C	.....	.....	C	.....	D	C	.....	C	C
Zose	D_1'	.....	.....	.....	D	.....	.....	D_1'	.....	.....	.....	.....
Zurich	.....	C	C	C	.....	C	.....	.....	.....	.....	.....	.....

Analysis of the Data

Earthquake of 19:14:29, Jan. 15, 1958. $\phi = 16\ 1/2°S$, $\lambda = 71\ 1/2°W$

The solution for this earthquake is shown in Figure 1. Circle *b* is closely defined by the PKP observations. By drawing circle *a* to pass through both Balboa and Chinchina both these stations may be regarded as correct and the position of circle *a* would then be defined exactly. This seems the more probable solution, but it does make the compressional observations at Huancayo and Santa Lucia inconsistent. These could be made consistent at the expense of Tacubaya and Chinchina by drawing circle *a* in the dashed position. This would have the effect of reversing the direction of displacement on *b*, supposing it to be the fault, or of reversing the direction of both dip and displacement on *a*, supposing it to be the fault. The score, given in Table III is the same in either case.

TABLE III

——	P	P_1'	P_2'
Total number of observations	95	13	1
Number of inconsistent observations	10	2	0

Earthquake of 16:10:15, Feb. 1, 1958. $\phi = 2°N$, $\lambda = 79°W$.

Data have been collected on this earthquake and five of its principal aftershocks, and these have yielded solutions in five of the six events. The solution for the main shock is shown in Figure 2. Circle *b* is quite closely defined in western North America and by PKP observations from South Pacific stations. Circle *a* is equally well defined by the PKP_2 observation at Djakarta

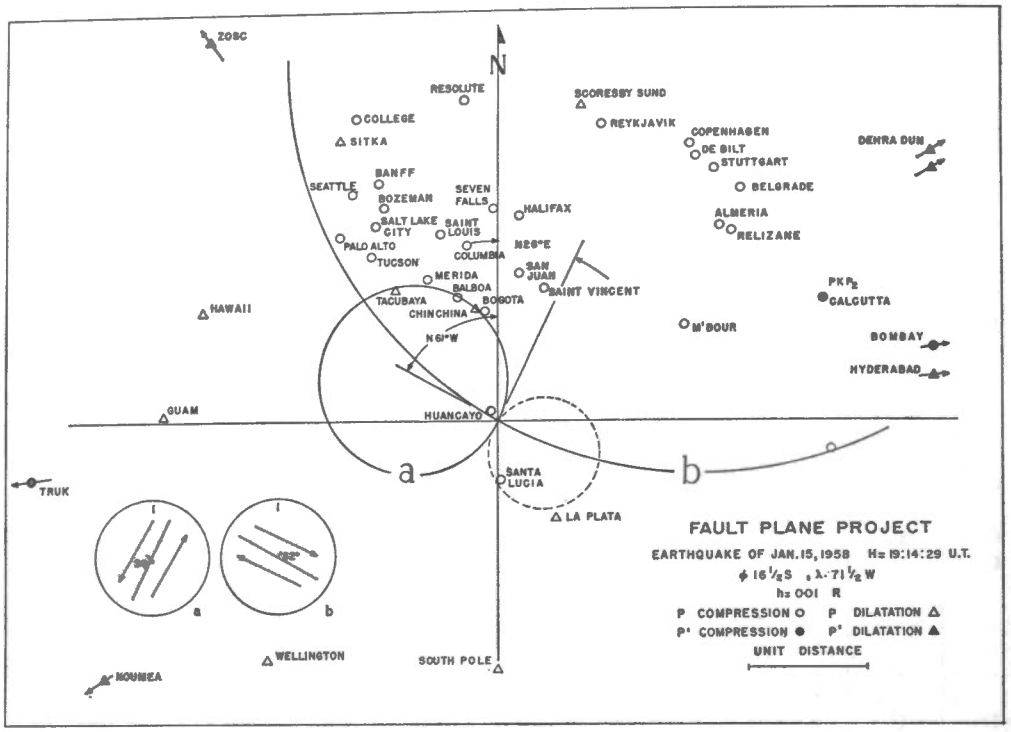

Figure 1.

and the PKP observation at Tananarive. However these observations, being from such distant stations, must not be relied on too strongly. If it were not for them, circle *a* could shrink to the position indicated by circle *a'*, and any position between *a* and *a'* could be admitted. Since all these circles would have the same strike as circle *a* there is little difference in the geological interpretation; only the dip is different, having decreased from 85° to 56°.

The dilatational observation at Chinchina represents the most serious inconsistency in the solution. The USCGS has assigned a focal depth to this earthquake of 60 km, whereas extended distance values have been taken from the 0.00R tables. If the tables had been interpolated to get 60 km the effect would have been to move Chinchina in very close to the epicentre, so that it would have become consistent.

The score for the solution is given in Table IV.

TABLE IV

——	P	P_1'	P_2'
Total number of observations.....	82	16	1
Number of inconsistent observations...	8	6	0

Earthquake of 18:02:39, Feb. 1, 1958. $\phi = 2°$N, $\lambda = 79°$ W.

This is a principal aftershock of the Ecuador earthquake. While there are less data, so that the solution is less definitely defined, the solution shown in Figure 2 again provides the best fit to the data. The score for this solution is given in Table V.

TABLE V

——	P	P_1'
Total number of observations.....	69	10
Number of inconsistent observations.....	11	0

Earthquake of 20:45:45, Feb. 1, 1958. $\phi = 1$ 1/2° N, $\lambda = 79°$ W.

In this, the third of the Ecuador series of shocks, the pattern of compressions and dilatations has changed sufficiently so that the solution is considerably different. It will be informative for the reader to compare Figure 3 with the earlier pattern shown in Figure 2. The first difference appears in western North America, where the contact between compressions and dilatations has dropped considerably to the south. This has resulted in

a shortening of the radius of circle *b*. The second difference is in South America, where the compressional observations at La Paz and Antofagasta force a shortening of the radius of circle *a*. Circle *a* has been shown in the normal position, indicating pure thrust faulting. In fact it is not so closely controlled, and a fairly high strike-slip component, in either sense, might be possible.

The score for the solution is shown in Table VI.

TABLE VI

——	P	P_2'	P_3'
Total number of observations.....	69	4	1
Number of inconsistent observations...	7	2	0

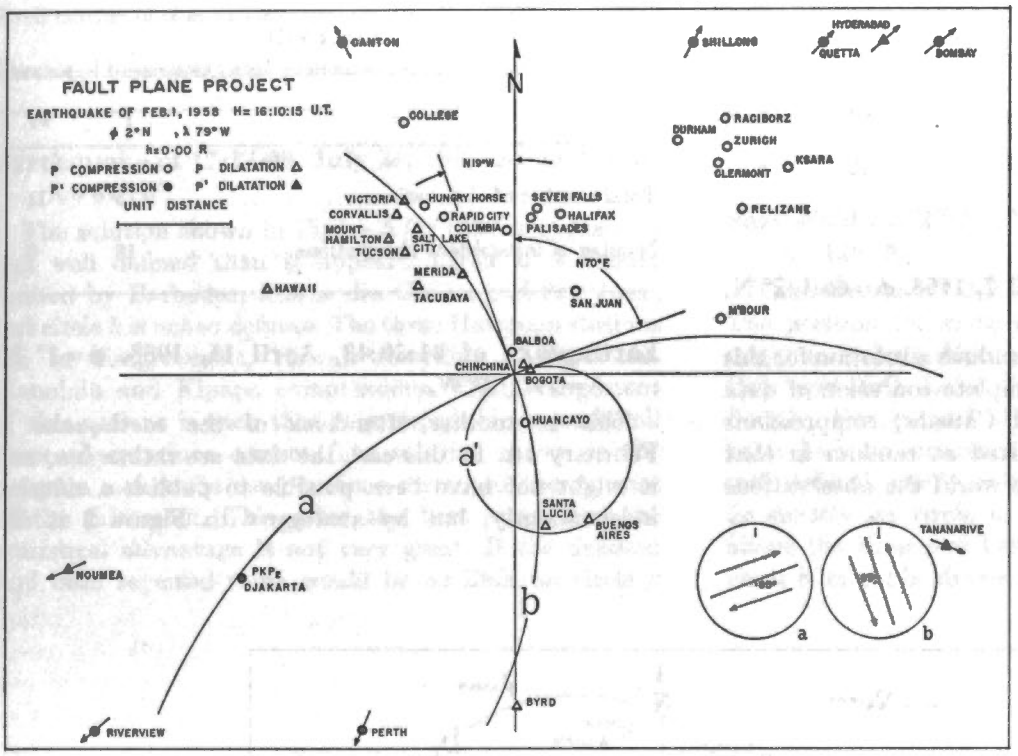

Figure 2.

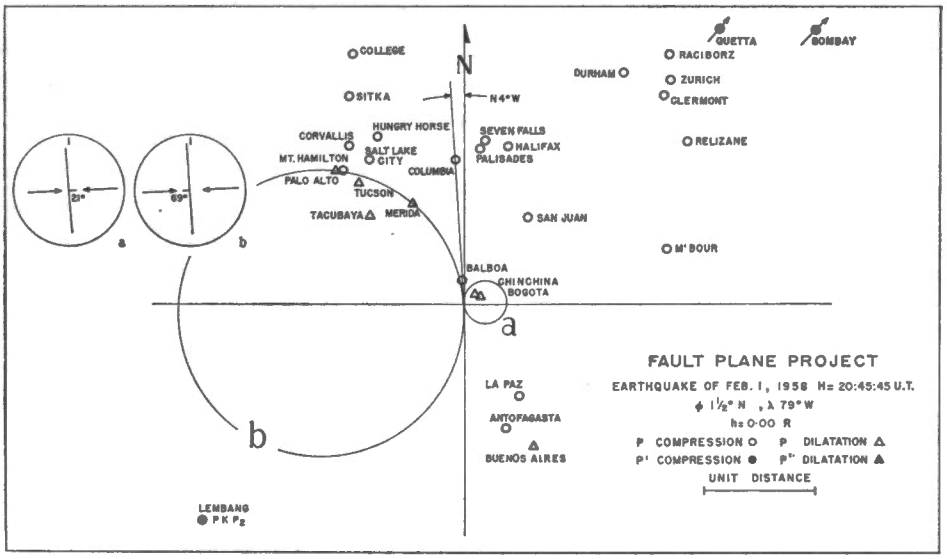

Figure 3.

Earthquake of 10:50:23, Feb. 22, 1958. $\phi = 50\ 1/2°$ N, $\lambda = 175°$ W.

The solution for this earthquake is shown in Figure 4 and the score is given in Table VII. The solution seems reasonably straightforward and the score is about normal except for the large number of inconsistencies in PKP. These probably result from the small magnitude (6 3/4) of the earthquake.

TABLE VII

	P	P_1'
Total number of observations.....	94	6
Number of inconsistent observations.....	13	4

Earthquake of 15:30:38, April 7, 1958. $\phi = 66\ 1/2°$ N, $\lambda = 157°$ W.

It has not been possible to produce a solution for this earthquake because there is complete confusion of data in western United States and Canada; compressions and dilatations seem to be mixed at random in that area. Elsewhere throughout the world the observations showed regional consistency.

Earthquake of 21:32:28, April 14, 1958. $\phi = 1°$ N, $\lambda = 79\ 1/2°$ W.

This earthquake is an aftershock of that of February 1A, and the solution is very similar to that shown in Figure 3. In the present case the fault plane is inclined a little more to the east, at about N30°E and the faulting is again predominantly thrust although some right-lateral strike-slip movement is possible. The score for the solution, shown in Table VIII is rather poor, reflecting the low magnitude of the earthquake, but no radically different solution would be possible.

TABLE VIII

——	P	P_1'
Total number of observations.....	75	11
Number of inconsistent observations.....	16	5

Earthquake of 01:30:43, April 15, 1958. $\phi = 1°$ N, $\lambda = 79\ 1/2°$ W.

This is another aftershock of the earthquake of February 1A. In this case the data are rather few, and it might not have been possible to publish a solution independently, but by analogy with Figure 3 it can

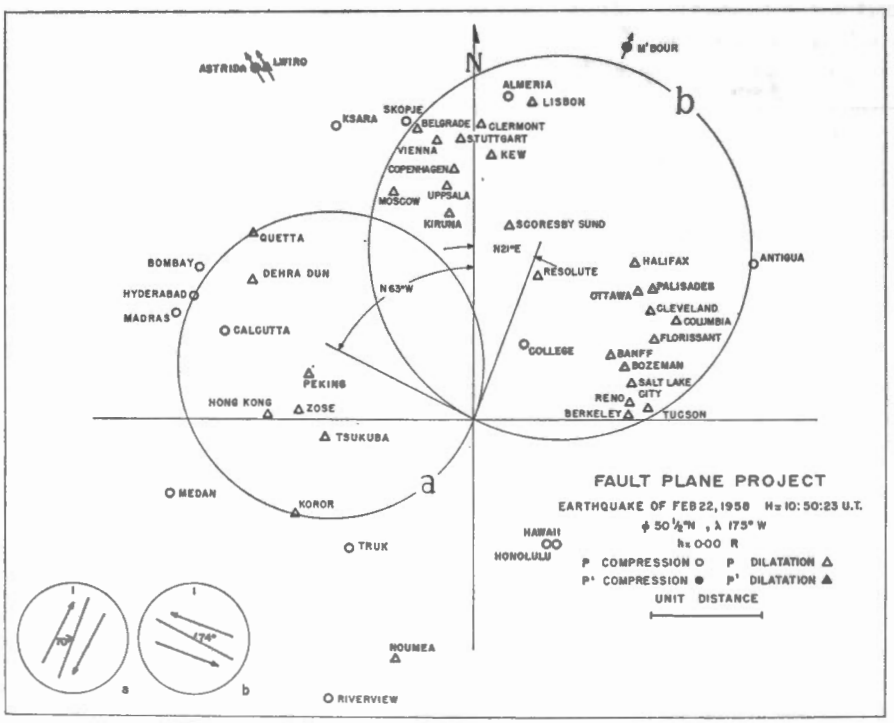

Figure 4.

again be said that thrust faulting on a plane striking N or slightly east of N, with a possible right-lateral strike-slip component, would be the only possible solution.

Score for this solution is given in Table IX.

TABLE IX

	P	P_1'
Total number of observations	49	5
Number of inconsistent observations	7	0

Earthquake of 17:37:09, July 26, 1958. $\phi = 13\ 1/2°$ S, $\lambda = 69°$ W.

The solution shown in Figure 5 for this earthquake is less well defined than it appears. Circle *a* is closely limited by Barbados, Morne des Cadets and San Juan, but circle *b* is not so definite. The three Hawaiian stations are in disagreement, Hawaii recording a dilatation, Honolulu and Kipapa compressions. The arrangement of the stations is such that it is impossible to make all three observations correct. The solution shown in the diagram makes the compressions correct at the expense of the dilatation. This gives the best score, but the statistical advantage is not very great. If the decision had been reversed there would be no limit on circle *b* and it might have been drawn in any position down to that normal to *a*.

It must therefore be concluded that faulting is on a plane striking between EW and ENE. The faulting is strongly normal with a possible strike-slip component. The score for the published solution is shown in Table X.

TABLE X

	P	P_1'
Total number of observations	105	17
Number of inconsistent observations	15	3

Earthquake of 22:29:17, August 15, 1958. $\phi = 1\ 1/2°$ N, $\lambda = 125°$ E.

The solution for this earthquake is given in Figure 6. The position for circle *a* is reasonably well defined; it might have been drawn slightly larger to make Boulder City and Salt Lake City correct at the expense of Seattle, Eureka and Halifax, but the increase would have had no geological significance. Circle *b* is less well defined, partly because both Lembang and Koror lie exactly on circle *a*. If Koror is regarded as lying above the circle and Lembang as lying below the circle, circle *b'* might be drawn to make Lembang and Colombo

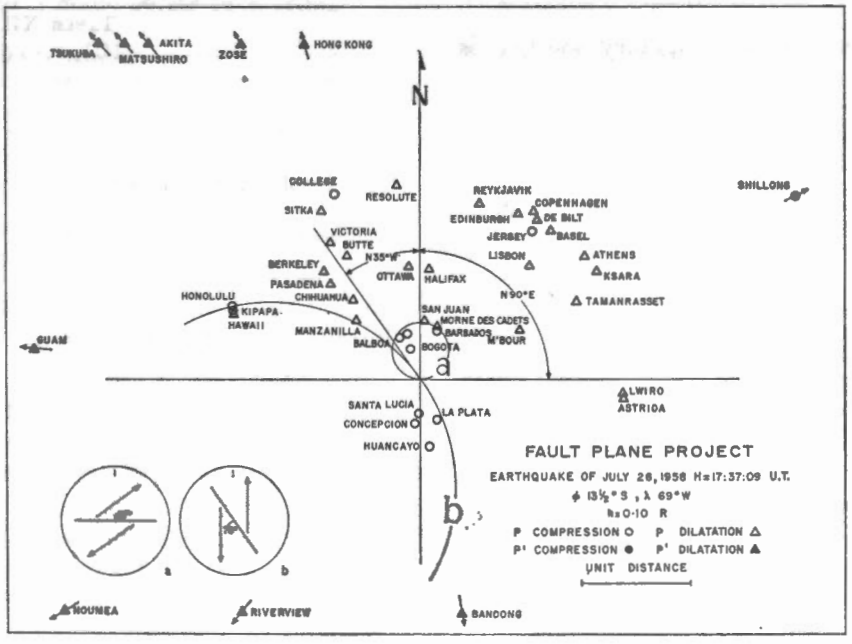

Figure 5.

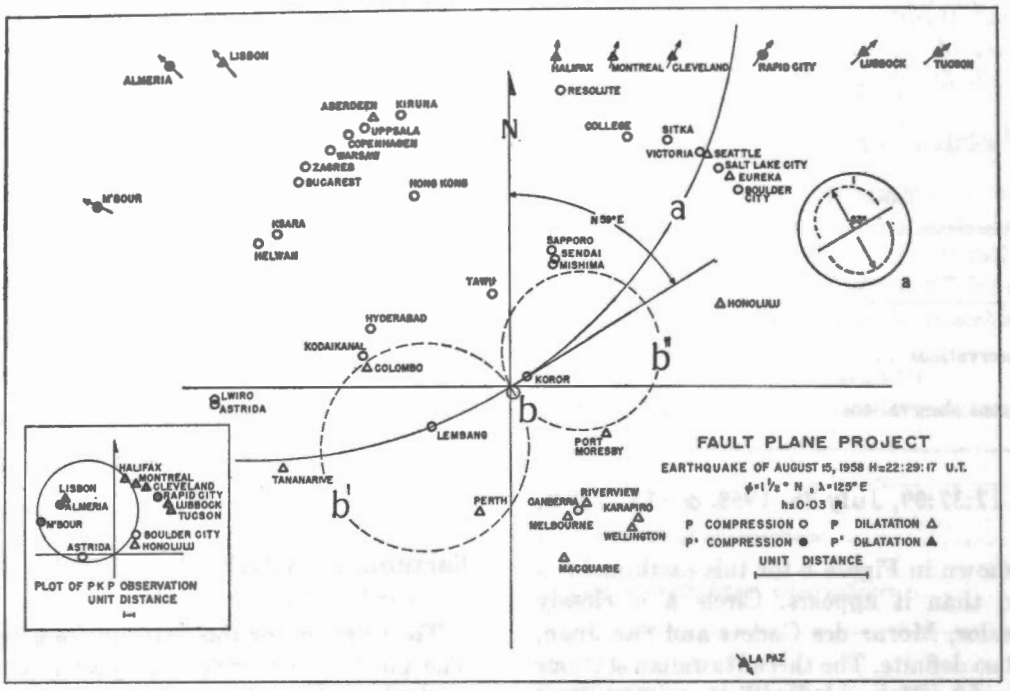

Figure 6.

correct at the expense of Perth. On the other hand, if Lembang is regarded as lying above the circle and Koror below, one is led to a circle such as b''. If both Lembang and Koror are regarded as being above the line, then a circle such as b is indicated. It may only be concluded that if a represents the fault, faulting is normal, with a possible strike-slip component in either sense; if circle b is the fault, strike and sense of motion are undefined.

The score for this rather unsatisfactory solution is given in Table XI.

TABLE XI

——	P	P_1'
Total number of observations.....	85	15
Number of inconsistent observations.....	15	6

Earthquake of 15:18:42, Oct. 12, 1958. $\phi = 27\ 1/2°$ N, $\lambda = 125\ 1/2°$ E.

In this earthquake all the nearby stations, in Japan, Formosa and the nearer parts of India, received initial compressions, all other stations—with the usual pergentage of inconsistencies—received dilatations. The diagram is so simple that it has not been reproduced. The solution is thus in terms of a pair of small compressional circles close to the centre of the map. One of these circles is partly defined, and appears to strike about N-S and to dip west at an angle of about 55°. The other circle is not at all defined. The faulting may be regarded as normal along a roughly N-S plane with a possible undefined strike-slip component.

The score is given in Table XII.

TABLE XII

——	P	P_1'
Total number of observations.....	91	2
Number of inconsistent observations.....	14	0

Earthquake of 22:58:06, Nov. 6, 1958. $\phi = 44\ 1/2°$ N, $\lambda = 148\ 1/2°$ E.

Except for the usual inconsistent observations, fewer in number than usual, the distant observations in this earthquake were solidly compressional. The solution is thus in terms of a pair of small dilatational circles which are well defined. The diagram of the central region, in an enlarged scale, is shown in Figure 7. The strike of circle a is extremely well defined by the Japanese stations. The nearby observations would have suggested a somewhat larger radius, to include Shimonoseki for

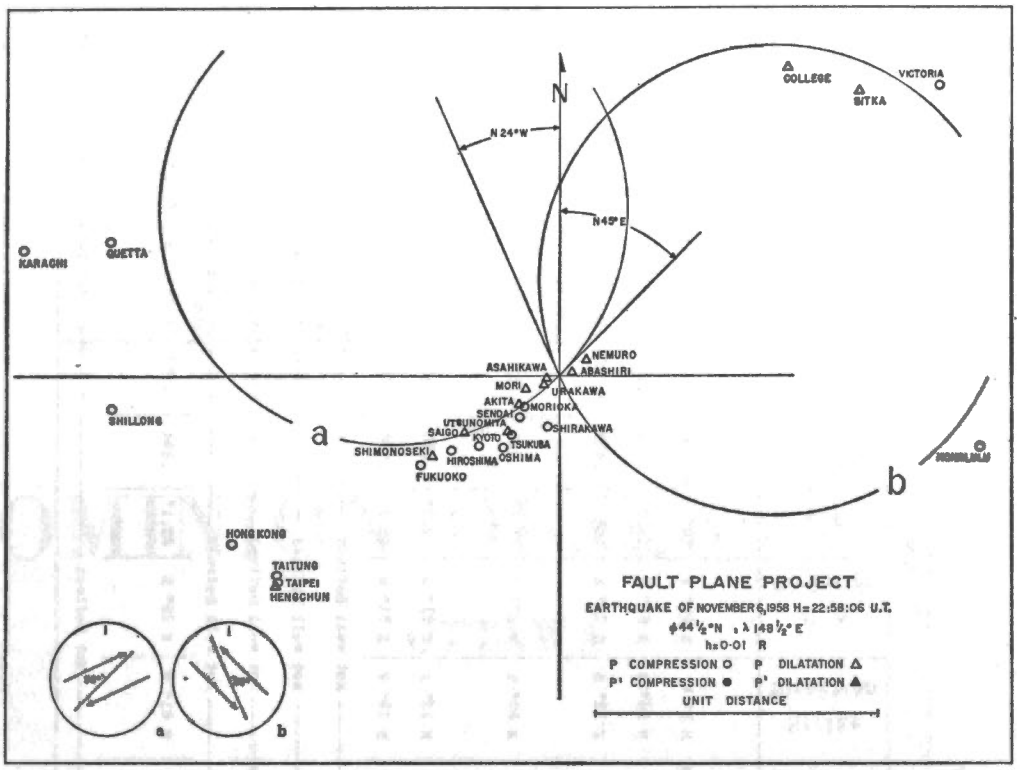

Figure 7.

example, but this conflicted with the more distant observations. The compromise suggested in the figure reduces the number of inconsistencies to a minimum. Circle *b* is well defined by the Alaskan stations, although one could wish for confirming evidence. The score is given in Table XIII and is much better than usual.

TABLE XIII

—	P	P_1'
Total number of observations.....	212	3
Number of inconsistent observations.....	20	2

Earthquake of 20:23:26, Nov. 12, 1958. $\phi = 44\ 1/2°$ N, $\lambda = 148\ 1/2°$ E.

This is an aftershock of the earthquake just discussed, and, while there are fewer observations, it is clear that the solution again is in terms of a pair of small dilatational circles drawn towards the centre of the map. In fact the solution differs very little from that shown in Figure 7; in the present case the system of circles is rotated slightly clockwise and the radii are slightly changed. The figure is not reproduced and the exact values may be obtained from Table XV. The score is shown in Table XIV.

TABLE XIV

—	P	P_1'
Total number of observations.....	136	1
Number of inconsistent observations.....	20	0

A solution was also attempted for the second principal aftershock, of 09:00:45 November 15, but the data were too few and too confused.

Summary

The results are summarized in Table XV in the form established in earlier papers. Discussion of these results is postponed since solutions for earthquakes of 1959 and 1960 will be available very shortly. A more complete discussion will then be possible.

References

HODGSON, J. H., STEVENS, A. E. and METZGER, M. E., 1961. Direction of faulting in some of the larger earthquakes of 1956-1957: *Dom. Obs. Publ.*, Ottawa, v. 26, no. 5.

TABLE XV

EARTHQUAKE				PLANE a					PLANE b					NULL VECTOR			
Date	φ	λ	Focal Depth	Strike Direction	Dip Direction	Dip	Strike Component	Dip Component	Strike Direction	Dip Direction	Dip	Strike Component	Dip Component	Trend	Plunge	Dextral Solution	Sinistral Solution
Ryukyus - Japan - Kuriles																	
October 12, 1958	27.5° N	125.5° E	0.03 R	← Not Defined →				– →	N 7° W	S 83° W	55°	← –		NS ca.-	Not Defined →		
November 6, 1958	44.5° N	148.5° E	0.01 R	N 45° E	N 45° W	58.7°	.799	+.601	N 24° W	N 66° E	58.7°	.799	+.601	N 10° E	43°	a	b
November 12, 1958	44.5° N	148.5° E	0.01 R	N 61° E	N 29° W	39.7°	.566	+.824	N 18° E	S 72° E	58°	.429	+.903	N 33.5° E	20.8°	a	b
Aleutians																	
February 22, 1958	50.5° N	175° W	0.00 R	N 21° E	N 69° W	76.1°	.956	+.293	N 63° W	N 27° E	73.8°	.935	+.355	N 27° W	63.8°	a	b
South America																	
February 1A, 1958	2° N	79° W	0.00 R	N 70° E	S 20° E	84.8°	.993	+.122	N 19° W	S 71° W	82.7°	.996	+.087	S 36° W	81.0°	a	b
February 1B, 1958	2° N	79° W	0.00 R	N 70° E	S 20° E	84.8°	.993	+.122	N 19° W	S 71° W	82.7°	.996	+.087	S 36° W	81.0°	a	b
February 1C, 1958	1.5° N	79° W	0.00 R	N 4° W	S 86° W	68.7°	← +	Not well Defined					+ →	NS ca.	← Not Defined →		
April 14, 1958	1° N	79.5° W	0.00 R	N 30° E	N 60° W	63°	← +	Not well Defined					+ →	N 30E ca.	← Not Defined →		
April 15, 1958	1° N	79.5° W	0.00 R	← Not well Defined			+	← Not well Defined					+ →	NS ca.	See text		
July 26, 1958	13.5° S	69° W	0.10 R	EW	N	27°	← –	Not well Defined					– →	← Not Defined. See text →			
January 15, 1958	16.5° S	71.5° W	0.01 R	N 26° E	N 64° W	58.5°	.987	-.162	N 61° W	N 29° E	82.1°	.854	-.521	N 48° W	57.3°	b	a
Celebes																	
August 15, 1958	1.5° N	125° E	0.03 R	N 59° E	N 31° W	83.5°	← –	Not Defined					– →	← Not Defined →			