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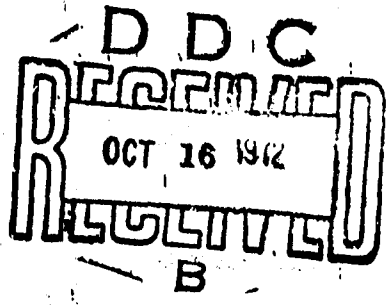
AIR FORCE CAMBRIDGE RESEARCH LABORATORIES
L. G. HANSCOM FIELD, BEDFORD, MASSACHUSETTS

Ground-Based Cosmic-Ray Instrumentation Catalog

M.A. SHEA



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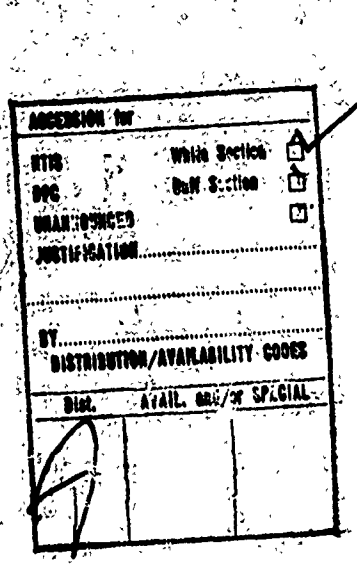

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Abstract

A comprehensive listing of ground-based cosmic-ray detectors in operation from 1932 through 1971 has been assembled and the pertinent information and data availability of each sensor is given. The cosmic-ray instrumentation cataloged consists of neutron monitors, muon detectors and ionization chambers.

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Ground-Based Cosmic-Ray Instrumentation Catalog

1. INTRODUCTION

A survey of ground-based geophysical sensors was conducted in 1969 by Working Group 3 (Interplanetary Disturbances) of the Inter-Union Commission on Solar-Terrestrial Physics (IUCSTP). The results of this survey indicated that most of the researchers in this area desired specific summary information on various ground-based detectors and observations in the following order of preference:

(1) Cosmic-ray detectors
(2) Riometers
(3) Geomagnetic field detectors and measurements
(4) Ionospheric observations
(5) Solar observations
(6) Auroral observations.

As a result of this survey, Panel G (Ground-Based Networks) of Working Group 3 was requested to compile a comprehensive listing of ground-level cosmic-ray detectors. This completed list includes 319 detectors both presently in operation and those which have ceased operating during the period 1932 through 1971. A summary of the status and type of detectors included in this catalog is given in Table 1.

(Received for publication 7 July 1972)

Table 1. Summary of the Status and Type of Cosmic-Ray Detectors Included in this Catalog

Type of Detector	Number
Detectors in Operation:	
IQSY-NM-64 Neutron Monitors	52
IGY-type Neutron Monitors	33
Muon Detectors	52
Underground Muon Detectors	16
Ionization Chambers	15
Miscellaneous Equipment	1
Total	169
Detectors no Longer in Operation:	
IGY-type Neutron Monitors	62
Muon Detectors	67
Underground Muon Detectors	4
Ionization Chambers	15
Miscellaneous Equipment	2
Total	150

2. PROCEDURE

When work on this catalog was started, it was planned to include only detectors which had been in operation at some period of time since the International Geophysical Year (1957) through 1970. Initially, the World Data Centers were consulted; it was found, however, that none of the World Data Centers contained a complete comprehensive listing of these detectors. Furthermore, they encouraged and supported this type of survey to update their own records. Accordingly, questionnaires were distributed to the known principal investigators of all cosmic-ray detectors, and assistance was requested from many of these for help in locating missing information.

Owing to the large amount of time and correspondence involved in checking and re-checking records with the principal investigators and the World Data Centers, an early completion of this catalog was not possible. As the work progressed it was found that information on many of the original ionization chambers in operation prior to IGY was being obtained, and accordingly this listing was extended backward in time to 1932. Subsequent delays and the changing status of many detectors in 1970 and 1971 made it advisable to update the entire listing through December 31, 1971.

As information on each detector was obtained, it was compiled in a standardized format and returned to the principal investigator for checking and correction. This process was repeated in January 1972 in an effort to update the entire listing. This compilation reflects the known status of all cosmic-ray detectors as of December 31, 1971. Any known or expected changes between January 1 and June 1, 1972 have been given under the comments section of each individual listing.

3. SUMMARY LISTING OF COSMIC-RAY STATIONS

Table 2 is a summary listing of the cosmic-ray stations and detectors detailed in this catalog. This list includes the preferred station name, as specified by the principal investigator, the geographic coordinates, the altitude in meters, the vertical cutoff rigidity, and the type and number of detectors at each station both in operation as of December 1971 and those for which operation has terminated. The vertical cutoff rigidities have all been calculated using the trajectory-tracing procedure described by Shea et al (1965). To ensure consistency, the Finch and Leaton (1957) sixth-degree internal geomagnetic field representation, Epoch 1955.0, was utilized for these calculations. Since many stations are known by more than one name, Table 3 lists alternate station names.

4. DESCRIPTION OF DETECTOR LISTINGS

The individual descriptions of the various cosmic-ray detectors have been divided into two principal groups; those in operation as of December 31, 1971, given in Appendix A, and those whose operation has been terminated, given in Appendix B. These groups have been subdivided with respect to the various type of detectors as follows: IQSY neutron monitors, IGY-type neutron monitors, muon detectors, underground muon detectors, ionization chambers and miscellaneous equipment. During the final revision of this catalog, information was received on the installation and anticipated operation of muon detectors located at Dourbes, Belgium and Trivandrum, India. The pertinent information is given in Appendix C.

Each individual listing contains the preferred station name, alternate names if any, the geographic coordinates in degrees and minutes if available, otherwise in decimal degrees, the vertical cutoff rigidity, and the station altitude in meters. The name and present address of the principal investigator is also given, or, whenever appropriate, the name and address of a person from whom specific information can be obtained. For detectors presently in operation, the starting date is given; for those stations where operation has terminated, the period of

Table 2. Summary Listing of Cosmic-Ray Stations

Station Name	Geographic Coordinates		Altitude (meters)	Vertical Cutoff Rigidity (GV)	Operating Equipment						Closed Equipment				
	Latitude	E. Longitude			IQSY Neutron Monitors	IGY-Type Neutron Monitors	Muon Detectors	Underground Muon Detectors	Ionization Chambers	Miscellaneous Equipment	IGY-Type Neutron Monitors	Muon Detectors	Underground Muon Detectors	Ionization Chambers	Miscellaneous Equipment
Ahmedabad, India	23.02	72.60	0	15.94	1		1				1	1			
Albuquerque, USA	35.03	253.30	1575	4.47							1				
Alert, Canada	82.52	297.40	66	0.00	1		1								
Aligarh, India	27.95	78.07	186	14.85		1									
Alma Ata, USSR	43.25	76.92	805	6.69		1	3								
Amsterdam, The Netherlands	52.22	4.92	0	2.69										1	
Apatity, USSR	67.55	33.33	182	.65	1		1				1	1			
Athens, Greece	37.97	23.72	110	8.72	1										
Belfast, Northern Ireland	54.58	354.07	16	1.92	1		1								
Belsk, Poland	51.83	20.78	180	3.18			1								
Bergen, Norway	60.40	5.32	0	1.13		1	1								
Berkeley, USA	37.87	237.70	0	4.54							1	1			
Bologna, Italy	44.50	11.35	0	5.22			1								
Brisbane, Australia	-27.53	152.92	0	7.21		1									
Budapest, Hungary	47.50	18.90	410	4.44				1							
Buenos Aires, Argentina	-34.60	301.52	0	10.63	1						1	1			
Calgary, Canada	51.08	245.87	1128	1.09	1										
Cambridge Tunnel, Australia	-42.85	147.42	110	1.19				1					3		
Cape Hallett, Antarctica	-72.30	170.20	0	.04							1				
Cape Schmidt, USSR	68.92	180.52	0	.60							1			1	
Cape Town, South Africa	-33.95	18.47	103	4.96								1			
Casey, Antarctica	-66.28	110.53	0	.01							1				
Chacaltaya, Bolivia	-16.32	291.85	5220	13.10	1		2				1	2			
Chacaltaya, Bolivia	-16.32	291.85	5243	13.10				1				1			
Cheltenham, USA	38.70	283.20	72	2.09										1	
Chicago, USA	41.83	272.33	200	1.72							1				
Christchurch, New Zealand	-43.50	172.60	8	2.71					1			1			
Churchill, Canada	58.75	265.92	39	.21	1										
Churchill, Canada	58.80	265.90	39	.21							1	1			
Climax, USA	39.37	253.82	3400	3.03		1									

College, USA	64.85	212.17	[illegible]	.54								1				
College Station, USA	30.63	263.65	76	4.95			1									
Colombo, Ceylon	6.90	7[illegible].87	0	17.46									1			
Cordoba, Argentina	-31.42	29[illegible].80	434	11.45		1										
Dacca, Bangladesh	23.75	90.42	0	16.22		1	1									
Dallas, USA	32.98	263.27	208	4.35	1											
Darjeeling, India	27.05	88.27	2200	15.35								1	1			
Deep River, Canada	46.10	282.50	145	1.02	1		2					1			2	
Denver, USA	39.67	255.03	1600	2.91	1	1	1									
Dourbes, Belgium	50.10	4.60	225	3.24	1		1					1				
Dumont d'Urville, Antarctica	-66.67	140.02	45	.01	1							1				
Durham, USA	42.10	289.17	9	1.41	1											
El Infiernillo, Chile	-33.17	289.72	4343	11.45		1							1			
Ellsworth, Antarctica	-77.72	318.86	0	.79								1				
Embudo, USA	35.20	253.59	2621	4.36				2								
Fredericksburg, USA	38.20	282.60	69	2.18					1							
Fukushima, Japan	37.75	140.48	66	10.55	1											
General Belgrano, Antarctica	-77.97	321.20	0	.77	1											
Gif Sur Yvette, France	48.68	2.13	40	3.61	1											
Godhavn, Greenland	69.20	306.00	9	.03											1	
Goose Bay, Canada	53.27	299.60	46	.52	1		1									
Gottingen, FRG	51.52	9.93	273	3.00								1				
Gulmarg, India	34.07	74.42	2743	11.91		1							1			
Hafelekar, Austria	47.32	11.38	2290	4.37	1		1		1			1				
Haifa, Israel	32.82	34.98	193	10.96									1			
Haleakala, USA	20.72	203.73	3052	13.30								1				
Halle, GDR	51.48	11.97	100	3.07					2			1				
Heiss Island, USSR	80.62	58.05	20	.10		1	1						1			
Hermanus, South Africa	-34.42	19.22	26	4.90	1							1	1			
Herstmonceux, England	50.87	.33	23	2.92								1	1			
Hobart, Australia	-42.90	147.33	0	1.88		1	2								1	
Hong Kong	22.42	114.20	30	16.23					1							
Howrah, India	22.66	88.32	0	16.43											1	
Huancayo, Peru	-12.03	284.67	3400	13.45		1										
Huancayo, Peru	-12.03	284.67	3350	13.45					1							
Inuvik, Canada	68.35	226.28	21	.18	1		1									
Invercargill, New Zealand	-46.60	168.40	0	1.86								1	1			
Irkutsk, USSR	52.47	104.03	433	3.66	1		2					1	1		1	
Jungfraujoch, Switzerland	46.50	8.00	3550	4.48		1										
Kerguelen Island	-49.35	70.22	0	1.19	1							1	1			

Table 2 (Contd.). Summary Listing of Cosmic-Ray Stations

Station Name	Geographic Coordinates		Altitude (meters)	Vertical Cutoff Rigidity (GV)	Operating Equipment							Closed Equipment				
	Latitude	E. Longitude			IQSY Neutron Monitors	IGY-Type Neutron Monitors	Muon Detectors	Underground Muon Detectors	Ionization Chambers	Miscellaneous Equipment		IGY-Type Neutron Monitors	Muon Detectors	Underground Muon Detectors	Ionization Chambers	Miscellaneous Equipment
Kiel, FRG	54.30	10.10	54	2.29	1							1	1			
Kiev, USSR	50.72	30.30	120	3.62	1											
Kiruna, Sweden	67.83	20.43	400	.54	1											
Kiruna, Sweden	67.83	20.43	390	.54									2			
Kodaikanal, India	10.23	77.48	2443	17.47								1	1			
Koenji, Japan	35.71	139.64	42	11.58					1				1			
Kühlungsborn, GDR	54.12	11.77	70	2.43								1	1		1	
Kula, USA	20.73	203.67	930	13.30	1		1									
Lae, New Guinea	-6.73	147.00	0	15.52								1	1			
Leeds, England	53.83	358.42	70	2.20	1											
Leeds, England	53.83	358.42	100	2.20								1				1
Lerwick, Scotland	60.15	358.85	83	1.09								1				
Lumeil, France	48.73	2.42	50	3.64								1	1			
Lincoln, USA	40.82	263.32	350	2.22								1	1			
Lindau/Harz, FRG	51.60	10.10	140	3.00	1	1	1						1			
Lisbon, Portugal	38.80	350.85	81	6.65									1			
Lomnický Stít, Czechoslovakia	49.20	20.22	2632	4.00		1	1						1			
London, England	51.53	359.90	45	2.73								1				
London, England	51.53	359.90	12	2.73									1			
Los Cerrillos Station, Chile	-33.50	289.30	512	11.44			1									
Macau	22.20	113.55	65	16.28									1			
Macquarie Island	-54.48	158.97	0	.55									1			
Macul Station, Chile	-33.45	289.40	570	11.41									1			
Magadan, USSR	60.11	151.01	0	2.10	1											
Makapuu Point, USA	21.30	202.35	91	13.23								1	1			
Makerere, Uganda	.34	32.56	1196	14.98		1							2			
Makerere (Kilembe), Uganda	0.00	30.06	1500	14.84				1								
Matsumoto, Japan	36.23	138.09	630	11.31				1								
Mawson, Antarctica	-67.60	2.6	0	.22		1	3									
McMurdo, Antarctica	-77.85	166.7	48	.01	1		1					1				

Meudon, France	48.82	2.25	110	3.60								1			
Mexico City, Mexico	19.33	260.82	2274	9.53	1	1	1								
Mexico City, Mexico	19.33	260.82	2267	9.53										1	
Mina Aguilar, Argentina	-23 10	294.30	4000	12.51		1									
Mirny, Antarctica	-66.55	93.02	30	.04		1								1	
MIT, USA	42.37	288.90	0	1.52								1			
Mont Blanc Tunnel, France	45.80	4.52	1300	4.65				1							
Morioka, Japan	39.70	141.13	135	10.16		1									
Moscow (IZMIRAN), USSR	55.47	37.32	200	2.46	1		2				1	2		1	
Mosc[illegible] University, USSR	55.73	37.63	200	2.39				1					1		
Mount Norikura, Japan	36.12	137.55	2770	11.39	1		1		1		1				
Mount Washington, USA	44.30	288.70	1900	1.24		1									
Mount Wellington, Australia	-42.92	147.23	725	1.89	1						1				
Munich, FRG	48.20	11.60	500	4.14							1				
Murchison Bay	80.05	18.25	0	.06							1	2			
Murmansk, USSR	65.25	33.08	0	.50							1				
Mussala, Bulgaria	42.18	25.58	2925	6.45		1									
Nagoya, Japan	35.01	136.90	5	12.06			1								
Nera, The Netherlands	52.23	5.08	-2	2.76							1				
Norilsk, USSR	69.26	88.05	0	.63	1										
Northfield, USA	44.47	266.75	287	1.43							1				
Ottawa, Canada	45.40	284.40	57	1.08		1						1			
Oulu, Finland	65.02	25.50	15	.81	1		1					1			
Pic Du Midi, France	42.93	.25	2860	5.36	1						1	1			
Potchefstroom, South Africa	-26.70	27.10	1351	7.30		1									
Prague, Czechoslovakia	50.08	14.42	215	3.53							1	1			
Predigtstuhl, FRG	47.70	12.88	1614	4.30	1		1								
Resolute, Canada	74.72	265.02	17	0.00	1						1	1			
Rio de Janeiro, Brazil	-22.95	316.83	0	11.73				-			1				
Rome, Italy	41.90	12.52	60	6.32	1						1	1			
Sacramento Peak, USA	32.72	254.25	3000	4.98							1				
Saint Maur, France	48.75	2.28	35	3.63							1				
Sanae, Antarctica	-70.30	357.65	53	1.06	1										
Sapporo, Japan	43.03	141.35	54	8.22											
Schauinsland, FRG	47.92	7.75	1200	4.10			2	-	1		1				
Seoul, Korea	37.56	127.05	50	10.79								1			
Simferopol, USSR	44.73	34.00	570	5.51							1	1			
Socorro, USA	34.07	253.07	1676	4.73				1							
Sofia, Bulgaria	42.67	23.30	518	6.15								1			
South Pole, Antarctica	-90.00	0.00	2820	.11	-	1	1						-		

Table 2 (Contd.). Summary Listing of Cosmic-Ray Stations

Station Name	Geographic Coordinates		Altitude (meters)	Vertical Cutoff Rigidity (GV)	Operating Equipment							Closed Equipment				
	Latitude	E. Longitude			IQSY Neutron Monitors	IGY-Type Neutron Monitors	Muon Detectors	Underground Muon Detectors	Ionization Chambers	Miscellaneous Equipment		IGY-Type Neutron Monitors	Muon Detectors	Underground Muon Detectors	Ionization Chambers	Miscellaneous Equipment
Sulphur Mountain, Canada	51.20	244.40	2283	1.14	1	1	1									
Swarthmore, USA	39.90	284.65	80	1.92	1		1									
Sydney, Australia	-33.89	151.19	43	4.69								1				
Syowa, Antarctica	-69.00	39.60	15	.42	1		1					1	1		1	
Sverdlovsk, USSR	56.73	61.07	290	2.30					1							
Takeyama, Japan	35.22	139.62	0	11.84				1								
Tbilisi, USSR	41.72	44.73	510	6.91		1	1								1	
Tehran, Iran	35.70	51.40	1400	10.56	1											
Thule, Greenland	76.58	291.58	260	0.00	1		1					1	1			
Tixie Bay, USSR	71.58	129.00	0	.53	1				1							
Tokyo-Itabashi, Japan	35.75	139.72	20	11.61	1				1				1			
Torino, Italy	45.05	7.75	240	4.94				1								
Tromso, Norway	69.70	18.90	0	.41									1			
University of Arizona, USA	32.45	249.22	2750	5.48						1						
Uppsala, Sweden	59.85	17.58	0	1.43		1	1						2			
Ushuaia, Argentina	-54.80	291.68	0	5.68		1							1			
Utrecht, The Netherlands	52.10	5.12	1	2.76	1		1									
Victoria, Canada	48.42	236.68	71	1.86	1											
Vostok, Antarctica	-78.47	106.80	3488	0.00		1										
Vostok, Antarctica	-78.45	106.87	3400	0.00									1			
Weissenau, FRG	47.80	9.50	427	4.16								1	1			
Wellington, New Zealand	-41.28	174.77	125	3.42								1				
Wellington, New Zealand	-41.22	174.92	0	3.42								1	1			
White Mountain, USA	37.58	241.75	3800	4.48												1
Wilkes, Antarctica	-66.25	110.52	0	.01								1	1			
Yakutsk, USSR	62.02	129.72	105	1.70			1	4	1			1				
Zugspitze, FRG	47.42	10.98	2960	4.24		1										
Zugspitze, FRG	47.42	10.98	2966	4.24									1			

See individual station listings (Appendix A or B).

Table 3. Identification of Alternate Station Names

Alternate Name	Preferred Name
Awarua	Invercargill
Banff	Sulphur Mountain
Belgrano	General Belgrano
Bolivia	Chacaltaya
Cambridge Tunnel (Hobart)	Cambridge Tunnel
Central Geophysical Observatory	Belsk
Chalais - Meudon	Meudon
C. U. (Cuidad Universitaria)	Mexico City
Fairbanks, Alaska	College
Fort Churchill	Churchill
Freiburg	Schaiunsland
Geopole Station	Thule
Hawaii	Haleakala
Hawaii	Makapuu Point
Hobart	Cambridge Tunnel
IZMIRAN	Moscow
Kampala	Makerere
Kilembe	Makerere*
Laparskaya	Murmansk
LMSC Neutron Multiplicity Monitor	White Mountain
Lockheed Neutron Multiplicity Monitor	White Mountain
Lower Hutt	Wellington **
Mabashi	Koenji
Makapuu Point Solar Observatory	Makapuu Point
Massachusetts Institute of Technology	MIT
Max Planck Institute	Zugspitze
Moscow	Moscow University
Mount Lemmon Cosmic-Ray Laboratory	University of Arizona
Mount Wellington (Hobart)	Mount Wellington
Nederhorst den Berg	Nera
Norway Station	Sanae
Port aux Francais	Kerguelen
Santiago	Los Cerrillos Station
Santiago	Macul Station
Servico Meteorológico de Macau	Macau
Station SVIRCO, Roma	Rome
Stazione de Cappuccini	Torino
Syowa Base	Syowa
Syowa Station	Syowa
Texas A&M Magnetic Spectrometer	College Station
Terre Adélie	Dumont d'Urville
Universidad Nacional de Mexico	Mexico City
University of Leeds	Leeds
University of New Hampshire	Durham
University of Oulu	Oulu
Zugspitze Laboratory	Zugspitze
Zui	Irkutsk***

* Underground muon detector only
** Sea level station only
*** Crossed wide-angle muon detector only

operation is included. For researchers interested in detectors operating for a specific time period, a calendar of operations is given in Appendix D.

The comments section contains miscellaneous items requested by the principal investigator. We have also made an effort to establish, whenever possible, if the data are deposited in the World Data Centers. Principal investigators are encouraged to routinely deposit their data into the appropriate data center; researchers are urged to utilize the data centers whenever possible The data centers have a working arrangement whereby data deposited in one data center will be made available, on request, to the other data centers. When requesting specific detailed information from a scientist in the Soviet Union, it is recommended that a copy of each individual request be sent to World Data Center B2 in Moscow. The addresses of the World Data Centers where cosmic-ray data are deposited are given in Table 4.

Table 4. Addresses of World Data Centers for Cosmic Radiation Data

WDC-A:	World Data Center A for Solar-Terrestrial Physics National Oceanic and Atmospheric Administration Boulder, Colorado 80302 U.S.A.
WDC-B:	World Data Center B2 on Solar-Terrestrial Physics Ulitza Molodezhnaya 3 Moscow B-296, U.S.S.R.
WDC-C1:	Cosmic-Ray Group Institute of Physics University of Uppsala Observatorieparken Uppsala, Sweden
WDC-C2:	World Data Center C2 for Cosmic Rays Cosmic-Ray Laboratory The Institute of Physical and Chemical Research 1-7-13, Kaga, Itabashi Tokyo 173, Japan

We have also included various publications which contain cosmic-ray data from individual stations. World Data Center C2 in Japan has been extremely conscientious in publishing cosmic-ray data from the world network of neutron monitors during IGY, IGC and IQSY as well as publishing data for other periods from the various Japanese stations. To avoid repetition, we have often listed these as the "Japanese Cosmic-Ray Intensity Data Books" with the appropriate book number and date of publication. A complete listing of these books is given in Appendix E. Also noted, but not mentioned in any of the individual listings, is a publication by Bachelet et al (1971) which contains daily averages for 65 neutron monitors from 1957 through 1965.

5. MOBILE SURVEYS

No attempt has been made to catalog the relevant information on the many varied mobile surveys. Three principal investigators, however, have specifically requested that some information be included about their experiments.

Dr. Horacio S. Ghielmetti has been operating an IGY-type neutron monitor (6 counters) on board a ship in the southern hemisphere primarily between Buenos Aires and Antarctica with a normal range in vertical cutoff rigidity of 10.6 to 0.7 GV. The details and counting rates obtained on the first five voyages are given by Ghielmetti (1969). Dr. Ghielmetti's address is given under the listing for the Buenos Aires operating IQSY neutron monitor (Appendix A).

Prof. Serge A. Korff, whose address is given under the closed College, U.S.A., IGY-type neutron monitor (Appendix B) has conducted a series of airplane flights with the purpose of determining how the flux of cosmic-ray neutrons in the energy interval between 1 and 10 MeV varies throughout the atmosphere as a function of the sunspot cycle. Details of their extended polar flights are given by Sandie et al (1965).

Since May 1965 Dr. Robert W. Peterson of the University of California Los Alamos Scientific Laboratory, P.O. Box 1663, Los Alamos, New Mexico, 87544, U.S.A., has been flying an IGY-type neutron monitor aboard a jet aircraft on selected flights. To date there have been approximately 30 trips extending from one day to a few weeks duration, and include both latitude and altitude surveys. A description of some of the cosmic-ray experiments aboard this aircraft is given by Peterson et al (1966).

It is not the intent of this catalog to provide a complete bibliography on various mobile surveys; a selected set of references, however, is given in Table 5. Principal investigators who conduct various latitude surveys are urged to keep the World Data Centers informed of their activities so that this information is readily available upon request.

Table 5. Selected Set of References Pertaining to Various Mobile Surveys

Bachelet, F., Balata, P., Dyring, E., and Iucci, N. (1965) The intercalibration of the cosmic-ray neutron monitors at 9 European sea-level stations and the deduction of a daily latitude effect in 1963, Il Nuovo Cimento, Series X 36:762-772.

Carmichael, H., and Bercovitch, M. (1969) Cosmic-ray latitude survey in Canada in December, 1965, Can. J. Phys. 47:2051-2055.

Carmichael, H., Bercovitch, M., Steljes, J. F., and Magidin, M. (1969) Cosmic-ray latitude survey in North America in summer, 1965, Can. J. Phys. 47:2037-2050.

Carmichael, H., Shea, M. A., and Peterson, R. W. (1969) Cosmic-ray latitude survey in Western U. S. A. and Hawaii in summer, 1966, Can. J. Phys. 47:2057-2065.

Compton, A. H., and Turner, R. N. (1937) Cosmic rays on the Pacific Ocean, Phys. Rev. 52:799-814.

Coxell, H., Pomerantz, M. A., and Agarwal, S. P. (1965) Survey of cosmic-ray intensity in the lower atmosphere, J. Geophys. Res. 71:143-154.

D'Arcy, R. G., and MacGregor, G. A. (1968) The Vertical and Omnidirectional Cosmic-Ray Intensities as a Function of Latitude and Longitude for Various Points Near the Geographic Equator, Lawrence Radiation Laboratory, University of California, Livermore, Technical Report UCRL-50502.

Dorman, L. I., Kovalenko, V. A., Milovidova, N. P., and Chernov, S. B. (1970) Cosmic-ray intensity distribution over the territory of the U. S. S. R., the latitude effect and coupling coefficients of the cosmic-ray muon component at sea level, Acta Physica, Academiae Scientiarum Hungaricae, 29(Suppl. 2):359-363. (Proceedings of the 11th International Conference on Cosmic Rays, Budapest, 1969.)

Fukushima, S. and Kodama, M. (1961) Solar modulation effect on the latitude dependence in cosmic ray intensity, Sci. Papers Inst. Phys. Chem. Res. 55:37-41.

Gauger, J. (1965) Neutron Flux Measurements During January and February 1964, Boeing Scientific Research Laboratories (Geo-Astrophysics Laboratory), Publication D1-82-0417.

Kent, D. W., and Pomerantz, M. A. (1971) Cosmic ray intensity variations in the low atmosphere, J. Geophys. Res. 76:1652-1661.

Kodama, M. (1959) World-wide distribution of cosmic-ray neutron intensity at sea level, Journal of Geomagnetism and Geoelectricity, X:37-46.

Kodama, M. (1960) Cosmic rays at sea level and the earth's magnetic field, Sci. Papers Inst. Phys. Chem. Res. 54:20-42.

Kodama, M. (1968) Geomagnetic and Solar Modulation Effects of Sea-Level Cosmic Ray Intensity, Japanese Antarctic Research Expedition Scientific Reports, Series A, No. 5.

Kodama, M., and Ohuchi, T. (1968) Latitude survey of neutron multiplicity using a shipborne NM-64 neutron monitor, Can. J. Phys. 46:S1090-S1093.

Miyazaki, Y., Kodama, M., Suda, H. and Kamata, K. (1962) World-survey of the cosmic ray intensity, Rep. Phys. Chem. Res. 38(No. 5):497-505.

Nobles, R. A., Hughes, E. B., and Wolfson, C. J. (1969) Empirical response functions for a neutron multiplicity monitor, J. Geophys. Res. 74:6459-6470.

Table 5 (Contd.) Selected Set of References Pertaining to Various Mobile Surveys

Pomerantz, M. A., and Agarwal, S. P. (1962) Spatial distribution of cosmic ray intensity and geomagnetic theory", Phil. Mag. 7:1503-1511.

Pomerantz, M. A., Potnis, V. R. and Agarwal, S. P. (1960) Cosmic ray investigations with an airborne neutron monitor, Il Nuovo Cimento, Series X 16:469-475.

Pomerantz, M. A., Potnis, V. R., and Sandstrom, A. E. (1960) The cosmic-ray equator and the earth's magnetic field, J. Geophys. Res. 65:3539-3543.

Rose, D. C., Fenton, K. B., Katzman, J., and Simpson, J. A. (1956) Latitude effect of the cosmic ray nucleon and meson components at sea level from the Arctic to the Antarctic, Can. J. Phys. 34:968-984.

Rose, D. C. and Katzman, J. (1956) The geomagnetic latitude effect on the nucleon and meson component of cosmic rays at sea level, Can. J. Phys. 34:1-19.

Rothwell, P., and Quenby, J. (1958) Cosmic rays in the earth's magnetic field, Il Nuovo Cimento, 8(Suppl.):249-256.

Sandström, A., Pomerantz, M. A., and Grönkvist, Bengt-Olov (1962) Latitude effect and atmospheric attenuation of the cosmic ray nucleon component, Tellus, XIV.

Sandström, A. E., Pomerantz, M. A. and Grönkvist, Bengt-Olov (1963) Sea level cosmic ray intensity and threshold rigidity, Tellus, XV.

van der Walt, A. J., Stoker, P. H., Maree, J. P., and Coetzee, W. F. (1970), Latitude distributions of cosmic ray components at sea level and at airplane altitudes in the South African magnetic anomaly, Acta Physica, Academiae Scientiarum Hungaricae 29 (Suppl. 2): 553-557. (Proceedings of the 11th International Conference on Cosmic Rays, Budapest, 1969.)

6. CORRECTION AND UPDATING PROCEDURES

We have tried to make this comprehensive listing as complete and accurate as possible. It is recognized that a list of this type is continually in need of updating. Therefore it is requested that the principal investigators carefully check the information relating to their equipment and notify the World Data Centers of any corrections to be made in this listing. They are also requested to notify the World Data Centers, in a timely fashion, of any future changes in the information contained herein. In this way the data centers can maintain an accurate and updated listing of all cosmic-ray detectors which can be readily available upon request.

Acknowledgments

As Chairman of Panel G, Working Group 3, IUCSTP, the author wishes to acknowledge the contributions and assistance of the other members of this panel, Miss J. Virginia Lincoln and Prof. L.I. Dorman. Also gratefully acknowledged is the assistance given by each of the principal investigators who have returned the various questionnaires with comments and corrections. In particular we wish to thank the following people who have willingly assisted in obtaining information for several stations in their country: P.J. Edwards, A. Ehmert (deceased), J.E. Humble, M.G. Milleret, Y. Miyazaki, and T. Obayashi. We also wish to thank Mrs. Frances Jackson of World Data Center A for sending us valuable information. Finally, the efforts of Mrs. Mary Spanos in typing all the necessary correspondence and the final listing for each detector is gratefully acknowledged.

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Bachelet, F., Iucci, N., Parisi, M., and Villoresi, G. (1971) Revised Daily Data 1957-1965 for 65 Cosmic Ray Neutron Monitors, Laboratio di Ricerca e Tecnologia per lo Studio del Plasma Nello Spazio (Rome, Italy) Scientific Report Number LPS-71-7.

Carmichael, H. (1964) Cosmic Rays, IQSY Instruction Manual No. 7.

Elliot, H. (1957) Standard meson intensity recorder, Annals of the IGY, 1957-1958, Vol. IV, IGY Instruction Manuals, Pergamon Press, London, pp 374-393.

Finch, H. P. and Leaton, B. R. (1957) The earth's main magnetic field - Epoch 1955.0, Monthly Notices Roy. Astron. Soc. Geophys. Suppl. 7:314-317.

Ghielmetti, H.S. (1969) Monitor de Neutrones Movil (in Spanish), Centro Nacional de Radiacion Cosmica publication CNRC-PR-MNM-1, Buenos Aires, Argentina.

Peterson, R.W., Liebenberg, D.H., and Keith, J.E. (1966) Research activities of the AEC aircraft, Recent Advances in Cosmic Ray Research, J. Gauger and A.J. Masley, Eds., Western Periodicals Co., North Hollywood, California, pp 287-311.

Sandie, W.G., Mendell, R.B. and Korff, S.A. (1965) The latitude variation of fast and slow neutrons at aircraft altitudes during solar minimum, The Scientific Report of the Rockwell Polar Flight, pp 36-50.

Shea, M.A., Smart, D.F. and McCracken, K.G. (1965) A study of vertical cutoff rigidities using sixth degree simulations of the geomagnetic field, J. Geophys. Res. 70:4117-4130.

Simpson, J.A. (1957) Cosmic-radiation neutron intensity monitor, Annals of the IGY, 1957-1958, Vol. IV, IGY Instruction Manuals, Pergamon Press, London, pp. 349-373.

Appendix A

Operating Cosmic-Ray Detectors

Section A1

IQSY Neutron Monitors

The following listings contain the pertinent information on the IQSY neutron monitors in operation on December 31, 1971. The locations of these detectors are shown in Figure A1.

These monitors are the standard "NM-64" design described by Carmichael (1964) and often referred to as "XX-NM-64" where the XX refers to the number of tubes in the monitor. Thus a 6-NM-64 monitor would contain 6 tubes. We have included the number of tubes in each monitor in the individual listings.

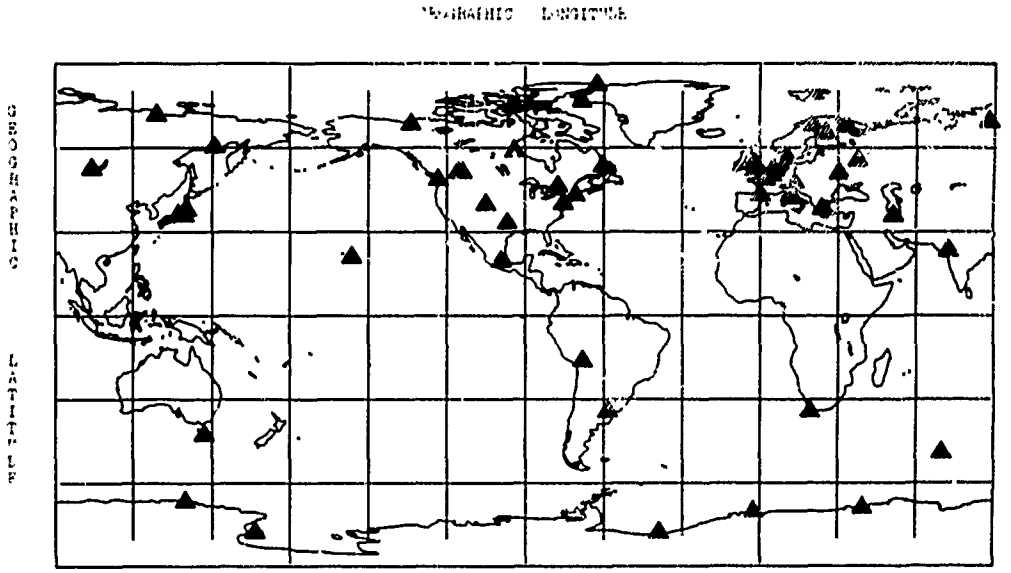

Figure A1. World Map Showing Locations of Operating IQSY Neutron Monitors

Operating IQSY-NM-64 Neutron Monitors

Station Name	AHMEDABAD, INDIA
Geographic Coordinates	$23^{\circ}01'N$, $72^{\circ}36'E$
Vertical Cutoff Rigidity	15.94 GV
Altitude	Sea level
Number of Tubes	18 tubes
Start of Observations	August 1968
Principal Investigator	Prof. U. R. Rao Physical Research Laboratory Ahmedabad 9, India

Comments:

Data to be submitted to the World Data Centers.

Station Name	ALERT, CANADA
Geographic Coordinates	$82^{\circ}31'N$, $62^{\circ}20'W$
Vertical Cutoff Rigidity	0.00 GV
Altitude	66 meters
Number of Tubes	18 tubes
Start of Observations	October 11, 1965
Principal Investigator	Dr. Hugh Carmichael Atomic Energy of Canada, Ltd. Chalk River, Ontario, Canada

Comments:

Data routinely submitted to the World Data Centers every 4 months about 6 weeks after last observation.

Data routinely published in the Atomic Energy of Canada "Cosmic-Ray NM-64 Neutron Monitor Data" series of reports.

Operating IQSY-NM-64 Neutron Monitors

Station Name	APATITY, U. S. S. R.
Geographic Coordinates	67°33'N, 33°20'E
Vertical Cutoff Rigidity	0.65 GV
Altitude	182 meters
Number of Tubes	8 tubes (October 1968 - March 15, 1969) 18 tubes (March 15, 1969 - present)
Start of Observations	October 1968
Principal Investigator	Dr. L. L. Lazutin Polar Geophysical Institute Akademgorodok, Apatity Murmansk Region, U. S. S. R.

Comments:

Data routinely submitted to the World Data Centers approximately 1 month after observations.

Data routinely published in monthly review of "Cosmical Data", (Kosmycheskiye dannіye), Publishing office "Nauka", Moscow, U. S. S. R.

Station Name	ATHENS, GREECE
Geographic Coordinates	37°58'N, 23°43'E
Vertical Cutoff Rigidity	8.72 GV
Altitude	40 meters
Number of Tubes	3 tubes
Start of Observations	August 29, 1970
Principal Investigator	Prof. A. Apostolakis Nuclear Physics Laboratory 104 Solonos Street Athens 144, Greece

Comments:

Data to be submitted to the World Data Centers.

Operating IQSY-NM-64 Neutron Monitors

Station Name	BELFAST, NORTHERN IRELAND
Geographic Coordinates	$54^{o}35'N$, $5^{o}56'W$
Vertical Cutoff Rigidity	1.92 GV
Altitude	16 meters
Number of Tubes	6 tubes
Start of Observations	March 1, 1966
Principal Investigator	Dr. C. S. Watt Department of Pure and Applied Physics Queen's University Belfast BT7 1NN Northern Ireland, U. K.

Comments:

Data to be submitted to the World Data Centers.

Station Name	BUENOS AIRES, ARGENTINA
Geographic Coordinates	$34^{o}36'S$, $58^{o}29'W$
Vertical Cutoff Rigidity	10.63 GV
Altitude	Sea level
Number of Tubes	18 tubes
Start of Observations	January 1, 1967
Principal Investigator	Dr. Horacio S. Ghielmetti Centro Nacional de Radiación Cósmica Perú 272 Buenos Aires, Argentina

Comments:

Data routinely submitted to the World Data Centers about 1 month after observations.

Plans being made to publish the data in a special Centro Nacional de Radiación Cósmica series.

Operating IQSY-NM-64 Neutron Monitors

Station Name	CALGARY, CANADA
Geographic Coordinates	51°05'N, 114°08'W
Vertical Cutoff Rigidity	1.09 GV
Altitude	1128 meters (See comments)
Number of Tubes	3 tubes (January 1, 1964-December 31, 1965) 6 tubes (January 1, 1966-January 31, 1966) 12 tubes (February 1, 1966-present)
Start of Observations	January 1, 1964
Principal Investigators	From January 1, 1964 to September 1, 1970: Dr. B. G. Wilson Present address: Vice President Simon Fraser University Burnaby 2, B.C., Canada From September 1, 1970 to present: Prof. D. Venkatesan and Dr. T. Mathews Physics Department University of Calgary Calgary 44, Alberta, Canada

Comments:

Prior to January 1, 1966, the station altitude was 1110 meters, giving a mean station pressure of 885.0 mb as compared with the present mean of 883.0 mb.

Efficiency relative to January 1, 1964

January 1, 1964 to December 31, 1964	= 1.000
January 1, 1965 to December 31, 1965	- 0.997
January 1, 1966 to January 31, 1966	- 2.130
February 1, 1966 to present	-14.260

Data routinely submitted to the World Data Centers approximately 3 months after observations.

Data for 1964 published in "Cosmic-Ray Intensity During the International Years of the Quiet Sun", No. 10, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1967.

Operating IQSY-NM-64 Neutron Monitors

Station Name	CHACALTAYA, BOLIVIA
Geographic Coordinates	16°19'S, 68°9'W
Vertical Cutoff Rigidity	13.10 GV
Altitude	5220 meters
Number of Tubes	10 tubes (October 12, 1966-November 14, 1968) 12 tubes (November 14, 1968-present)
Start of Observations	October 12, 1966
Principal Investigator	Inz. Ricardo Anda Laboratorio de Física Cósmica Universidad Mayor de San Andrés La Paz, Bolivia

Comments:

Normalizing factor: To normalize the data obtained from 10 tubes to that obtained by 12 tubes, multiply the 10-tube data by 1.1945.

Data routinely submitted to the World Data Centers.

Data published in the series "CUADERNOS", a publication of the Laboratorio de Física Cósmica. Data for October 12, 1966 through December 31, 1970 also published in the Atomic Energy of Canada, Ltd., "Cosmic Ray NM-64 Neutron Monitor Data" series of reports as a joint publication between the Laboratorio de Física Cósmica, La Paz, Bolivia and the Atomic Energy of Canada, Ltd., Chalk River, Ontario, Canada.

Operating IQSY-NM-64 Neutron Monitors

Station Name	CHURCHILL, CANADA
Alternate Name	Fort Churchill
Geographic Coordinates	58°45'N, 94°5'W
Vertical Cutoff Rigidity	0.21 GV
Altitude	39 meters
Number of Tubes	18 tubes
Start of Observations	April 20, 1964
Principal Investigator	Dr. Ricardo A. R. Palmeira The University of Texas at Dallas P.O. Box 30365 Dallas, Texas 75230, U.S.A.

Comments:

Data routinely submitted to the World Data Centers approximately 3 months after observations.

Data for 1964 published in "Cosmic-Ray Intensity During the International Years of the Quiet Sun", No. 10, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1967.

Daily averages published in "Solar-Geophysical Data", NOAA, Boulder, Colorado, 80302, U.S.A.

Operating IQSY-NM-64 Neutron Monitors

Station Name	DALLAS, U.S.A.
Geographic Coordinates	$32^{o}59'N$, $96^{o}44'W$
Vertical Cutoff Rigidity	4.35 GV
Altitude	208 meters
Number of Tubes	18 tubes
Start of Observations	January 25, 1964
Principal Investigator	Dr. Ricardo A. R. Palmeira The University of Texas at Dallas P.O. Box 30365 Dallas, Texas 75230, U.S.A.

Comments:

Data routinely submitted to the World Data Centers approximately 3 months after observations.

Data for 1964 published in "Cosmic-Ray Intensity During the International Years of the Quiet Sun", No. 10, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1967.

Daily averages published in "Solar-Geophysical Data", NOAA, Boulder, Colorado, 80302, U.S.A.

Operating IQSY-NM-64 Neutron Monitors

Station Name	DEEP RIVER, CANADA
Geographic Coordinates	46°06'N, 77°30'W
Vertical Cutoff Rigidity	1.02 GV
Altitude	145 meters
Number of Tubes	48 tubes
Start of Observations	April 1, 1962
Principal Investigator	Dr. Hugh Carmichael Atomic Energy of Canada, Ltd. Chalk River, Ontario, Canada

Comments:

The monitor was enlarged on February 1, 1965.

Data routinely submitted to the World Data Centers approximately a week after observations.

Data published in the Atomic Energy of Canada, "Cosmic Ray NM-64 Neutron Monitor Data" series of reports.

Data for 1964 published in "Cosmic-Ray Intensity During the International Years of the Quiet Sun", No. 10, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1967.

Daily averages published in "Solar-Geophysical Data", NOAA, Boulder, Colorado, 80302, U.S.A.

Station Name	DENVER, U.S.A.
Geographic Coordinates	39°40'N, 104°58'W
Vertical Cutoff Rigidity	2.91 GV
Altitude	1600 meters
Number of Tubes	3 tubes with additional moderator
Start of Observations	January 1, 1969
Principal Investigator	Prof. R. L. Chasson Department of Physics University of Denver Denver, Colorado 80210, U.S.A.

Comments:

Data to be submitted to the World Data Centers.

Operating IQSY-NM-64 Neutron Monitors

Station Name	DOURBES, BELGIUM
Geographic Coordinates	50°06'N, 4°36'E
Vertical Cutoff Rigidity	3.24 GV
Altitude	225 meters
Number of Tubes	9 tubes
Start of Observations	January 1, 1969
Principal Investigators	Prof. L. Bossy and Dr. J. C. Jodogne Géophysique externe Institut royal météorologique 3 Avenue Circulaire Bruxelles 18, Belgium

Comments:

This detector was in operation for specific short periods of time during 1968.

Data routinely submitted to the World Data Centers approximately 2 months after observations.

Data routinely published in the Institut royal météorologique, Bulletin mensuel, Observations ionosphériques et du rayonnement cosmique.

Station Name	DUMONT d'URVILLE, ANTARCTICA
Alternate Name	Terre Adélie
Geographic Coordinates	66°40'S, 140°01'E
Vertical Cutoff Rigidity	0.01 GV
Altitude	45 meters
Number of Tubes	9 tubes
Start of Observations	April 9, 1968
Principal Investigator	From April 1968 to October 1971: Dr. A. Freon (deceased)
Name and Address of Person to Contact for Information	Dr. M. G. Milleret (see comments) Laboratoire de Physique Cosmique Fort de Verrieres Route des Gatines 91 Verrieres-Le-Buisson, France

Comments:

The principal investigator replacing Dr. Freon is expected to be appointed sometime during 1972.

Data routinely submitted to the World Data Centers approximately 3 months after observations.

Plans being made to publish the data in the "Bulletin des TAAF".

Operating IQSY-NM-64 Neutron Monitors

Station Name	DURHAM, U. S. A.
Alternate Name	University of New Hampshire
Geographic Coordinates	43°06'N, 70°50'W
Vertical Cutoff Rigidity	1.41 GV
Altitude	Sea level
Number of Tubes	18 tubes (see comments)
Start of Observations	July 1, 1964
Principal Investigator	Dr. J. A. Lockwood Department of Physics University of New Hampshire Durham, New Hampshire 03824, U. S. A.

Comments:

From July 1964-June 1968 there were 18 tubes in this monitor. In July 1968 six of these tubes were placed under an additional absorber equal to 320 g cm^{-2}. The remaining 12 tubes were not changed.

Data routinely submitted to the World Data Centers approximately 1 year after observations.

Data published in "Geophysics and Space Data Bulletin", AFCRL, L. G. Hanscom Field, Bedford, Massachusetts, 01730, U. S. A.

Data for 1964 published in "Cosmic-Ray Intensity During the International Years of the Quiet Sun", No. 10, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1967.

Station Name	FUKUSHIMA, JAPAN
Geographic Coordinates	37°45'16"N, 140°28'48"E
Vertical Cutoff Rigidity	10.55 GV
Altitude	66.2 meters
Number of Tubes	3 tubes
Start of Observations	November 1, 1971
Principal Investigator	Prof. Tsunekichi Kanno Department of Physics Faculty of Education Fukushima University 12-23 Hamada-cho, Fukushima, Japan

Comments:

Data to be submitted to the World Data Centers.

Operating IQSY-NM-64 Neutron Monitors

Station Name	GENERAL BELGRANO, ANTARCTICA
Alternate Name	Belgrano
Geographic Coordinates	77°58'S, 38°48'W (See comments)
Vertical Cutoff Rigidity	0.77 GV
Altitude	Sea level
Number of Tubes	6 tubes
Start of Observations	January 1971
Principal Investigator	Dr. H. S. Ghielmetti Centro Nacional de Radiación Cósmica Perú 272, Buenos Aires, Argentina

Comments:

The station coordinates change slightly from year to year. The corrected geographic coordinates for the station (valid for May 1970) are 77°48'50"S, 38°15'19.5"W.

Data to be routinely submitted to the World Data Centers in yearly increments approximately 6 months after the end of each increment.

Station Name	GIF SUR YVETTE, FRANCE
Geographic Coordinates	48°41'N, 2°08'E
Vertical Cutoff Rigidity	3.61 GV
Altitude	40 meters
Number of Tubes	3 tubes
Start of Observations	March 1, 1966
Principal Investigator	Madame Delibrias Centre des Faibles Radioactivites CNRS, 91 Gif-sur-Yvette, France

Comments:

The Centre des Faibles Radioactivites uses this detector for corrections in carbon 14 measurements.

Plans are being made to process and submit these data to the World Data Centers.

Operating IQSY-NM-64 Neutron Monitors

Station Name	GOOSE BAY, CANADA
Geographic Coordinates	53°16'N, 60°24'W
Vertical Cutoff Rigidity	0.52 GV
Altitude	46 meters
Number of Tubes	18 tubes
Start of Observations	November 17, 1964
Principal Investigator	Dr. Hugh Carmichael Atomic Energy of Canada, Ltd. Chalk River, Ontario, Canada

Comments:

Data routinely submitted to the World Data Centers every 4 months about 6 weeks after last observations.

Data published in the Atomic Energy of Canada "Cosmic Ray NM-64 Neutron Monitor Data" series of reports.

Data for 1964 published in "Cosmic-Ray Intensity During the International Years of the Quiet Sun", No. 10, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1967.

Station Name	HAFELEKAR, AUSTRIA
Geographic Coordinates	47°19'N, 11°23'E
Vertical Cutoff Rigidity	4.37 GV
Altitude	2290 meters
Number of Tubes	6 tubes
Start of Observations	May 15, 1968
Principal Investigators	From May 1968 to February 1971: Prof. Dr. A. Ehmert (deceased) From February 1971 to the present: Prof. Dr. V. J. Kisselbach Institut für Stratosphären-Physik Max Planck Institut für Aeronomie 3411 Lindau/Harz PB 40, F.R.G. From May 1968 to the present: Prof. Dr. Rudolph Steinmaurer Dr. Herbert Oberguggenberger Physikalisches Institut Schöpfstrasse 41 A-6020-Innsbruck, Austria

Comments:

Data routinely submitted to the World Data Centers.

Operating IQSY-NM-64 Neutron Monitors

Station Name	HERMANUS, SOUTH AFRICA
Geographic Coordinates	$34^{\circ}25.5'S$, $19^{\circ}13.5'E$
Vertical Cutoff Rigidity	4.90 GV
Altitude	26 meters
Number of Tubes	3 tubes
Start of Observations	September 1, 1964
Principal Investigator	Chief, Magnetic Observatory P.O. Box 32 Hermanus, Republic of South Africa

Comments:

Effective 10 U.T. on March 9, 1967, the data accumulators are routinely stopped 20 seconds every hour for read-out. This change resulted in a decrease of $0.6 \pm 0.2\%$ in the observed hourly counts. The published data have not been corrected for this apparent change in counting rate.

Prof. P. H. Stoker of the University of Potchefstroom has determined the "efficiency factor" of the Hermanus neutron monitor statistically, using the 48-NM-64 super monitor at Deep River as a reference standard. The analysis yielded an efficiency factor of 0.9904 ± 0.0004 for the period April 1967 to May 1969, relative to the period February 1965 to February 1967. This efficiency factor corresponds to a decrease of $0.96\% \pm 0.04$ in the counting rate compared with the 0.5%-0.6% obtained when only the change in readout time is taken into account. At least part of the discrepancy can be ascribed to instability and drift in the high-voltage power supply during the period covered by the statistical analysis.

Data routinely submitted to the World Data Centers approximately 6 months after observations.

Data published in the following Hermanus Magnetic Observatory publications: (a) Cosmic Ray Bulletin (monthly); (b) Geophysical Series 1 (September 1, 1964-December 31, 1968); and (c) CSIR Report MAG D (January 1, 1969 to the present).

Date for 1964 published in "Cosmic-Ray Intensity During the International Years of the Quiet Sun", No. 10, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1967.

Operating IQSY-NM-64 Neutron Monitors

Station Name	INUVIK, CANADA
Geographic Coordinates	68°21'N, 133°43'W
Vertical Cutoff Rigidity	0.18 GV
Altitude	21 meters
Number of Tubes	18 tubes
Start of Observations	July 12, 1964
Principal Investigator	Dr. Hugh Carmichael Atomic Energy of Canada, Ltd. Chalk River, Ontario, Canada

Comments:

Data routinely submitted to the World Data Centers every 4 months about 6 weeks after the last observation.

Data published in the Atomic Energy of Canada, "Cosmic Ray NM-64 Neutron Monitor Data" series of reports.

Data for 1964 published in "Cosmic-Ray Intensity During the International Years of the Quiet Sun", No. 11, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1968.

Station Name	IRKUTSK, U.S.S.R.
Geographic Coordinates	52°28'N, 104°02'E
Vertical Cutoff Rigidity	3.66 GV
Altitude	433 meters
Number of Tubes	18 tubes
Start of Observations	April 1967
Principal Investigator	Dr. A. A. Luzov Siberian IZMIRAN Lenin Street, 5, Irkutsk, U.S.S.R.

Comments:

Data routinely submitted to the World Data Centers approximately 12 months after observations.

Data routinely published in monthly review of "Cosmical Data" (Kosmycheskiye danniye), Publishing Office "Nauka", Moscow, U.S.S.R.

Operating IQSY-NM-64 Neutron Monitors

Station Name	KERGUELEN
Alternate Name	Fort aux Francais
Geographic Coordinates	49°21'S, 70°13'E
Vertical Cutoff Rigidity	1.19 GV
Altitude	Sea level
Number of Tubes	18 tubes
Start of Observations	February 1, 1964
Principal Investigator	From February 1964 to October 1971: Dr. A. Freon (deceased)
Name and Address of Person to Contact for Information	Dr. M. G. Milleret (see comments) Laboratoire de Physique Cosmique Fort de Verrieres Route des Gatines 91 Verrieres-Le-Buisson, France

Comments:

The principal investigator replacing Dr. Freon is expected to be appointed sometime during 1972.

Data routinely submitted to the World Data Centers approximately 2 to 3 months after observations.

Data to be published in the "Bulletin des TAAF".

Data for 1964 published in "Cosmic-Ray Intensity During the International Years of the Quiet Sun", No. 11, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1968.

Operating IQSY-NM-64 Neutron Monitors

Station Name	KIEL, F. R. G.
Geographic Coordinates	54. 3°N, 10. 1°E
Vertical Cutoff Rigidity	2. 29 GV
Altitude	54 meters
Number of Tubes	18 tubes
Start of Observations	September 1, 1964
Principal In · stigator	Prof. Dr. E. Bagge Institut für Reine und Angewandte Kernphysik der Christian-Albrechts-Universität 23 Kiel, F. R. G.

Comments:

Data routinely submitted to the World Data Centers approximately 2 weeks after observations.

Data for 1964 published in "Cosmic-Ray Intensity During the International Years of the Quiet Sun", No. 11, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1968.

Station Name	KIEV, U. S. S. R.
Geographic Coordinates	50°43'N, 30°16'E
Vertical Cutoff Rigidity	3. 62 GV
Altitude	120 meters
Number of Tubes	18 tubes
Start of Observations	September 1, 1969
Principal Investigator	Dr. N. A. Ivanov Lenina Street 67/21 pos Dimer d. c. Keivo-Svjaloshinsky Kiev Region, U. S. S. R.

Comments:

Plans being made to submit data to the World Data Centers.

Operating IQSY-NM-64 Neutron Monitors

Station Name	KIRUNA, SWEDEN
Geographic Coordinates	67°50'N, 20°26'E
Vertical Cutoff Rigidity	0.54 GV
Altitude	400 meters
Number of Tubes	12 tubes
Start of Observations	January 1, 1970
Principal Investigator	Prof. A. E. Sandström Uppsala University Box 516 751 20 Uppsala 1, Sweden

Comments:

Data routinely submitted to the World Data Centers.

Station Name	KULA, U.S.A.
Geographic Coordinates	20°44'N, 156°20'W
Vertical Cutoff Rigidity	13.30 GV
Altitude	930 meters
Number of Tubes	3 tubes
Start of Observations	July 10, 1966
Principal Investigator	Dr. Hugh Carmichael Atomic Energy of Canada, Ltd. Chalk River, Ontario, Canada

Comments:

Data routinely submitted to the World Data Centers approximately 6 months after observations.

Data routinely published in the Atomic Energy of Canada "Cosmic-Ray NM-64 Neutron Monitor Data" series of reports.

Operating IQSY-NM-64 Neutron Monitors

Station Name	LEEDS, ENGLAND
Alternate Name	University of Leeds
Geographic Coordinates	53°50'N, 1°35'W
Vertical Cutoff Rigidity	2.20 GV.
Altitude	100 meters (January 1, 1965-September 1969) 70 meters (September 1, 1969-present)
Number of Tubes	18 tubes
Start of Observations	January 1, 1965
Principal Investigator	Prof. P. L. Marsden Physics Department University of Leeds Leeds 2, England

Comments:

Data routinely submitted to the World Data Centers.

Station Name	LINDAU/HARZ, F. R. G.
Geographic Coordinates	51°36'N, 10°6'E
Vertical Cutoff Rigidity	3.00 GV
Altitude	140 meters
Number of Tubes	18 tubes
Start of Observations	November 1, 1964
Principal Investigators	From November 1964 to February 1971: Prof. Dr. A. Ehmert (deceased) From February 1971 to the present: Prof. Dr. V. J. Kisselbach Institut für Stratosphären-Physik Max Planck Institut für Aeronomie 3411 Lindau/Harz PB 40, F. R. G.

Comments:

Data routinely submitted to the World Data Centers approximately 6 months after observations.

Data for 1964 published in "Cosmic-Ray Intensity During the International Years of the Quiet Sun", No. 11, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1968.

Operating IQSY-NM-64 Neutron Monitors

Station Name	MAGADAN, U.S.S.R.
Geographic Coordinates	60°07'N, 151°01'E
Vertical Cutoff Rigidity	2.10 GV
Altitude	Sea level
Number of Tubes	18 tubes
Start of Observations	January 1971 or before
Principal Investigator	Dr. G. Todikov

Comments:

Data for the January 24-25, 1971 ground level cosmic-ray increase have been deposited in the World Data Centers. It is not known if any earlier data are available.

Requests for data should be sent to the World Data Center B2 on Solar-Terrestrial Physics, Ulitza Molodezhnaya 3, Moscow B-296, U.S.S.R.

Station Name	McMURDO, ANTARCTICA
Geographic Coordinates	77°51'S, 166°43'E
Vertical Cutoff Rigidity	0.01 GV
Altitude	48 meters
Number of Tubes	18 tubes
Start of Observations	January 1964
Principal Investigator	Dr. Martin A. Pomerantz Bartol Research Foundation Swarthmore, Pennsylvania 19081, U.S.A.

Comments:

Data routinely submitted to the World Data Centers approximately 1 year after observations.

Station Name	MEXICO CITY, MEXICO
Alternate Names	C.U. (Ciudad Universitaria)
Geographic Coordinates	19°20'N, 99°11'W
Vertical Cutoff Rigidity	9.53 GV
Altitude	2274 meters
Number of Tubes	6 tubes
Start of Observations	November 1, 1970
Principal Investigator	Mr. Oscar Troncoso Institute de Geofísica Torre de Ciencias Ciudad Universitaria Mexico 20, D.F. Mexico

Comments:

Data to be routinely submitted to the World Data Centers.

Operating IQSY-NM-64 Neutron Monitors

Station Name	MOSCOW, U.S.S.R.
Alternate Name	IZMIRAN
Geographic Coordinates	55°28'N, 37°19'E
Vertical Cutoff Rigidity	2.46 GV
Altitude	200 meters
Number of Tubes and Periods of Observations	6 tubes (February 1966-February 1968) 6 tubes (July 1968-October 1968) 12 tubes (October 1968-present)
Principal Investigator	Dr. Y. L. Blokh IZMIRAN Institute of Terrestrial Magnetism Ionosphere and Radiowave Propagation Academy of Sciences of the U.S.S.R. p/o Akademgorodok, Moscow Region, U.S.S.R.

Comments:

Data routinely submitted to the World Data Centers approximately 6 months after observations.

Data routinely published in monthly review of "Cosmical Data" (Kosmycheskiye danniye), Publishing Office "Nauka", Moscow, U.S.S.R.

Station Name	MT. NORIKURA, JAPAN
Geographic Coordinates	36°07'N, 137°33'E
Vertical Cutoff Rigidity	11.39 GV
Altitude	2770 meters
Number of Tubes	3 tubes (September 1963-September 18, 1970) 4 tubes (September 19, 1970-present)
Start of Observations	September 1968 (see comments)
Principal Investigator	Dr. M. Wada Cosmic Ray Laboratory The Institute of Physical and Chemical Research 7-13, Kaga-1, Itabashi-ku Tokyo, Japan

Comments:

Data for preliminary observations, under different conditions, are available from the principal investigator for the period July 1968 - August 1968.

Data routinely submitted to the World Data Centers approximately 3 months after observations.

Operating IQSY-NM-64 Neutron Monitors

Station Name	MT. WELLINGTON, AUSTRALIA
Geographic Coordinates	$42^{o}55'S$, $147^{o}14'E$
Vertical Cutoff Rigidity	1.89 GV
Altitude	725 meters
Number of Tubes	6 tubes
Start of Observations	June 5, 1970
Principal Investigator	Dr. A. G. Fenton Physics Department University of Tasmania Box 252C, G. P. O. Hobart, Tasmania 7001, Australia

Comments:

Data will be submitted to the World Data Centers.

Station Name	NORILSK, U. S. S. R.
Geographic Coordinates	$69.26^{o}N$, $88.05^{o}E$
Vertical Cutoff Rigidity	0.63 GV
Altitude	Sea level
Number of Tubes	18 tubes
Start of Observations	January 1971 or before (See comments)
Principal Investigator	Dr. Yu. A. Kurchenko

Comments:

Data starting in January 1971 have been deposited in the World Data Centers. It is not known if any earlier data are available.

Data routinely submitted to the World Data Centers approximately 6 months after observations. Requests for data should be sent to the World Data Center B2 on Solar-Terrestrial Physics, Ulitza Molodezhnaya 3, Moscow B-296, U. S. S. R.

Operating IQSY-NM-64 Neutron Monitors

Station Name	OULU, FINLAND
Alternate Name	University of Oulu
Geographic Coordinates	65°1'N, 25°30'E
Vertical Cutoff Rigidity	0.81 GV
Altitude	15 meters
Number of Tubes	9 tubes
Start of Observations	May 5, 1964
Principal Investigator	Dr. Pekka Tanskanen Department of Physics University of Oulu Kontinkangas, Oulu, Finland

Comments:

Multiplicity measurements also being made.

Data routinely submitted to the World Data Centers approximately 6 months after observations.

Data for 1964 published in "Cosmic-Ray Intensity During the International Years of the Quiet Sun", No. 11, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1968.

Station Name	PIC DU MIDI, FRANCE
Geographic Coordinates	42°56'N, 00°15'E
Vertical Cutoff Rigidity	5.36 GV
Altitude	2860 meters
Number of Tubes	9 tubes
Start of Observations	November 1, 1964
Principal Investigator	From November 1964 to October 1971: Dr. A. Freon (deceased)
Name and Address of Person to Contact for Information	Dr. M. G. Milleret (see comments) Laboratoire de Physique Cosmique Fort de Verrieres Route des Gatines 91 Verrieres-Le-Buisson, France

Comments:

The principal investigator replacing Dr. Freon is expected to be appointed sometime during 1972.

Data routinely submitted to the World Data Centers approximately 2 to 3 months after observations.

Data for 1964 published in "Cosmic-Ray Intensity During the International Years of the Quiet Sun", No. 12, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1968.

Operating IQSY-NM-64 Neutron Monitors

Station Name	PREDIGTSTUHL, F. R. G.
Geographic Coordinates	47°42'N, 12°53'E
Vertical Cutoff Rigidity	4.30 GV
Altitude	1614 meters
Number of Tubes	3 tubes
Start of Observations	January 1, 1969
Principal Investigator	Dr. B. Beckmann FTZ D 33 Am Kavalleriesand 3 61 Darmstadt, F. R. G.

Comments:

Data to be submitted to the World Data Centers.

The operation of this equipment is expected to be terminated during 1972.

Station Name	RESOLUTE, CANADA
Geographic Coordinates	74°43'N, 94°59'W
Vertical Cutoff Rigidity	0.09 GV
Altitude	17 meters
Number of Tubes	6 tubes
Start of Observations	March 1, 1966
Principal Investigators	From March 1966 to August 1971: Dr. J. Katzman (retired) From August 1971 to the present: Dr. M. Bercovitch Division of Physics National Research Council of Canada Sussex Drive Ottawa, Ontario, Canada

Comments:

Data routinely submitted to the World Data Centers approximately 3 months after observations.

Operating IQSY-NM-64 Neutron Monitors

Station Name	ROME, ITALY
Alternate Name	Station SVIRCO, Roma
Geographic Coordinates	41°54'N, 12°31'E
Vertical Cutoff Rigidity	6.32 GV
Altitude	60 meters
Number of Tubes	9 tubes (May 1, 1966-July 14, 1966) 12 tubes (July 15, 1966-May 8, 1969) 9 tubes (May 9, 1969-present)
Start of Observations	May 1, 1966
Principal Investigators	From May 1, 1966 to December 31, 1970: Prof. Francesca Bachelet Present address: Istituto di Fisica dell' Università, Rome, Italy From January 1, 1971 to present: Prof. Nunzio Iucci Istituto de Fisica dell'Università Laboratorio del Plasma nello Spazio- C.N.R. P. le delle Scienze, 5 Universita, Rome, Italy

Comments:

Data routinely submitted to the World Data Centers approximately a year after observations.

Station Name	SANAE, ANTARCTICA
Alternate Name	Norway Station
Geographic Coordinates	70°18'S, 2°21'W
Vertical Cutoff Rigidity	1.06 GV
Altitude	53 meters
Number of Tubes	3 tubes
Start of Observations	February 17, 1964
Principal Investigator	Dr. P. H. Stoker Cosmic Ray Research Unit Potchefstroom University for C.H.E. Potchefstroom, South Africa

Comments:

Data routinely submitted to the World Data Centers approximately 18 months after observations.

Data for 1964 published in "Cosmic-Ray Intensity During the International Years of the Quiet Sun", No. 12, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1968.

Operating IQSY-NM-64 Neutron Monitors

Station Name	SULPHUR MOUNTAIN, CANADA
Alternate Name	Banff
Geographic Coordinates	51.2°N, 115.6°W
Vertical Cutoff Rigidity	1.14 GV
Altitude	2283 meters
Number of Tubes	6 tubes
Start of Observations	March 1, 1963
Principal Investigators	From March 1, 1963 to September 1, 1970: Dr. B. G. Wilson Present address: Vice President Simon Fraser University Burnaby 2, B.C., Canada From September 1, 1970 to present: Prof. D. Venkatesan and Dr. T. Mathews Physics Department University of Calgary Calgary 44, Alberta, Canada

Comments:

Mean station pressure is 766.0 mb.

Data routinely submitted to the World Data Centers approximately 3 months after observations.

Data for 1964 published in "Cosmic-Ray Intensity During the International Years of the Quiet Sun", No. 12, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1968.

Station Name	SWARTHMORE, U.S.A.
Geographic Coordinates	39°54'N, 75°21'W
Vertical Cutoff Rigidity	1.92 GV
Altitude	80 meters
Number of Tubes	9 tubes
Start of Observations	September 1963
Principal Investigator	Dr. Martin A. Pomerantz Bartol Research Foundation Swarthmore, Pennsylvania 19081, U.S.A.

Comments:

Data routinely submitted to the World Data Centers approximately 1 year after observations.

Data from July through December 1964 published in "Cosmic-Ray Intensity During the International Years of the Quiet Sun", No. 12, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1968.

Operating IQSY-NM-64 Neutron Monitors

Station Name	SYOWA, ANTARCTICA
Alternate Names	Syowa Base Syowa Station
Geographic Coordinates	69°00'S, 39°36'E
Vertical Cutoff Rigidity	0.42 GV
Altitude	15 meters
Number of Tubes	12 tubes
Start of Observations	March 1, 1967
Principal Investigator	Dr. M. Kodama The Institute of Chemical and Physical Research 7-13, Kaga-1, Itabashi-ku Tokyo, Japan

Comments:

Plans are being made to submit the data to the World Data Centers.

Station Name	TEHRAN, IRAN
Geographic Coordinates	35°42'N, 51°24'E
Vertical Cutoff Rigidity	10.56 GV
Altitude	1400 meters
Number of Tubes	Not available
Start of Observations	November 1, 1969
Principal Investigator	Dr. H. K. Afshar Institute of Geophysics Tehran University Amirabad, Tehran, Iran

Comments:

Data to be submitted to the World Data Centers.

For specific information contact Dr. J. B. Mercer, c/o Physics Department, The University of Leeds, Leeds 2, England.

Operating IQSY-NM-64 Neutron Monitors

Station Name	THULE, GREENLAND
Alternate Name	Geopole Station
Geographic Coordinates	76°35'N, 68°25'W
Vertical Cutoff Rigidity	0.00 GV
Altitude	260 meters
Number of Tubes	9 tubes
Start of Observations	February 1964
Principal Investigator	Dr. Martin A. Pomerantz Bartol Research Foundation Swarthmore, Pennsylvania 19081, U.S.A.

Comments:

Data routinely submitted to the World Data Centers approximately 1 year after observations.

Data published in the AFCRL Geophysics and Space Data Bulletin, AFCRL, L.G. Hanscom Field, Bedford, Massachusetts 01730, U.S.A.

Data from October through December 1964 published in "Cosmic-Ray Intensity During the International Years of the Quiet Sun", No. 12, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1968.

Station Name	TIXIE BAY, U.S.S.R.
Geographic Coordinates	71°35'N, 129°00'E
Vertical Cutoff Rigidity	0.53 GV
Altitude	Sea level
Number of Tubes	18 tubes
Start of Observations	August 1966
Principal Investigators	Dr. N. P. Chirkov and Dr. V. I. Ipatev Institute of Cosmophysical Investigations and Aeronomy Lenin Avenue, 61 Yakutsk, Siberia, U.S.S.R.

Comments:

Data routinely submitted to the World Data Centers approximately 6 months after observations.

Data routinely published in monthly review of "Cosmical Data" (Kosmycheskiye danniye), Publishing Office "Nauka", Moscow, U.S.S.R.

Operating IQSY-NM-64 Neutron Monitors

Station Name	TOKYO, ITABASHI, JAPAN
Geographic Coordinates	35°45'N, 139°43'E
Vertical Cutoff Rigidity	11.61 GV
Altitude	20 meters
Number of Tubes	9 tubes (November 1969-April 1971) 18 tubes (May 1971-present)
Start of Observations	November 1969
Principal Investigator	Dr. M. Wada Cosmic Ray Laboratory The Institute of Physical and Chemical Research 7-13, Kaga-1, Itabashi-ku Tokyo, Japan

Comments:

Data routinely submitted to the World Data Centers approximately 3 months after observations.

Preliminary data with 3 tubes are available since January 1969.

Station Name	UTRECHT, THE NETHERLANDS
Geographic Coordinates	52°06'N, 5°07'E
Vertical Cutoff Rigidity	2.76 GV
Altitude	1 meter
Number of Tubes	18 tubes
Start of Observations	February 1, 1967
Principal Investigators	Dr. L. D. de Feiter Space Research Laboratory Beneluxlaan 21 Utrecht, The Netherlands Dr. H. F. Jongen Natuurkundig Laboratorium Universiteit van Amsterdam Valckenierstraat 65 Amsterdam, The Netherlands

Comments:

Observations were interrupted from February 1, 1967 until July 1, 1969 because of interference from the nuclear accelerator.

Data from July 1, 1969 will be submitted to the World Data Centers.

Data routinely published in the Monthly Bulletin, Royal Meteorological Institute, De Bilt, The Netherlands.

Operating IQSY-NM-64 Neutron Monitors

Station Name	VICTORIA, CANADA
Geographic Coordinates	$48^{\circ}25'N$, $123^{\circ}19'W$
Vertical Cutoff Rigidity	1.86 GV
Altitude	71 meters
Number of Tubes	18 tubes
Start of Observations	August 28, 1964
Principal Investigators	Dr. R. M. Pearce and Dr. G. R. Mason Department of Physics University of Victoria Victoria, British Columbia, Canada

Comments:

Data routinely submitted to the World Data Centers approximately 1 to 7 months after observations.

Data from September through December 1964 published in "Cosmic-Ray Intensity During the International Years of the Quiet Sun", No. 12, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1968.

Section A2

IGY-type Neutron Monitors

The following listings contain the pertinent information on the IGY-type neutron monitors in operation on December 31, 1971. The locations of these detectors are snown in Figure A2. These monitors are the standard design adopted by the IGY and described by Simpson (1957).

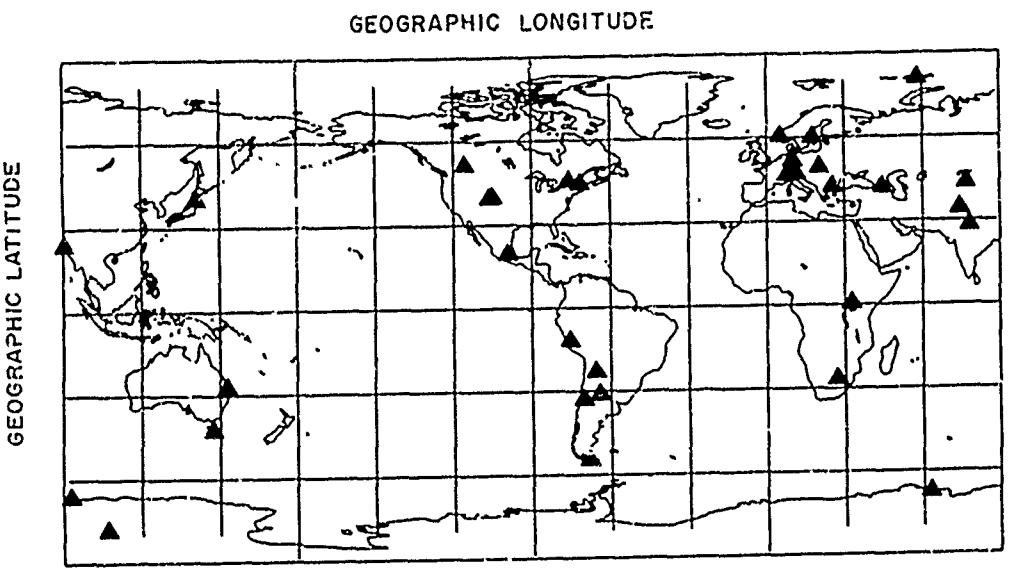

Figure A2. World Map Showing Locations of Operating IGY -ype Neutron Monitors

Operating IGY-Type Neutron Monitors

Station Name	ALIGARH, INDIA
Geographic Coordinates	$27^{o}54'30"N$, $78^{o}4'26"E$
Vertical Cutoff Rigidity	14.85 GV
Altitude	185.93 meters
Start of Observations	December 1971
Principal Investigator	Dr. R. S. Yadav Department of Physics Aligarh Muslin University Aligarh, India

Comments:

Data to be submitted to the World Data Centers.

Station Name	ALMA-ATA, U.S.S.R.
Geographic Coordinates	$43^{o}15'N$, $76^{o}55'E$
Vertical Cutoff Rigidity	6.69 GV
Altitude	806 meters
Periods of Observations	July 1957 - December 1959 June 1960 - present
Principal Investigator	Dr. E. V. Kolomeets Kazakh State University Kirov Street, 136, Alma-Ata, U.S.S.R.

Comments:

Data routinely submitted to the World Data Centers approximately 12 months after observations.

Data routinely published in monthly review of "Cosmical Data", (Kosmycheskiye danniye), Publishing Office "Nauka", Moscow, U.S.S.R.

Data during IGY published in "Cosmic-Ray Intensity During the International Geophysical Year", National Committee for the International Geophysical Year, Science Council of Japan, Ueno Park, Tokyo, Japan, as follows:

July-December 1957	Book No. 1, March 1959
January-June 1958	Book No. 2, December 1959
July-December 1958	Book No. 3, April 1960

Data for 1964 published in "Cosmic-Ray Intensity During the International Years of the Quiet Sun", No. 10, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1967.

Operating IGY-Type Neutron Monitors

Station Name	BERGEN, NORWAY
Geographic Coordinates	60°24'N, 5°19'E
Vertical Cutoff Rigidity	1.13 GV
Altitude	Sea level
Start of Observations	April 1958
Principal Investigator	Prof. Dr. B. Trumpy Department of Physics University of Bergen Allegt. 53-55, Bergen, Norway

Comments:

Data to be sent to the World Data Centers.

Station Name	BRISBANE, AUSTRALIA
Geographic Coordinates	27°32'S, 152°55'E
Vertical Cutoff Rigidity	7.21 GV
Altitude	Sea level
Start of Observations	November 30, 1960
Principal Investigator	Dr. A. G. Fenton Physics Department University of Tasmania Box 252 C, G.P.O. Hobart, Tasmania 7001, Australia

Comments:

This instrument was transferred from Sydney.

Data from January 1968 onwards to be submitted to the World Data Centers.

Operating IGY-Type Neutron Monitors

Station Name	CLIMAX, U.S.A.
Geographic Coordinates	39.37°N, 106.18°W
Vertical Cutoff Rigidity	3.03 GV
Altitude	3400 meters
Start of Observations	September 1951
Principal Investigator	Prof. J. A. Simpson LASR-EFI University of Chicago 933 E. 56th Street Chicago, Illinois 60637, U.S.A.

Comments:

This equipment was in operation for short periods from 1950 to September 1951.

Data routinely submitted to the World Data Centers approximately 3 to 6 months after observations.

Master magnetic tapes of the data are available for copy.

Daily averages published in Part 1, Solar-Geophysical Data (Prompt Reports), NOAA Research Laboratories, U.S. Department of Commerce, Boulder, Colorado, 80302, U.S.A.

Data during IGY published in "Cosmic-Ray Intensity During the International Geophysical Year", National Committee for the International Geophysical Year, Science Council of Japan, Ueno Park, Tokyo, Japan, as follows:

July-December 1957	Book No. 1, March 1959
January-June 1958	Book No. 2, December 1959
July-December 1958	Book No. 3, April 1960

Data for 1964 published in "Cosmic-Ray Intensity During the International Years of the Quiet Sun", No. 10, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1967.

Operating IGY-Type Neutron Monitors

Station Name	DENVER, U.S.A.
Geographic Coordinates	39°40'N, 104°58'W
Vertical Cutoff Rigidity	2.91 GV
Altitude	1600 meters
Start of Observations	January 1965
Principal Investigator	Prof. R. L. Chasson Department of Physics University of Denver Denver, Colorado 80210, U.S.A.

Comments:

Data routinely submitted to the World Data Centers approximately 1 year after observations.

Station Name	EL INFIERNILLO, CHILE
Geographic Coordinates	33°10'S, 70°17'W
Vertical Cutoff Rigidity	11.45 GV
Altitude	4343 meters
Start of Observations	January 1968
Principal Investigator	Prof. Gabriel Alvial Centro de Radiación Cósmica (Facultad de Ciencias Físicas y Matemáticas) Universidad de Chile Casilla 1314, Santiago de Chile, Chile

Comments:

Plans being made to submit data to the World Data Centers.

Station Name	GULMARG, INDIA
Geographic Coordinates	34.07°N, 74.42°E
Vertical Cutoff Rigidity	11.91 GV
Altitude	2743 meters
Start of Observations	February 15, 1968
Principal Investigator	Dr. H. Razdan Physical Research Laboratory Ahmedabad-9, Gujarat, India

Comments:

Equipment consists of 20 BF_3 counters, each 0.9144 meter in length.

Data to be submitted to the World Data Centers.

Operating IGY-Type Neutron Monitors

Station Name	CORDOBA, ARGENTINA
Geographic Coordinates	31°25'S, 64°12'W
Vertical Cutoff Rigidity	11.45 GV
Altitude	434 meters
Start of Observations	July 1, 1964
Principal Investigator	Dr. Horacio F. Heredia Instituto de Matemática, Astronomía y Física Laprida 854, Córdoba, Argentina

Comments:

Data routinely submitted to the World Data Centers about 3 months after observations.

Data for July through December 1964 published in "Cosmic-Ray Intensity During the International Years of the Quiet Sun", No. 10, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Japan, March 1967.

Station Name	DACCA, BANGLADESH
Geographic Coordinates	23°45'N, 90°25'E
Vertical Cutoff Rigidity	16.22 GV
Altitude	Sea level
Start of Observations	January 23, 1964
Principal Investigators	Dr. M. S. Islam and Dr. Q. N. Begum Cosmic Radiation Research Laboratory Physics Department Dacca University Dacca 2, Bangladesh

Comments:

Data routinely submitted to the World Data Centers

The operation of this equipment was temporarily stopped on March 1, 1971. The monitor consists of one unit only, another unit is expected to be added.

Operating IGY-Type Neutron Monitors

Station Name	DENVER, U.S.A.
Geographic Coordinates	39°40'N, 104°58'W
Vertical Cutoff Rigidity	2.91 GV
Altitude	1600 meters
Start of Observations	January 1965
Principal Investigator	Prof. R. L. Chasson Department of Physics University of Denver Denver, Colorado 80210, U.S.A.

Comments:

Data routinely submitted to the World Data Centers approximately 1 year after observations.

Station Name	EL INFIERNILLO, CHILE
Geographic Coordinates	33°10'S, 70°17'W
Vertical Cutoff Rigidity	11.45 GV
Altitude	4343 meters
Start of Observations	January 1968
Principal Investigator	Prof. Gabriel Alvial Centro de Radiación Cósmica (Facultad de Ciencias Físicas y Matemáticas) Universidad de Chile Casilla 1314, Santiago de Chile, Chile

Comments:

Plans being made to submit data to the World Data Centers.

Station Name	GULMARG, INDIA
Geographic Coordinates	34.07°N, 74.42°E
Vertical Cutoff Rigidity	11.91 GV
Altitude	2743 meters
Start of Observations	February 15, 1968
Principal Investigator	Dr. H. Razdan Physical Research Laboratory Ahmedabad-9, Gujarat, India

Comments:

Equipment consists of 20 BF_3 counters, each 0.9144 meter in length.

Data to be submitted to the World Data Centers.

Operating IGY-Type Neutron Monitors

Station Name	HEISS ISLAND, U. S. S. R.
Geographic Coordinates	80°37'N, 58°03'E
Vertical Cutoff Rigidity	0.10 GV
Altitude	20 meters
Start of Observations	January 1, 1958 - October 1, 1967 November 1, 1967 - May 1968 November 1968 - August 1970 (See comments)
Principal Investigator	Dr. L. L. Lazutin Polar Geophysical Institute Akademgorodok, Apatity Murmansk Region, U. S. S. R.

Comments:

This monitor has operated at irregular intervals since August 1970.

Data routinely submitted to the World Data Centers

Data during IGY published in "Cosmic-Ray Intensity During the International Geophysical Year", National Committee for the International Geophysical Year, Science Council of Japan, Ueno Park, Tokyo, Japan, as follows:

April - June 1958	Book No. 2, December 1959
July - December 1958	Book No. 3, April 1960

Data for 1964 published in "Cosmic-Ray Intensity During the International Years of the Quiet Sun", No. 10, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1967.

Station Name	HOBART, AUSTRALIA
Geographic Coordinates	42°54'S, 147°20'E
Vertical Cutoff Rigidity	1.88 GV
Altitude	Sea level
Start of Observations	March 1, 1967
Principal Investigator	Dr. A. G. Fenton Physics Department University of Tasmania Box 252C, G. P. O. Hobart, Tasmania 7001, Australia

Comments:

Data routinely submitted to the World Data Centers approximately 6 to 12 months after observation.

Operating IGY-Type Neutron Monitors

Station Name	HUANCAYO, PERU
Geographic Coordinates	12.03°S, 75.33°W
Vertical Cutoff Rigidity	13.45 GV
Altitude	3400 meters
Start of Observations	January 1952
Principal Investigator	Prof. J. A. Simpson LASR-EFI University of Chicago 933 E. 56th Street Chicago, Illinois 60637, U.S.A.

Comments:

Data routinely submitted to the World Data Centers approximately 3 to 6 months after observations.

Master magnetic tapes of the data are available for copy.

Data published in the AFCRL Geophysics and Space Data Bulletin, AFCRL, L.G. Hanscom Field, Bedford, Massachusetts, 01730. U.S.A.

Data during IGY published in "Cosmic-Ray Intensity During the International Geophysical Year", National Committee for the International Geophysical Year, Science Council of Japan, Ueno Park, Tokyo, Japan, as follows:

July-December 1957	Book No. 1, March 1959
January-June 1958	Book No. 2, December 1959
July-December 1958	Book No. 3, April 1960

Data for 1964 published in "Cosmic-Ray Intensity During the International Years of the Quiet Sun", No. 10, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1967.

Operating IGY-Type Neutron Monitors

Station Name	JUNGFRAUJOCH, SWITZERLAND
Geographic Coordinates	46.5°N, 8.0°E
Vertical Cutoff Rigidity	4.48 GV
Altitude	3550 meters
Start of Observations	October 1, 1958
Principal Investigator	Dr. H. Debrunner Cosmic Ray Group Physikalisches Institut Universität Bern Sidlerstrasse 5, Bern, Switzerland

Comments:

Data routinely submitted to the World Data Centers approximately 6 months after observation.

Apparatus consists of 3 sections with 6 counters each.

Data for October through December 1958 published in "Cosmic-Ray Intensity During the International Geophysical Year", No. 3, National Committee for the International Geophysical Year, Science Council of Japan, Ueno Park, Tokyo, Japan, April 1960.

Data for 1964 published in "Cosmic-Ray Intensity During the International Years of the Quiet Sun", No. 11, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1968.

Station Name	LINDAU/HARZ, F.R.G.
Geographic Coordinates	51°36'N, 10°6'E
Vertical Cutoff Rigidity	3.00 GV
Altitude	140 meters
Start of Observations	May 1, 1959
Principal Investigators	From May 1959 to February 1971: Prof. Dr. A. Ehmert (deceased) From February 1971 to the present: Prof. Dr. V. J. Kisselbach Institut für Stratosphären-Physik Max Planck Institut für Aeronomie 3411 Lindau/Harz PB 40, F.R.G.

Comments:

Data routinely submitted to the World Data Centers approximately 6 months after observations.

Data for 1964 published in "Cosmic-Ray Intensity During the International Years of the Quiet Sun", No. 11, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1968.

Operating IGY-Type Neutron Monitors

Station Name	LOMNICKÝ ŠTÍT, CZECHOSLOVAKIA
Geographic Coordinates	49.20°N, 20.22°E
Vertical Cutoff Rigidity	4.00 GV
Altitude	2632 meters
Period of Observations	January 1958 - October 1960 May 1, 1964 - present
Principal Investigator	Dr. Pavel Chaloupka UEF SAV Lomnický Štít p. Tatranská Lomnica, Czechoslovakia

Comments:

Data routinely submitted to the World Data Centers approximately a year after observations.

Data during IGY published in "Cosmic-Ray Intensity During the International Geophysical Year", National Committee for the International Geophysical Year, Science Council of Japan, Ueno Park, Tokyo, Japan as follows:

January - June 1958	Book No. 2, December 1959
July - December 1958	Book No. 3, April 1960

Data for May through December 1964 published in "Cosmic-Ray Intensity During the International Years of the Quiet Sun", No. 11, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1968.

Operating IGY-Type Neutron Monitors

Station Name	MAKERERE, UGANDA
Alternate Names	Kampala
Geographic Coordinates	$0^{\circ}20.2'$N, $32^{\circ}33.8'$E
Vertical Cutoff Rigidity	14.98 GV
Altitude	1196 meters
Start of Observations	October 26, 1957
Principal Investigator	Prof. D. M. Thomson Physics Department Makerere University College P.O. Box 7062 Kampala, Uganda, E. Africa

Comments:

Data routinely submitted to the World Data Centers approximately 6 months after observations.

Data during IGY published in "Cosmic-Ray Intensity During the International Geophysical Year", National Committee for the International Geophysical Year, Science Council of Japan, Ueno Park, Tokyo, Japan, as follows:

October-December 1957	Book No. 1, March 1959
January-June 1958	Book No. 2, December 1959
July-December 1958	Book No. 3, April 1960

Data for 1964 published in "Cosmic-Ray Intensity During the International Years of the Quiet Sun", No. 11, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1968.

Operating IGY-Type Neutron Monitors

Station Name	MAWSON, ANTARCTICA
Geographic Coordinates	67°36'S, 62°53'E
Vertical Cutoff Rigidity	0.22 GV
Altitude	Sea level
Start of Observations	April 1, 1957
Principal Investigator	Dr. A. G. Fenton Physics Department University of Tasmania Box 252C, G.P.O. Hobart, Tasmania 7001, Australia

Comments:

Data routinely submitted to the World Data Centers 6 to 12 months after observations.

Data are published in "ANARE Data Reports", Antarctic Division, 568 St. Kilda Road, Melbourne, Victoria 3004, Australia.

Data during IGY published in "Cosmic-Ray Intensity During the International Geophysical Year", National Committee for the International Geophysical Year, Science Council of Japan, Ueno Park, Tokyo, Japan, as follows:

July-December 1957	Book No. 1, March 1959
January-June 1958	Book No. 2, December 1959
July-December 1958	Book No. 3, April 1960

Data for 1964 published in "Cosmic-Ray Intensity During the International Years of the Quiet Sun", No. 11, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1968.

Operating IGY-Type Neutron Monitors

Station Name	MEXICO CITY, MEXICO
Alternate Names	C.U. (Ciudad Universitaria)
Geographic Coordinates	19°20'N, 99°11'W
Vertical Cutoff Rigidity	9.53 GV
Altitude	2274 meters
Start of Observations	1954
Principal Investigators	1954-1968: Prof. J. A. Simpson LASR-EFI University of Chicago 933 E. 56th Street Chicago, Illinois 60637, U.S.A. 1969-present Mr. Oscar Troncoso Instituto de Geofísica Torre de Ciencias Ciudad Universitaria Mexico 20 D.F. Mexico

Comments:

This is a modified IGY design (not standard).

Data from 1954-1968 not submitted to the World Data Centers. Data from 1969 to present routinely submitted to the World Data Centers.

Station Name	MINA AGUILAR, ARGENTINA
Geographic Coordinates	23°06'S, 65°42'W
Vertical Cutoff Rigidity	12.51 GV
Altitude	4000 meters
Start of Observations	July 16, 1957
Principal Investigators	Dr. José R. Manzano and Prof. Orestes R. Santochi Universidad de Tucumán Ayacucho 482, Tucumán, Argentina

Comments:

Data routinely submitted to the World Data Centers approximately 6 months after observations.

Data during IGY published in "Cosmic-Ray Intensity During the International Geophysical Year", National Committee for the International Geophysical Year, Science Council of Japan, Ueno Park, Tokyo, Japan, as follows:

July-December 1957	Book No. 1, March 1959
January-June 1958	Book No. 2, December 1959
July-September 1958	Book No. 3, April 1960

Data for 1964 published in "Cosmic-Ray Intensity During the International Years of the Quiet Sun", No. 11, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1968.

Operating IGY-Tvpe Neutron Monitors

Station Name	MIRNY, ANTARCTICA
Geographic Coordinates	66°33'S, 93°01'E
Vertical Cutoff Rigidity	0.04 GV
Altitude	30 meters
Start of Observations	April 1958
Principal Investigator	Dr. N. S. Kaminer IZMIRAN Institute of Terrestrial Magnetism Ionosphere and Radiowave Propagation Academy of Sciences of the U. S. S. R. p/o Akademgorodok, Moscow Region, U. S. S. R.

Comments:

Data routinely submitted to the World Data Centers approximately 2 years after observation.

Data for 1964 published in "Cosmic-Ray Intensity During the International Years of the Quiet Sun", No. 11, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1968.

Station Name	MORIOKA, JAPAN
Geographic Coordinates	39°42'N, 141°08'E
Vertical Cutoff Rigidity	10.16 GV
Altitude	135 meters
Start of Observations	August 11, 1970
Principal Investigator	Prof. Hachiro Takahashi Department of Physics Iwate University Morioka, Japan

Comments:

Data will be supplied upon request.

Information on this monitor will be found in the following publications:

1. Takahashi, H., T. Chiba and N. Yahagi, "Observation of Cosmic-Ray Neutron Intensity at Morioka, Part I. The Neutron Monitor", Annual Report Faculty of Education, University Iwate, Vol. 31, Pt. 3, 15, 1971.

2. Chiba, T., "Observation of Cosmic-Ray Intensity at Morioka, Part II. Barometric Pressure Effect", Annual Report Faculty of Education, University Iwate, Vol. 31, Pt. 3, 25, 1971.

Operating IGY-Type Neutron Monitors

Station Name	MT. WASHINGTON, U.S.A.
Geographic Coordinates	44°18'N, 71°18'W
Vertical Cutoff Rigidity	1.24 GV
Altitude	1900 meters
Start of Observations	July 1954
Principal Investigator	Dr. J. A. Lockwood Department of Physics University of New Hampshire Durham, New Hampshire 03824, U.S.A.

Comments:

Data routinely submitted to the World Data Centers approximately 1 year after observations.

Data published in the AFCRL Geophysics and Space Data Bulletin, AFCRL, L. G. Hanscom Field, Bedford, Massachusetts, 01730, U.S.A.

Data during IGY published in "Cosmic-Ray Intensity During the International Geophysical Year", National Committee for the International Geophysical Year, Science Council of Japan, Ueno Park, Tokyo, Japan, as follows:

July-December 1957	Book No. 1, March 1959
January-June 1958	Book No. 2, December 1959
July-December 1958	Book No. 3, April 1960

Data for 1964 published in "Cosmic-Ray Intensity During the International Years of the Quiet Sun", No. 11, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1968.

Station Name	MUSSALA, BULGARIA
Geographic Coordinates	42°11'N, 25°35'E
Vertical Cutoff Rigidity	6.45 GV
Altitude	2925 meters
Start of Observations	March 10, 1964
Principal Investigator	Dr. N. Ahababian Bulgarian Academy of Sciences Institute of Physics Sofia, Bulgaria

Comments:

Bi-hourly data routinely submitted to the World Data Centers every 6 months.

Operating IGY-Type Neutron Monitors

Station Name	OTTAWA, CANADA
Geographic Coordinates	45°24'N, 75°36'W
Vertical Cutoff Rigidity	1.08 GV
Altitude	101 meters (April 1954-August 1960) 57 meters (August 1960-present)
Start of Observations	April 1, 1954
Principal Investigators	From April 1954 to August 1971: Dr. J. Katzman (retired) From August 1971 to the present: Dr. M. Bercovitch Division of Physics National Research Council of Canada Sussex Drive Ottawa, Ontario, Canada

Comments:

Data routinely submitted to the World Data Centers approximately 3 months after observations.

Between 1954 and 1960 several changes were made to the monitor. Normalization factors for this time period are on file at World Data Center A.

Data during IGY published in "Cosmic-Ray Intensity During the International Geophysical Year", National Committee for the International Geophysical Year, Science Council of Japan, Ueno Park, Tokyo, Japan, as follows:

July-December 1957	Book No. 1, March 1959
January-June 1958	Book No. 2, December 1959
July-December 1958	Book No. 3, April 1960

Data for 1964 published in "Cosmic-Ray Intensity During the International Years of the Quiet Sun", No. 11, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1968.

Station Name	POTCHEFSTROOM, SOUTH AFRICA
Geographic Coordinates	26.70°S, 27.10°E
Vertical Cutoff Rigidity	7.30 GV
Altitude	1351 meters
Start of Observations	May 1, 1971
Principal Investigator	Prof. P. H. Stoker Cosmic Ray Research Unit Potchefstroom University for C. H. E. Potchefstroom, South Africa

Comments:

Data to be submitted to the World Data Centers.

Operating IGY-Type Neutron Monitors

Station Name	SOUTH POLE, ANTARCTICA
Geographic Coordinates	90°0'S, 0°0'E
Vertical Cutoff Rigidity	0.11 GV
Altitude	2820 meters
Start of Observations	February 1964
Principal Investigator	Dr. Martin A. Pomerantz Bartol Research Foundation Swarthmore, Pennsylvania 19081, U.S.A.

Comments:

Data routinely submitted to the World Data Centers approximately 1 year after observation.

Data for March through December 1964 published in "Cosmic-Ray Intensity During the International Years of the Quiet Sun", No. 12, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1968.

Operating IGY-Type Neutron Monitors

Station Name	SULPHUR MOUNTAIN, CANADA
Alternate Names	Banff
Geographic Coordinates	51.2°N, 115.6°W
Vertical Cutoff Rigidity	1.14 GV
Altitude	2283 meters
Start of Observations	July 1, 1957
Principal Investigators	From July 1, 1957 to September 1, 1970: Dr. B. G. Wilson Present address: Vice President Simon Fraser University Burnaby 2, British Columbia, Canada From September 1, 1970 to present: Prof. D. Venkatesan and Dr. T. Mathews Physics Department University of Calgary Calgary 44, Alberta, Canada

Comments:

Data routinely submitted to the World Data Centers approximately 3 months after observations.

Efficiency factors on file at the World Data Centers.

Data during IGY published in "Cosmic-Ray Intensity During the International Geophysical Year", National Committee for the International Geophysical Year, Science Council of Japan, Ueno Park, Tokyo, Japan, as follows:

July-December 1957	Book No. 1, March 1959
January-June 1958	Book No. 2, December 1959
July-December 1958	Book No. 3, April 1960

Data for 1964 published in "Cosmic-Ray Intensity During the International Years of the Quiet Sun", No. 12, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1968.

Operating IGY-Type Neutron Monitors

Station Name	TBILISI, U. S. S. R.
Geographic Coordinates	41°43'N, 44°48'E
Vertical Cutoff Rigidity	6.91 GV
Altitude	510 meters
Periods of Observations	January 1958-December 1960 March 1961 - May 1961 January 1963-June 1963 January 1964-present
Principal Investigator	Dr. L. G. Dzhavakhishvile Institute of Geophysics Academy of Sciences, Georgian S. S. R. L. Rikhadze Street, 1 Tbilisi 15, U. S. S. R.

Comments:

Data routinely submitted to the World Data Centers approximately 12 months after observations.

Data routinely published in monthly review of "Cosmical Data" (Kosmycheskiye danniye), Publishing Office "Nauka", Moscow, U. S. S. R.

Data for January 22 through December 31, 1964 published in "Cosmic-Ray Intensity During the International Years of the Quiet Sun", No. 12, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1968.

Station Name	UPPSALA, SWEDEN
Geographic Coordinates	59°51'N, 17°35'E
Vertical Cutoff Rigidity	1.43 GV
Altitude	Sea level
Start of Observations	September 1, 1956
Principal Investigator	Prof. A. E. Sandström Uppsala University Box 516 751 20 Uppsala 1, Sweden

Comments:

Data routinely submitted to the World Data Centers approximately a year after observations.

Data during IGY published in "Cosmic-Ray Intensity During the International Geophysical Year", National Committee for the International Geophysical Year, Science Council of Japan, Ueno Park, Tokyo, Japan, as follows:

July-December 1957	Book No. 1, March 1959
January-June 1958	Book No. 2, December 1959
July-December 1958	Book No. 3, April 1960

Data for 1964 published in "Cosmic-Ray Intensity During the International Years of the Quiet Sun", No. 12, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1968.

Operating IGY-Type Neutron Monitors

Station Name	USHUAIA, ARGENTINA
Geographic Coordinates	54°48'S, 68°19'W
Vertical Cutoff Rigidity	5.68 GV
Altitude	Sea level
Start of Observations	July 1, 1957
Principal Investigator	Dr. Horacio S. Ghielmetti Centro Nacional de Radiación Cósmica Perú 272 Buenos Aires, Argentina

Comments:

Data routinely submitted to the World Data Centers.

Data during IGY published in "Cosmic-Ray Intensity During the International Geophysical Year", National Committee for the International Geophysical Year, Science Council of Japan, Ueno Park, Tokyo, Japan, as follows:

July-December 1957	Book No. 1, March 1959
January-June 1958	Book No. 2, December 1959
July-August 1958	Book No. 3, April 1960

Data for 1964 published in "Cosmic-Ray Intensity During the International Years of the Quiet Sun", No. 12, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1968.

Operating IGY-Type Neutron Monitors

Station Name	VOSTOK, ANTARCTICA
Geographic Coordinates	$78^{o}28'S$, $106^{o}48'E$
Vertical Cutoff Rigidity	0.00 GV
Altitude	3488 meters
Start of Observations	July 14, 1963
Principal Investigators	For 1963: Dr. S. Fischer Institute of Experimental Physics Cosmic Ray Laboratory Lomnický Štít, p. Tatranská Lomnica, Czechoslovakia For 1964: Dr. P. Chaloupka Institute of Experimental Physics Cosmic Ray Laboratory Lomnický Štít p. Tatranská Lomnica, Czechoslovakia From 1965-present: Dr. N. S. Kaminer IZMIRAN Institute of Terrestrial Magnetism Ionosphere and Radiowave Propagation Academy of Sciences of the U.S.S.R. p/o Akademgorodok, Moscow Region, U.S.S.R.

Comments:

Data from 1963-1967 submitted to the World Data Centers. More recent data will be submitted to the Data Centers.

Data for 1964 published in "Cosmic-Ray Intensity During the International Years of the Quiet Sun", No. 12, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1968.

Operating IGY-Type Neutron Monitors

Station Name	ZUGSPITZE, F. R. G.
Alternate Names	Zugspitze Laboratory Max Planck Institut
Geographic Coordinates	$47^{\circ}25'N$, $10^{\circ}59'E$
Vertical Cutoff Rigidity	4.24 GV
Altitude	2960 meters
Start of Observations	January 1, 1957
Principal Investigator	Dr. Dieter Hovestadt Max Planck Institut für Physik and Astrophysik Institut für Extraterrestrische Physik 8046 Garching, München, F. R. G.

Comments:

Data routinely submitted to the World Data Centers approximately 1 year after observations.

Data during IGY published in "Cosmic-Ray Intensity During the International Geophysical Year", National Committee for the International Geophysical Year, Science Council of Japan, Ueno Park, Tokyo, Japan, as follows:

July-December 1957	Book No. 1, March 1959
January-June 1958	Book No. 2, December 1959
July-December 1958	Book No. 3, April 1960

Section A3

Muon Detectors

The following listings contain the pertinent information on the various muon detectors, not including those operating underground, in operation on December 31, 1971. The locations of these detectors are shown in Figure A3. A separate listing is given for each detector even though there may be more than one detector operating at the same location.

There is no standard description for the many muon detectors in existance, and many variations exist. For the IGY there was a standard cubical design described by Elliot (1957). In later years it has been common in many countries to replace the banks of geiger counters with scintillators, but many individual variations in design exist ranging from single detectors to the crossed telescope technique. A description of the meta-muon detector, sometimes referred to as the X-MT-64 (where X denotes the number of independent sections) is given by Carmichael (1964). Whenever possible a description of the detector or an appropriate reference has been included in the detector listing.

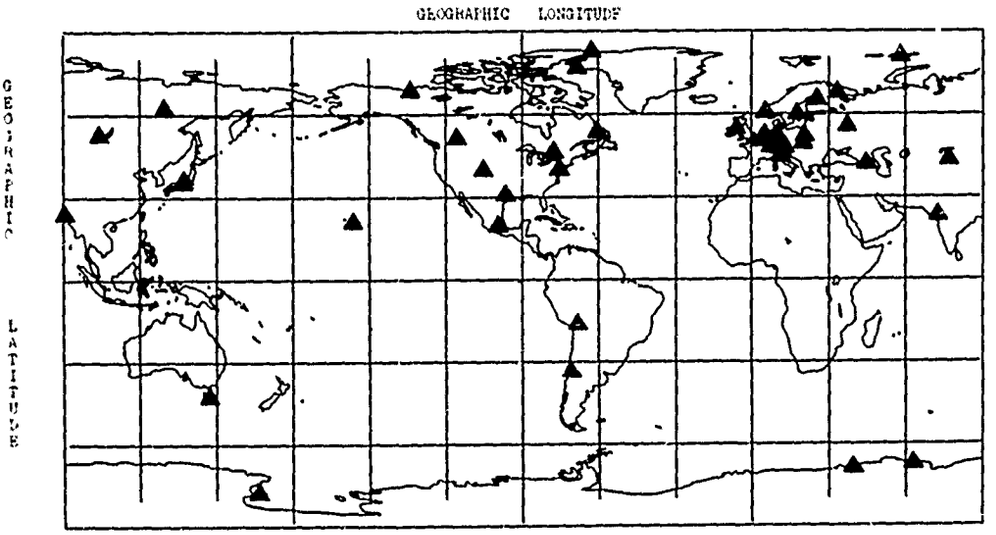

Figure A3. World Map Showing Locations of Operating Muon Detectors

Operating Muon Detectors

Station Name	AHMEDABAD, INDIA
Geographic Coordinates	23°01'N, 72°36'E
Vertical Cutoff Rigidity	15.94 GV
Altitude	Sea level
Type of Equipment and Configuration	Muon scintillator telescope forming 2 vertical and 2 inclined telescopes (zenith angle = 50°)
Start of Observations	December 1968
Principal Investigators	From December 1968 to January 1972: Prof. V. Sarabhai (deceased) From January 1972 to the present: Prof. U. R. Rao Physical Research Laboratory Ahmedabad 9, India

Comments:

Data will be submitted to the World Data Centers.

Station Name	ALERT, CANADA
Geographic Coordinates	82°31'N, 62°20'W
Vertical Cutoff Rigidity	0.00 GV
Altitude	66 meters
Type of Equipment and Configuration	4-MT-64 cubical muon monitor
Start of Observations	October 11, 1965
Principal Investigator	Dr. Hugh Carmichael Atomic Energy of Canada, Ltd. Chalk River, Ontario, Canada

Comments:

Data routinely submitted to the World Data Centers.

Data routinely published in the Atomic Energy of Canada "Cosmic Ray MT-64 Muon Monitor Data" series of reports.

Station Name	ALMA-ATA, U.S.S.R.
Geographic Coordinates	43°15'N, 76°55'E
Vertical Cutoff Rigidity	6.69 GV
Altitude	806 meters
Type of Equipment and Configuration	Crossed muon telescope (Angle less than 45° N and S)
Start of Observations	July 1, 1961
Principal Investigator	Dr. E. V. Kolomeets Kazakh State University Kirov Street, 136 Alma-Ata, U.S.S.R.

Comments:

No plans to submit data to the World Data Centers.

Operating Muon Detectors

Station Name	ALMA-ATA, U. S. S. R.
Geographic Coordinates	43°15'N, 76°55'E
Vertical Cutoff Rigidity	6. 69 GV
Altitude	806 meters
Periods of Observations	January 1962-June 1962 January 1964-present
Principal Investigator	Dr. E. V. Kolomeets Kazakh State University Kirov Street, 136 Alma-Ata, U. S. S. R.

Comments:

Data routinely submitted to the World Data Centers approximately 6 months after observations.

Station Name	ALMA-ATA, U. S. S. R.
Geographic Coordinates	43°15'N, 76°55'E
Vertical Cutoff Rigidity	6. 69 GV
Altitude	806 meters
Type of Equipment and Configuration	Crossed muon telescope (angle less than 45° N, S, E, W and vertical)
Start of Observations	November 10, 1963
Principal Investigator	Dr. E. V. Kolomeets Kazakh State University Kirov Street, 136 Alma-Ata, U. S. S. R.

Comments:

No plans to submit data to the World Data Centers.

Station Name	APATITY, U. S. S. R.
Geographic Coordinates	67°33'N, 33°20'E
Vertical Cutoff Rigidity	0. 65 GV
Altitude	182 meters
Type of Equipment and Configuration	Crossed wide-angle muon telescope
Start of Observations	September 1, 1967
Principal Investigator	Dr. L. L. Lazutin Polar Geophysical Institute Akademgorodok, Apatity Murmansk Region, U. S. S. R.

Comments:

Data from September 1, 1967 through December 31, 1970 deposited in the World Data Centers. Data after 1970 available on request.

Operating Muon Detectors

Station Name	BELFAST, NORTHERN IRELAND
Geographic Coordinates	$54^{o}35'N$, $5^{o}56'W$
Vertical Cutoff Rigidity	1.92 GV
Altitude	16 meters
Start of Observations	March 1, 1966
Principal Investigator	Dr. C. S. Watt Department of Pure and Applied Physics Queen's University Belfast BT7 1NN Northern Ireland, U.K.

Comments:

Data to be submitted to the World Data Centers.

Station Name	BELSK, POLAND
Alternate Name	Central Geophysical Observatory
Geographic Coordinates	$51^{o}50'N$, $20^{o}47'E$
Vertical Cutoff Rigidity	3.18 GV
Altitude	180 meters
Type of Equipment and Configuration	Duplex cubical counter telescope, standard IGY-type with 10 cm lead
Start of Observations	February 1966
Principal Investigators	Dr. T. Kowalski and Dr. Z. Kobylinski Geophysical Institute of Polish Academy of Science Ul Pasteura 3, Warsaw, Poland

Comments:

Data routinely submitted to the World Data Centers approximately 6 months after observations.

Data are published in the Journal: Materiaty i Prace, Zaklad Geofizyki PAN. (English Translation - Materials and Papers, Geophysical Institute of Polish Academy of Science).

Operating Muon Detectors

Station Name	BERGEN, NORWAY
Geographic Coordinates	60°24'N, 5°19'E
Vertical Cutoff Rigidity	1.13 GV
Altitude	Sea level
Type of Equipment and Configuration	Wide and narrow angle muon telescope with GM counters mounted about a standard cubical telescope with 10 cm lead shield
Start of Observations	December 1956
Principal Investigator	Prof. Dr. B. Trumpy Department of Physics University of Bergen, L Allegi. 53-55, Bergen, Norway

Comments:

Data to be sent to the World Data Centers.

Station Name	BOLOGNA, ITALY
Geographic Coordinates	44°30'N, 11°21'E
Vertical Cutoff Rigidity	5.22 GV
Altitude	Sea level
Type of Equipment and Configuration	Cubical standard coincidence telescope. Hard coincidences 45° E and 45° W. Omnidirectional ionizing total. (See comments).
Start of Observations	January 1, 1965
Principal Investigator	Prof. M. Galli Istituto de Fisica Universita Via Irnerio 46 40126 Bologna, Italy

Comments:

Data routinely submitted to the World Data Centers within a year of observations.

The total ionizing component is described in the paper "Observations on Cosmic-Ray Variations During Cold-Front Perturbations" by M. C. Fazzini, M. Galli, I. Guidi, and P. Randi, Canadian Journal of Physics, 46, S1073, 1968.

Operating Muon Detectors

Station Name	CHACALTAYA, BOLIVIA
Geographic Coordinates	16°19'S, 68°9'W
Vertical Cutoff Rigidity	13.10 GV
Altitude	5220 meters
Type of Equipment and Configuration	East-west muon telescopes of three fold coinc. ce Geiger counters. It detects the total component.
Start of Observations	March 1957
Principal Investigator	Ing. Ricardo Anda Laboratorio de Física Cósmica Universidad Mayor de San Andrés La Paz, Bolivia

Comments:

Equipment was operated intermiitently until March 1968 when continuous operation was started.

Data not submitted to the World Data Centers.

Station Name	CHACALTAYA, BOLIVIA
Geographic Coordinates	16°19'S, 68°9'W
Vertical Cutoff Rigidity	13.10 GV
Altitude	5220 meters
Type of Equipment and Configuration	East-west and vertical scintillation coincidence muon telescopes
Start of Observations	March 16, 1970
Principal Investigator	Ing. Ricardo Anda Laboratorio de Física Cósmica Universidad Mayor de San Andrés La Paz, Bolivia

Comments:

Data routinely submitted to the World Data Centers.

Data published in the series "CUADERNOS", a publication of the Laboratorio de Física Cósmica.

Operating Muon Detectors

Station Name	COLLEGE STATION, U. S. A.
Alternate Name	Texas A&M Magnetic Spectrometer
Geographic Coordinates	30.63°N, 96.35°W
Vertical Cutoff Rigidity	4.95 GV
Altitude	76 meters
Type of Equipment and Configuration	Two directional muon magnetic spectrometer telescopes. The smaller has a maximum detectable momentum (MDM) of approximately 350 GeV/c. The larger has a MDM of approximately 1000 GeV/c.
Start of Observations	March 1968 (the smaller) October 1968 (the larger)
Principal Investigator	Dr. Nelson M. Duller Texas A&M University Department of Physics College Station, Texas 77843, U. S. A.

Comments:

These detectors are in continual operation.

Data are not submitted to the World Data Centers.

Station Name	DACCA, BANGLADESH
Geographic Coordinates	23°45'N, 90°25'E
Vertical Cutoff Rigidity	16.22 GV
Altitude	Sea level
Type of Equipment and Configuration	Vertical narrow angle muon telescope
Start of Observations	June 24, 1966
Principal Investigators	Dr. M. S. Islam and Dr. Q. N. Begum Cosmic Radiation Research Laboratory Physics Department Dacca University Dacca 2, Bangladesh

Comments:

Data routinely submitted to the World Data Centers.

The operation of this equipment was temporarily stopped on March 1, 1971. Plans are being made to convert this telescope to a cubical telescope in the near future. The present telescope has a total absorber thickness equivalent to 25 cm of lead.

Operating Muon Detectors

Station Name	DEEP RIVER, CANADA
Geographic Coordinates	46°06'N, 77°30'W
Vertical Cutoff Rigidity	1.02 GV
Altitude	145 meters
Type of Equipment and Configuration	Wide angle muon monitor
Start of Observations	May 1, 1962
Principal Investigator	Dr. Hugh Carmichael Atomic Energy of Canada, Ltd. Chalk River, Ontario, Canada

Comments:

Data may be submitted to World Data Centers.

Data may be published from start until end of 1965 to overlap cubical muon monitor observations beginning February 20, 1965.

Station Name	DEEP RIVER, CANADA
Geographic Coordinates	46°06'N, 77°30'W
Vertical Cutoff Rigidity	1.02 GV
Altitude	145 meters
Type of Equipment and Configuration	4-MT-64 cubical muon monitor
Start of Observations	February 20, 1965
Principal Investigator	Dr. Hugh Carmichael Atomic Energy of Canada, Ltd. Chalk River, Ontario, Canada.

Comments:

Data routinely submitted to the World Data Centers.

Data routinely published in the Atomic Energy of Canada "Cosmic Ray MT-64 Muon Monitor Data" series of reports.

Operating Muon Detectors

Station Name	DENVER, U.S.A.
Geographic Coordinates	39°40'N, 104°58'W
Vertical Cutoff Rigidity	2.91 GV
Altitude	1600 meters
Type of Equipment and Configuration	Multi-directional muon telescope (see comments)
Start of Observations	January 1, 1967
Principal Investigator	Prof. R. L. Chasson Department of Physics University of Denver Denver, Colorado 80210, U.S.A.

Comments:

This muon telescope is not a standard array. A complete description of this detector is given in the paper "Results from the New Denver Multidirectional Meson Telescope" by R. L. Chasson, M. Iona, V. J. Kisselbach and P. Baker, Jr., Proceedings of the Ninth International Conference on Cosmic Rays, Vol. 1, 282, 1965.

Data routinely submitted to the World Data Centers.

Station Name	DOURBES, BELGIUM
Geographic Coordinates	50°06'N, 4°36'E
Vertical Cutoff Rigidity	3.24 GV
Altitude	225 meters
Type of Equipment and Configuration	Standard cubical telescope (10 cm lead). Two telescopes directed to the East and West with zenith angles of 45° (no lead).
Start of Observations	January 1, 1969
Principal Investigators	Prof. L. Bossy and Dr. J. C. Jodogne Géophysique externe Institut royal météorologique 3, Avenue Circulaire Bruxelle 18, Belgium

Comments:

This detector was in operation for specific short periods of time during 1968.

Operating Muon Detectors

Station Name	GOOSE BAY, CANADA
Geographic Coordinates	53°16'N, 60°24'W
Vertical Cutoff Rigidity	0.52 GV
Altitude	46 meters
Type of Equipment and Configuration	4-MT-64 cubical muon monitor
Start of Observations	November 17, 1964
Principal Investigator	Dr. Hugh Carmichael Atomic Energy of Canada, Ltd. Chalk River, Ontario, Canada

Comments:

Data routinely submitted to the World Data Centers.

Data routinely published in the Atomic Energy of Canada "Cosmic Ray MT-64 Muon Monitor Data" series of reports.

Station Name	HAFELEKAR, AUSTRIA
Geographic Coordinates	47°19'N, 11°23'E
Vertical Cutoff Rigidity	4.37 GV
Altitude	2290 meters
Start of Observations	December 15, 1957
Principal Investigators	Prof. Dr. Rudolf Steinmaurer and Dr. Herbert Oberguggenberger Physikalisches Institut Schöpfstrasse 41 A-6020-Innsbruck, Austria

Comments:

Data routinely submitted to the World Data Centers.

Station Name	HEISS ISLAND, U.S.S.R.
Geographic Coordinates	80°37'N, 58°03'E
Vertical Cutoff Rigidity	0.10 GV
Altitude	20 meters
Type of Equipment and Configuration	Mega-muon telescope
Start of Observations	October 15, 1970
Principal Investigator	Dr. L. L. Lazutin Polar Geophysical Institute Akademgorodok, Apatity Murmansk Region, U.S.S.R.

Comments:

Data available upon request.

Operating Muon Detectors

Station Name	HOBART, AUSTRALIA
Geographic Coordinates	42°54'S, 147°20'E
Vertical Cutoff Rigidity	1.88 GV
Altitude	Sea level
Type of Equipment and Configuration	Vertical muon telescope
Start of Observations	September 1, 1953
Principal Investigator	Dr. A. G. Fenton Physics Department University of Tasmania Box 252C, G. P. O. Hobart, Tasmania 7001, Australia

Comments:

The telescope was designed so that count rates of particles passing through 10 cm and 20 cm of lead were obtained separately. The 20 cm lead channel was discontinued early in 1967.

Data to the end of 1967 were deposited in the World Data Centers. There are no present plans to submit more recent data.

Station Name	HOBART, AUSTRALIA
Geographic Coordinates	42°54'S, 147°20'E
Vertical Cutoff Rigidity	1.88 GV
Altitude	Sea level
Type of Equipment and Configuration	Inclined rotating East-West muon telescope with zenith angle of 45°.
Start of Observations	December 22, 1955
Principal Investigator	Dr. A. G. Fenton Physics Department University of Tasmania Box 252C, G. P. O. Hobart, Tasmania 7001, Australia

Comments:

Data not submitted to the World Data Centers.

Operating Muon Detectors

Station Name	INUVIK, CANADA
Geographic Coordinates	68°21'N, 133°43'W
Vertical Cutoff Rigidity	0.18 GV
Altitude	21 meters
Type of Equipment and Configuration	4-MT-64 cubical muon monitor
Start of Observations	July 12, 1964
Principal Investigator	Dr. Hugh Carmichael Atomic Energy of Canada, Ltd. Chalk River, Ontario, Canada

Comments:

Data routinely submitted to the World Data Centers.

Data routinely published in the Atomic Energy of Canada "Cosmic Ray MT-64 Muon Monitor Data" series of reports.

Station Name	IRKUTSK, U.S.S.R.
Alternate Name	Zui
Geographic Coordinates	52°28'N, 104°02'E
Vertical Cutoff Rigidity	3.66 GV
Altitude	433 meters
Type of Equipment and Configuration	Crossed wide-angle muon telescope
Start of Observations	September 1, 1968
Principal Investigator	Dr. A. A. Luzov Siberian IZMIRAN Lenin Street 8, Irkutsk, U.S.S.R.

Comments:

Data not routinely submitted to the World Data Centers.

Station Name	IRKUTSK, U.S.S.R.
Geographic Coordinates	52°28'N, 104°02'E
Vertical Cutoff Rigidity	3.66 GV
Altitude	433 meters
Type of Equipment and Configuration	High counting rate muon telescope
Start of Observations	October 1968
Principal Investigator	Dr. A. A. Luzov Siberian IZMIRAN Lenin Street 5, Irkutsk, U.S.S.R.

Comments:

Data routinely submitted to the World Data Centers approximately 6 months after observations.

Operating Muon Detectors

Station Name	KULA, U. S. A.
Geographic Coordinates	20°44'N, 156°20'W
Vertical Cutoff Rigidity	13.30 GV
Altitude	930 meters
Type of Equipment and Configuration	2-MT-64 cubical muon monitor
Start of Observations	July 10, 1966
Principal Investigator	Dr. Hugh Carmichael Atomic Energy of Canada, Ltd. Chalk River, Ontario, Canada

Comments:

Data routinely submitted to the World Data Centers.

Data routinely published in the Atomic Energy of Canada "Cosmic Ray MT-64 Muon Monitor Data" series of reports.

Station Name	LINDAU/HARZ, F. R. G.
Geographic Coordinates	51°36'N, 10°6'E
Vertical Cutoff Rigidity	3.00 GV
Altitude	140 meters
Type of Equipment and Configuration	Muon scintillator telescope
Start of Observations	January 1, 1970
Principal Investigators	From January 1970 to February 1971: Prof. Dr. A. Ehmert (deceased) From February 1971 to the present: Prof. Dr. V. J. Kisselbach Institut für Stratosphären-Physik Max Planck Institut für Aeronomie 3411 Lindau/Harz PB 40, F. R. G.

Comments:

Data routinely submitted to the World Data Centers.

Station Name	LOMNICKÝ ŠTÍT, CZECHOSLOVAKIA
Geographic Coordinates	49.20°N, 20.22°E
Vertical Cutoff Rigidity	4.00 GV
Altitude	2632 meters
Type of Equipment and Configuration	Crossed muon telescope
Start of Observations	January 1, 1968
Principal Investigator	Dr. Pavel Chaloupka UEF SAV Lomnický Štít p. Tatranská Lomnica, Czechoslovakia

Comments:

Data routinely submitted to the World Data Centers approximately a year after observations.

Operating Muon Detectors

Station Name	LOS CERRILLOS STATION, CHILE
Alternate Name	Santiago
Geographic Coordinates	33°30'S, 70°42'W
Vertical Cutoff Rigidity	11.44 GV
Altitude	512 meters
Type of Equipment and Configuration	Cubic scintillator monitor of 1/2 m^2 (each counter), unshielded
Start of Observations	January 1, 1967
Principal Investigator	Prof. Gabriel Alvial Centro de Radiación Cósmica (Facultad de Ciencias Físicas y Matemáticas) Universidad de Chile Casilla 1314 Santiago de Chile, Chile

Comments:

Data to be submitted to the World Data Centers.

Station Name	MAWSON, ANTARCTICA
Geographic Coordinates	67°36'S, 62°53'E
Vertical Cutoff Rigidity	0.22 GV
Altitude	Sea level
Type of Equipment and Configuration	Vertical muon telescope
Start of Observations	May 3, 1955
Principal Investigator	Dr. R. M. Jacklyn Antarctic Division Department of Supply Melbourne, Victoria 3004, Australia

Comments:

Data to the end of 1967 submitted to the World Data Centers.

Data are published in "ANARE Data Reports", Antarctic Division, 568 St. Kilda Road, Melbourne, Victoria 3004, Australia.

Data for July 1, 1957 to December 31, 1958 published in "Cosmic-Ray Intensity During the International Geophysical Year", No. 5, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, July 1961.

Operating Muon Detectors

Station Name	MAWSON, ANTARCTICA
Geographic Coordinates	67°36'S, 62°53'E
Vertical Cutoff Rigidity	0.22 GV
Altitude	Sea level
Type of Equipment and Configuration	Inclined rotating East-West muon telescope with zenith angle of 45°
Start of Observations	May 5, 1955
Principal Investigator	Dr. R. M. Jacklyn Antarctic Division Department of Supply Melbourne, Victoria 3004, Australia

Comments:

Data not submitted to the World Data Centers.

Data are published in "ANARE Data Reports", Antarctic Division, 568 St. Kilda Road, Melbourne, Victoria 3004, Australia.

Station Name	MAWSON, ANTARCTICA
Geographic Coordinates	67°36'S, 62°53'E
Vertical Cutoff Rigidity	0.22 GV
Altitude	Sea level
Type of Equipment and Configuration	North-south muon telescope with high zenith angle (75°)
Start of Observations	March 31, 1968
Principal Investigator	Dr. R. M. Jacklyn Antarctic Division Department of Supply Melbourne, Victoria 3004, Australia

Comments:

Data not submitted to the World Data Centers.

Data are published in "ANARE Data Reports", Antarctic Division, 568 St. Kilda Road, Melbourne, Victoria 3004, Australia.

Station Name	McMURDO, ANTARCTICA
Geographic Coordinates	77°51'S, 166°43'E
Vertical Cutoff Rigidity	0.01 GV
Altitude	48 meters
Start of Observations	March 1961
Principal Investigator	Dr. Martin A. Pomerantz Bartol Research Foundation Swarthmore, Pennsylvania 19081, U.S.A.

Comments:

Data not submitted to the World Data Centers.

Operating Muon Detectors

Station Name	MEXICO CITY, MEXICO
Alternate Names	C. U. (Ciudad Universitaria)
Geographic Coordinates	19°20'N, 99°11'W
Vertical Cutoff Rigidity	9.53 GV
Altitude	2274 meters
Type of Equipment and Configuration	Scintillator muon telescope
Start of Observations	April 1971
Principal Investigator	Mr. Oscar Troncoso Instituto de Geofísica Torre de Ciencias Ciudad Universitaria Mexico 20, D. F. Mexico

Comments:

Data to be routinely submitted to the World Data Centers.

Station Name	MOSCOW, U. S. S. R.
Alternate Name	IZMIRAN
Geographic Coordinates	55°28'N, 37°19'E
Vertical Cutoff Rigidity	2.46 GV
Altitude	200 meters
Type of Equipment and Configuration	High counting rate muon telescope
Start of Observations	August 1968
Principal Investigator	Dr. Y. L. Blokh IZMIRAN Institute of Terrestrial Magnetism Ionosphere and Radiowave Propagation Academy of Sciences of the U. S. S. R. p/o Akademgorodok, Moscow Region, U. S. S. R.

Comments:

Data submitted to the World Data Centers approximately 1 year after observations.

Operating Muon Detectors

Station Name	MOSCOW, U. S. S. R.
Alternate Name	IZMIRAN
Geographic Coordinates	$55^{\circ}28'$N, $37^{\circ}19'$E
Vertical Cutoff Rigidity	2.46 GV
Altitude	200 meters
Type of Equipment and Configuration	Wide-angle crossed telescope
Start of Observations	August 1968
Principal Investigator	Dr. Y. L. Blokh IZMIRAN Institute of Terrestrial Magnetism Ionosphere and Radiowave Propagation Academy of Sciences of The U.S.S.R. p/o Akademgorodck, Moscow Region, U. S. S. R.

Comments:

Data not submitted to the World Data Centers.

Station Name	MT. NORIKURA, JAPAN
Geographic Coordinates	$36^{\circ}07'$N, $137^{\circ}33'$E
Vertical Cutoff Rigidity	11.39 GV
Altitude	2770 meters
Type of Equipment and Configuration	Multi-directional large area muon telescope (36 $m^2 \times 2$). Measurements are made in 13 directions: vertical, and four azimuths with zenith angles 30°, 39° and 49°.
Start of Observations	December 1968
Principal Investigator	Prof. K. Nagashima Department of Physics Nagoya University Furocho, Chikusa-ku Nagoya, Japan

Comments:

Data routinely submitted to the World Data Centers.

Operating Muon Detectors

Station Name	NAGOYA, JAPAN
Geographic Coordinates	35.01°N, 136.90°E
Vertical Cutoff Rigidity	12.06 GV
Altitude	4.9 meters
Type of Equipment and Configuration	Multi-directional large area muon telescope (36 $m^2 \times 2$). Measurements are made in 17 directions, vertical and four azimuths with zenith angles 30°, 39°, 49° and 55°
Start of Observations	October 1970
Principal Investigator	Prof. Y. Sekido Department of Physics Nagoya University Chikusaku, Nagoya, Japan

Comments:

Data routinely submitted to the World Data Centers.

Station Name	OULU, FINLAND
Alternate Name	University of Oulu
Geographic Coordinates	65°1'N, 25°30'E
Vertical Cutoff Rigidity	0.81 GV
Altitude	15 meters
Type of Equipment and Configuration	Mega-meson telescope
Start of Observations	August 1, 1968
Principal Investigator	Dr. Pekka Tanskanen Department of Physics University of Oulu Kontinkangas, Oulu, Finland

Comments:

Data to be submitted to the World Data Centers.

Operating Muon Detectors

Station Name	PREDIGTSTUHL, F. R. G.
Geographic Coordinates	47°42'N, 12°53'E
Vertical Cutoff Rigidity	4. 30 GV
Altitude	1614 meters
Type of Equipment	Three scintillators - sodium iodide thallium activated crystals; diameter equals 5 inches, bottom shielded with 10 cm lead.
Start of Observations	November 22, 1966
Principal Investigator	Dr. B. Beckmann FTZ D33 Am Kavalleriesand 3 61 Darmstadt, F. R. G.

Comments:

Data not submitted to the World Data Centers.

Data expected to be published.

The operation of this equipment is expected to be terminated during 1972.

Station Name	SCHAUINSLAND, F. R. G.
Alternate Name	Freiburg
Geographic Coordinates	47°55'N, 7°45'E
Vertical Cutoff Rigidity	4. 10 GV
Altitude	1200 meters
Type of Equipment and Configuration	Vertical telescope
Start of Observations	January 1, 1959
Principal Investigator	Dr. A. Sittkus Max Planck-Institut für Kernphysik Katharinenstr. 25 78 Freiburg (Breisgau), F. R. G.

Comments:

Data not submitted to the World Data Centers.

Operating Muon Detectors

Station Name	SCHAUINSLAND, F. R. G.
Alternate Name	Freiburg
Geographic Coordinates	47°55'N, 7°45'E
Vertical Cutoff Rigidity	4.10 GV
Altitude	1200 meters
Type of Equipment and Configuration	Inclined angle telescope
Start of Observations	August 1, 1969
Principal Investigator	Dr. A. Sittkus Max Planck-Institut für Kernphysik Katharinenstr. 25 78 Freiburg (Breisgau), F. R. G.

Comments:

Data not submitted to the World Data Centers.

Station Name	SOUTH POLE, ANTARCTICA
Geographic Coordinates	90°0'S, 0°0'E
Vertical Cutoff Rigidity	0.11 GV
Altitude	2820 meters
Start of Observations	May 1964
Principal Investigator	Dr. Martin A. Pomerantz Bartol Research Foundation Swarthmore, Pennsylvania 19081, U. S. A.

Comments:

Data not submitted to the World Data Centers.

Operating Muon Detectors

Station Name	SULPHUR MOUNTAIN, CANADA
Alternate Names	Banff
Geographic Coordinates	51.2°N, 115.6°W
Vertical Cutoff Rigidity	1.14 GV
Altitude	2283 meters
Type of Equipment and Configuration	Cubical muon telescope
Periods of Observations	July 1, 1957-September 30, 1964 November 6, 1968-present
Principal Investigators	From July 1, 1957 to September 1, 1970: Dr. B. G. Wilson Present address: Vice President Simon Fraser University Burnaby 2, B.C., Canada From September 1, 1970 to present: Prof. D. Venkatesan and Dr. T. Mathews Physics Department University of Calgary Calgary 44, Alberta, Canada

Comments:

Efficiency factors on file at the World Data Centers.

Data routinely submitted to the World Data Centers approximately 3 months after observations.

Data from July 1, 1957 to December 31, 1958 published in "Cosmic-Ray Intensity During the International Geophysical Year", No. 5, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, July, 1961.

Station Name	SWARTHMORE, U.S.A.
Geographic Coordinates	39°54'N, 75°21'W
Vertical Cutoff Rigidity	1.92 GV
Altitude	80 meters
Start of Observations	June 1964
Principal Investigator	Dr. Martin A. Pomerantz Bartol Research Foundation Swarthmore, Pennsylvania 19081, U.S.A.

Comments:

Data not submitted to the World Data Centers.

Operating Muon Detectors

Station Name	SYOWA, ANTARCTICA
Alternate Names	Syowa Base Syowa Station
Geographic Coordinates	69°00'S, 39°36'E
Vertical Cutoff Rigidity	0.42 GV
Altitude	15 meters
Type of Equipment and Configuration	Area equals 4 square meters
Start of Observations	February 1970
Principal Investigator	Dr. Y. Miyazaki Cosmic Ray Laboratory The Institute of Physical and Chemical Research 7-13, Kaga-1, Itabashi Tokyo, Japan

Comments:

Data will be submitted to the World Data Centers in yearly increments approximately 1 year after data are returned to Japan via the Japanese expedition ship.

Station Name	TBILISI, U.S.S.R.
Geographic Coordinates	41°43'N, 44°48'E
Vertical Cutoff Rigidity	6.91 GV
Altitude	510 meters
Periods of Observations	February 1960 - June 1961 January 1963 - May 1964 August 1964 - December 1964 February 1965 - November 1966 January 1967 - June 1967 August 1967 - January 1968 April 1968 - present
Principal Investigator	Dr. T. V. Kebuladze Institute of Geophysics Academy of Sciences, Georgian SSR L. Rukhadze Street, 1 Tbilisi, 15, U.S.S.R.

Comments:

Data routinely submitted to the World Data Centers approximately 6 months after observations.

Operating Muon Detectors

Station Name	THULE, GREENLAND
Alternate Name	Geopole Station
Geographic Coordinates	76°35'N, 68°25'W
Vertical Cutoff Rigidity	0.00 GV
Altitude	260 meters
Start of Observations	January 1962
Principal Investigator	Dr. Martin A. Pomerantz Bartol Research Foundation Swarthmore, Pennsylvania 19081, U.S.A.

Comments:

Data not submitted to the World Data Centers.

Station Name	UPPSALA, SWEDEN
Geographic Coordinates	59°51'N, 17°35'E
Vertical Cutoff Rigidity	1.43 GV
Altitude	Sea level
Type of Equipment and Configuration	Vertical and inclined telescopes (plastic scintillators) looking north, south, east and west (see comments)
Start of Observations	July 1, 1963
Principal Investigator	Prof. A. E. Sandström Uppsala University Box 516 751 20 Uppsala 1, Sweden

Comments:

For details of the telescopes see Arkiv för Fysik, 29, 329-341 (1965).

Vertical direction data starting with July 1, 1965 will be submitted to the World Data Centers. To obtain vertical direction data prior to July 1, 1965 and inclined direction data, contact the principal investigator.

Operating Muon Detectors

Station Name	UTRECHT, THE NETHERLANDS
Geographic Coordinates	52°06'N, 5°07'E
Vertical Cutoff Rigidity	2.76 GV
Altitude	1 meter
Type of Equipment and Configuration	Plastic scintillator muon telescope (Bercovitch design)
Start of Observations	February 1, 1967
Principal Investigators	Dr. L. D. de Feiter Space Research Laboratory Beneluxlaan 21 Utrecht, The Netherlands
	Dr. H. F. Jongen Natuurkundig Laboratorium Universiteit van Amsterdam Valckenierstraat 65 Amsterdam, The Netherlands

Comments:

Observations were interrupted from February 1, 1967 until July 1, 1969 because of interference from the nuclear accelerator.

Data from July 1, 1969 will be submitted to the World Data Centers.

Data routinely published in the Monthly Bulletin, Royal Meteorological Institute, De Bilt, The Netherlands.

Station Name	YAKUTSK, U.S.S.R.
Geographic Coordinates	62°01'N, 129°43'E
Vertical Cutoff Rigidity	1.70 GV
Altitude	105 meters
Type of Equipment and Configuration	Crossed muon telescope (angle less than 30° N and S, and vertical)
Start of Observations	March 1, 1958
Principal Investigator	Dr. A. I. Kuzmin Institute of Cosmophysical Investigations and Aeronomy Lenin Avenue, 61 Yakutsk, Siberia, U.S.S.R.

Comments:

Data not submitted to the World Data Centers.

The vertical muon telescope data from March 1958 to December 1959 have been published in the monograph "High Energy Cosmic Ray Variations" by A. I. Kuzmin, published by "Nauka", 1964.

The vertical muon telescope data for 1960 and 1961 have been published in the monograph "Cosmic Ray Variations and Solar Activity" by A. I. Kuzmin, published by "Nauka", 1968.

Section A4

Underground Muon Detectors

At the request of many of the principal investigators, a separate listing of the underground muon detectors has been included. The following listings contain the pertinent information on the underground muon detectors that were in operation on December 31, 1971. The locations of these detectors are shown in Figure A4.

In all cases the underground depth in meters water equivalent (m. w. e.) has been specified. The meters water equivalent are also included in the listing of the calendar of operations for underground muon detectors given in Appendix D.

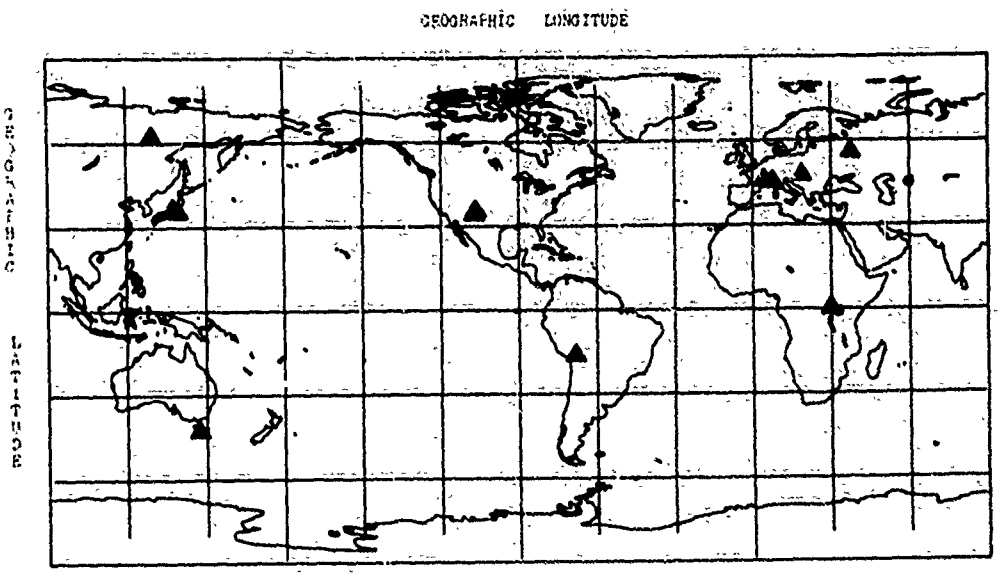

Figure A4. World Map Showing Locations of Operating Underground Muon Detectors

Operating Underground Muon Detectors

Station Name	BUDAPEST, HUNGARY
Geographic Coordinates	47.5°N, 18.9°E
Vertical Cutoff Rigidity	4.44 GV
Altitude	410 meters
Type of Equipment and Configuration	Underground muon telescope system; 40 m. w. e.
Periods of Operation	February 1958 - October 1963 April 1966 - present
Principal Investigator	Prof. A. Somogyi Department of Cosmic Rays Central Research Institute of Physics Budapest 114, P. O. B. 49, Hungary

Comments:

Data from February 1958 to October 1963 submitted to the World Data Center. Data from April 1966 to be submitted.

Station Name	CAMBRIDGE TUNNEL, AUSTRALIA
Alternate Names	Cambridge Tunnel (Hobart) Hobart
Geographic Coordinates	42°51'S, 147°25'E
Vertical Cutoff Rigidity	1.91 GV
Altitude	110 meters
Type of Equipment and Configuration	Underground vertical muon telescope; 36 m. w. e.
Start of Observations	September 23, 1957
Principal Investigator	Dr. A. G. Fenton Physics Department University of Tasmania Box 252C, G. P. O. Hobart, Tasmania 7001, Australia

Comments:

This observatory is about 6 miles from Hobart and is the only underground site in the area.

Equipment is situated below approximately 36 meters water equivalent of shale (this corrects earlier estimates of 40 m. w. e.).

No present plans to submit data to the World Data Centers.

Operating Underground Muon Detectors

Station Name	CHACALTAYA, BOLIVIA
Alternate Names	Bolivia
Geographic Coordinates	16°19'S, 68°9'W
Vertical Cutoff Rigidity	13.10 GV
Altitude	5243 meters
Type of Equipment and Configuration	Multi-directional muon solid scintillator coincidence telescope located at 30 m. w. e. underground
Start of Observations	September 1964
Principal Investigators	Dr. V. H. Regener and Dr. D. B. Swinson Dept. of Physics and Astronomy The University of New Mexico 800 Yale Boulevard N. E. Albuquerque, New Mexico 87106, U.S.A.

Comments:

Data not submitted to the World Data Centers.

Station Name	EMBUDO, U.S.A.
Geographic Coordinates	35.20°N, 106.41°W
Vertical Cutoff Rigidity	4.36 GV
Altitude	2621 meters
Type of Equipment and Configuration	Multi-directional muon solid scintillator coincidence telescope located at 20 m. w. e. underground
Start of Observations	August 1969
Principal Investigators	Dr. V. H. Regener and Dr. D. B. Swinson Dept. of Physics and Astronomy The University of New Mexico 800 Yale Boulevard N. E. Albuquerque, New Mexico 87106, U.S.A.

Comments:

Data not submitted to the World Data Centers.

Only intermittent data obtained from August 1969 to January 1970.

Operating Underground Muon Detectors

Station Name	EMBUDO, U.S.A.
Geographic Coordinates	35.20°N, 106.41°W
Vertical Cutoff Rigidity	4.36 GV
Altitude	2621 meters
Type of Equipment and Configuration	Multi-directional muon solid scintillator coincidence telescope located at 40 m.w.e. underground
Start of Observations	December 1964
Principal Investigators	Dr. V. H. Regener and Dr. D. B. Swinson Department of Physics and Astronomy The University of New Mexico 800 Yale Boulevard, N.E. Albuquerque, New Mexico 87106, U.S.A.

Comments:

Equipment not in operation during November 1966.

Data not submitted to the World Data Centers.

Station Name	MAKERERE, UGANDA
Alternate Names	Kilembe
Geographic Coordinates	0°00'N, 30°00'E
Vertical Cutoff Rigidity	14.84 GV
Altitude	1500 meters
Type of Equipment and Configuration	Underground muon telescope; 40 m.w.e.
Start of Observations	October 1969
Principal Investigator	Prof. D. M. Thomson Physics Department Makerere University College P.O. Box 7062 Kampala, Uganda, E. Africa

Comments:

No plans at present to submit data to the World Data Centers.

This equipment was previously operated at ground level as E-W telescopes. See details under closed muon telescopes--Makerere.

Only limited data available for the period October 1969-May 1970.

Operating Underground Muon Detectors

Station Name	MATSUMOTO, JAPAN
Geographic Coordinates	$36^{\circ}14'N$, $138^{\circ}00'E$
Vertical Cutoff Rigidity	11.31 GV
Altitude	630 meters
Type of Equipment and Configuration	Multi-directional muon telescope, having 8 m^2 area each of two-fold coincidence. Depths are: 50 m.w.e. for vertical, 43 m.w.e. for north, 92 m.w.e. for south, 65 m.w.e. for east, and 52 m.w.e. for west direction
Start of Observations	August 2, 1971
Principal Investigator	Dr. Satoru Mori Department of Physics Faculty of Science Shinshu University Matsumoto, Japan

Comments:

Details of the telescope have been given in the paper "Continuous Measurements of Cosmic-Ray Intensity with Multi-directional Muon Telescope 50 m.w.e. Underground at Matsumoto", by M. Ichinose, S. Mori, S. Sagisaka, and S. Yasue, In Jour. Liberal Arts, Shinshu Univ., No. 6, 9-31, 1972.

Observation has been made from April 7, 1971 with the same telescope, but 6 m^2 area each of two-fold coincidence.

Data will be available on an exchange basis.

Station Name	MONT BLANC TUNNEL, FRANCE
Geographic Coordinates	45°48'N, 4°31'E
Vertical Cutoff Rigidity	4.65 GV
Altitude	1300 meters
Type of Equipment and Configuration	Underground muon telescope system. The depth is varied from 900 to 3000 m. w. e. (see comments)
Period of Operation	September 1968 - present (see comments)
Principal Investigators	Prof. W. R. Sheldon Physics Department University of Houston Houston, Texas 77004, U. S. A. Prof. Gilbert Vedrenne P. O. Box 4057 University of Toulouse Toulouse, France

Comments:

This system of muon telescopes, located near Chamonix, France, has an aperture of 5000 cm^2 sr, a viewing angle equal to ±15°, with an angular resolution ~1°. The system has been in operation at different depths, different orientations and for different periods as follows:

Time Period	Depth (m. w. e.)	Orientation
September 15, 1968-February 20, 1969	900	Vertical
February 25, 1969-May 5, 1969	900	63° West
June 5, 1969-December 10, 1969	3000	63° West
December 15, 1969-July 30, 1970	3000	Vertical
November 10, 1970-June 10, 1971	3000	63° West
September 5, 1971-March 1, 1972	2000	Vertical
March 15, 1972-present (June 1972)	2000	63° West

Data available only from the principal investigators.

Operating Underground Muon Detectors

Station Name	MOSCOW UNIVERSITY, U. S. S. R.
Alternate Names	Moscow
Geographic Coordinates	55°44'N, 37°38'E
Vertical Cutoff Rigidity	2.39 GV
Altitude	200 meters
Type of Equipment and Configuration	Underground crossed telescope; 40 m. w. e.
Start of Observations	January 1971
Principal Investigator	Dr. Y. L. Blokh IZMIRAN Institute of Terrestrial Magnetism Ionosphere and Radiowave Propagation Academy of Sciences of the U. S. S. R. p/o Akademgorodok, Moscow Region, U. S. S. R.

Comments:

This is an experimental station; the data are not submitted to the World Data Centers.

Operating Underground Muon Detectors

Station Name	SOCORRO, U. S. A.
Geographic Coordinates	34.04°N, 106.56°W
Vertical Cutoff Rigidity	4.73 GV
Altitude	1676 meters
Type of Equipment and Configuration	Multi-directional muon solid scintillator coincidence telescope located at 80 m. w. e. underground
Start of Observations	March 1968
Principal Investigators	Dr. V. H. Regener and Dr. D. B. Swinson Dept. of Physics and Astronomy The University of New Mexico 800 Yale Boulevard, N. E. Albuquerque, New Mexico 87106, U.S.A.

Comments:

Data not submitted to the World Data Centers.

Station Name	TAKEYAMA, JAPAN
Geographic Coordinates	35°13'N, 139°37'E
Vertical Cutoff Rigidity	11.84 GV
Altitude	Sea level
Type of Equipment and Configuration	Underground muon telescope; 54 m. w. e.
Start of Observations	January 1, 1970
Principal Investigator	Dr. Kazuaki Murakami Cosmic Ray Laboratory The Institute of Physical and Chemical Research 7-13, Kaga-1 Itabashi, Tokyo, Japan

Comments:

Plans being made to submit data to the World Data Centers.

Data to be published in a report of the World Data Center C-2 for Cosmic Rays.

The details of the apparatus are given in the Journal of the Institute of Physical and Chemical Research (in Japanese) by Murakami et al., RIKEN HOKOKU, Vol. 47, No. 1, Page 1, 1971.

Operating Underground Muon Detectors

Station Name	TORINO, ITALY
Alternate Name	Stazione de Cappuccini
Geographic Coordinates	45°03'N, 7°45'E
Vertical Cutoff Rigidity	4.94 GV
Altitude	240 meters
Type of Equipment and Configuration	Underground semi-cubical muon telescopes; 70 m.w.e.
Start of Observations	October 16, 1967
Principal Investigator	Prof. Giuliana Cini Castognoli Istituto de Fisica Generale Via P. Giuria 1 10125 Torino, Italy

Comments:

Data routinely submitted to the World Data Centers approximately 6 months after observations.

Station Name	YAKUTSK, U.S.S.R.
Geographic Coordinates	62°01'N, 129°43'E
Vertical Cutoff Rigidity	1.70 GV
Altitude	105 meters
Type of Equipment and Configuration	Underground crossed muon telescope; 7 m.w.e. (angle 30°N, 30°S, and vertical)
Start of Observations	March 1, 1958
Principal Investigator	Dr. A. I. Kuzmin Institute of Cosmophysical Investigations and Aeronomy Lenin Avenue, 61 Yakutsk, Siberia, U.S.S.R.

Comments:

Data not submitted to the World Data Centers.

The vertical muon telescope data from March 1958 to December 1959 have been published in the monograph "High Energy Cosmic Ray Variations" by A. I. Kuzmin, published by "Nauka", 1964.

The vertical muon telescope data for 1960 and 1961 have been published in the monograph "Cosmic Ray Variations and Solar Activity" by A.I. Kuzmin, published by "Nauka", 1968.

Operating Underground Muon Detectors

Station Name	YAKUTSK, U. S. S. R.
Geographic Coordinates	62°01'N, 129°43'E
Vertical Cutoff Rigidity	1.70 GV
Altitude	105 meters
Type of Equipment and Configuration	Underground crossed muon telescope; 20 m. w. e. (angle 30°N, 30°S, and vertical)
Start of Observations	March 1, 1958
Principal Investigator	Dr. A. I. Kuzmin Institute of Cosmophysical Investigations and Aeronomy Lenin Avenue, 61 Yakutsk, Siberia, U. S. S. R.

Comments:

Data not submitted to the World Data Centers.

The vertical muon telescope data from March 1958 to December 1959 have been published in the monograph "High Energy Cosmic Ray Variations" by A. I. Kuzmin, published by "Nauka", 1964.

The vertical muon telescope data for 1960 and 1961 have been published in the monograph "Cosmic Ray Variations and Solar Activity" by A. I. Kuzmin published by "Nauka", 1968.

Station Name	YAKUTSK, U. S. S. R.
Geographic Coordinates	62°01'N, 129°43'E
Vertical Cutoff Rigidity	1.70 GV
Altitude	105 meters
Type of Equipment and Configuration	Underground muon telescope; 60 m. w. e.
Periods of Observations	July 1957 - December 1960 January 1962 - July 1964 September 1964 - present
Principal Investigator	Dr. A. I. Kuzmin Institute of Cosmophysical Investigations and Aeronomy Lenin Avenue, 61 Yakutsk, Siberia, U. S. S. R.

Comments:

Data submitted to the World Data Centers approximately 6 months after observations.

Operating Underground Muon Detectors

Station Name	YAKUTSK, U. S. S. R.
Geographic Coordinates	62°01'N, 129°43'E
Vertical Cutoff Rigidity	1.70 GV
Altitude	105 meters
Type of Equipment and Configuration	Underground crossed muon telescope, 60 m. w. e. (angle 30°N, 30°S, and vertical). This is a semi-cubical telescope.
Start of Observations	March 1, 1958
Principal Investigator	Dr. A. I. Kuzmin Institute of Cosmophysical Investigations and Aeronomy Lenin Avenue, 61 Yakutsk, Siberia, U. S. S. R.

Comments:

Data not submitted to the World Data Centers.

The vertical muon telescope data from March 1958 to December 1959 have been published in the monograph "High Energy Cosmic Ray Variations", by A. I. Kuzmin, published by "Nauka", 1964.

The vertical muon telescope data for 1960 and 1961 have been published in the monograph "Cosmic Ray Variations and Solar Activity" by A. I. Kuzmin, published by "Nauka", 1968

Section A5

Ionization Chambers

The ionization chambers are the oldest type of cosmic-ray detector with continual cosmic-ray monitoring since 1932. The following listings contain the pertinent information on these detectors in operation on December 31, 1971. The locations of these ionization chambers are shown in Figure A5.

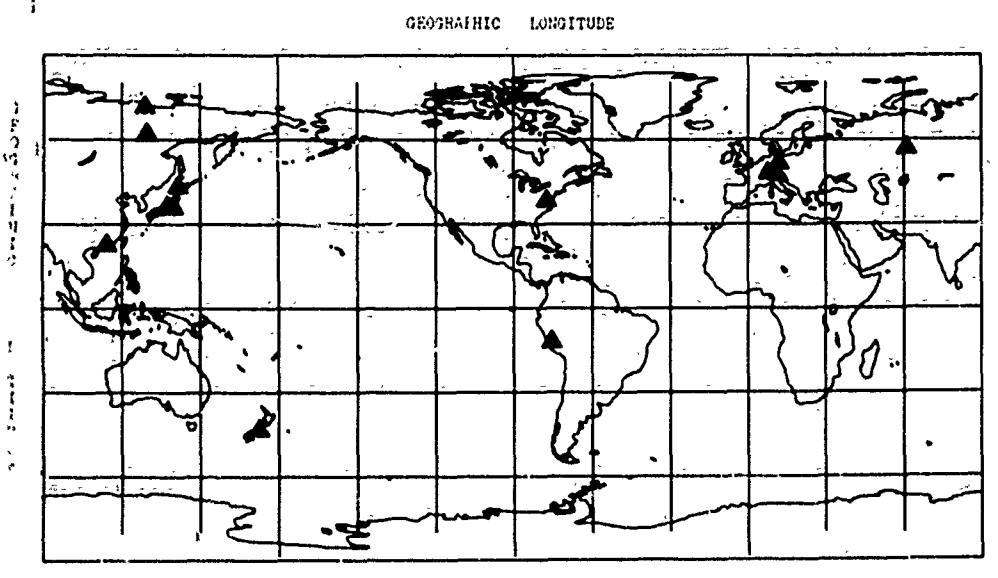

Figure A5. World Map Showing Locations of Operating Ionization Chambers

Operating Ionization Chambers

Station Name	CHRISTCHURCH, NEW ZEALAND
Geographic Coordinates	43.5°S, 172.6°E
Vertical Cutoff Rigidity	2.71 GV
Altitude	8 meters
Period of Observations	April 1, 1936 - December 31, 1961 March 1968 - present
Principal Investigator	Dr. Scott E. Forbush Dept. of Terrestrial Magnetism Carnegie Institution of Washington 1530 P Street, NW Washington, D.C. 20005, U.S.A.

Comments:

Data from 1957 through 1961 deposited in the World Data Centers.

Data published in the "Researches of the Department of Terrestrial Magnetism", Carnegie Institution of Washington Publication 175, Washington, D.C. as follows:

April 1, 1936 - December 31, 1946	Vol XIV (1948)
January 1, 1947 - December 31, 1955	Vol XX (1957)
January 1, 1956 - June 30, 1959	Vol XXI (1961)
January 1, 1959 - December 31, 1961	Vol XXII (1969)

From July 1, 1959 to December 31, 1961 the equipment was operated by the Department of Scientific and Industrial Research, Magnetic Survey Division, Geophysical Observatory, Christchurch, New Zealand.

Operating Ionization Chambers

Station Name	FREDERICKSBURG, U. S. A.
Geographic Coordinates	38.2°N, 77.4°W
Vertical Cutoff Rigidity	2.18 GV
Altitude	69 meters
Start of Observations	October 10, 1956 - present
Principal Investigator	Dr. Scott E. Forbush Department of Terrestrial Magnetism Carnegie Institution of Washington 1530 P Street, NW Washington, D.C. 20005, U.S.A.

Comments:

Data from July 1957 - January 1960 deposited in the World Data Centers.

The measurements made at Fredericksburg, Virginia, U.S.A. were essentially a continuation of those started at Cheltenham, Maryland, U.S.A.

Data published in the "Researches of the Department of Terrestrial Magnetism", Carnegie Institution of Washington Publication 175, Washington, D.C. as follows:

October 10, 1956 - December 31, 1959	Vol XXI (1961)
January 1, 1960 - December 31, 1968	Vol XXII (1969)

Station Name	HAFELEKAR, AUSTRIA
Geographic Coordinates	47°19'N, 11°23'E
Vertical Cutoff Rigidity	4.37 GV
Altitude	2290 meters
Periods of Operation	January 1932 - December 1934 February 1936 - April 1939 April 1943 - July 1945 August 29, 1952 - present
Principal Investigators	Prof. Dr. R. Steinmaurer and Dr. Herbert Oberguggenberger Physikalisches Institut der Universitat Innsbruck Schöpfstrasse 41 A-6020 Innsbruck, Austria

Comments:

Data routinely submitted to the World Data Centers.

Operating Ionization Chambers

Station Name	HALLE, G. D. R.
Geographic Coordinates	51°29'N, 11°58'E
Vertical Cutoff Rigidity	3.07 GV
Altitude	100 meters
Type of Equipment	Two ionization chambers of the same kind described in Experimentelle Technik der Physik, 6, 145-156, 1958.
Start of Observations	April 1, 1956
Principal Investigator	Prof. Dr. W. Messerschmidt Sektion Physik der Universität Friedemann-Bach-Platz 6 402 Halle (Saale), G. D. R.

Comments:

Data routinely submitted to the World Data Centers approximately 6 to 12 months after observations.

Station Name	HALLE, G. D. R.
Geographic Coordinates	51°29'N, 11°58'E
Vertical Cutoff Rigidity	3.07 GV
Altitude	100 meters
Type of Equipment	Two ionization chambers of the same kind, underground 14 m. w. e. This equipment was described in Experimentelle Technik der Physik, 6, 145-156, 1958.
Start of Observations	April 1, 1956
Principal Investigator	Prof. Dr. W. Messerschmidt Sektion Physik der Universität Friedemann-Bach-Platz 6 402 Halle (Saale), G. D. R.

Comments:

Data routinely submitted to the World Data Centers approximately 6 to 12 months after publication.

Equipment not in operation November 1-15, 1963.

Operating Ionization Chamber

Station Name	HONG KONG
Geographic Coordinates	22°25'N, 114°12'E
Vertical Cutoff Rigidity	16.23 GV
Altitude	30 meters
Start of Observations	August, 1970
Principal Investigator	Dr. L. S. Chuang Chunh Chi College The Chinese University of Hong Kong Shatin, New Territories, Hong Kong

Comments:

Data routinely submitted to the World Data Centers approximately 3 months after observation.

Station Name	HUANCAYO, PERU
Geographic Coordinates	12.03°S, 75.33°W
Vertical Cutoff Rigidity	13.45 GV
Altitude	3350 meters
Start of Observations	June 13, 1936
Principal Investigator	Dr. Scott E. Forbush Department of Terrestrial Magnetism Carnegie Institution of Washington 1530 P Street, NW Washington, D.C. 20005, U.S.A.

Comments:

Data for 1957-1962 deposited in the World Data Centers.

Data published in the "Researches of the Department of Terrestrial Magnetism", Carnegie Institution of Washington Publication 175, Washington, D.C. as follows:

June 13, 1936 - December 31, 1946	Vol XIV (1948)
January 1, 1946 - December 31, 1955	Vol XX (1957)
January 1, 1956 - December 31, 1959	Vol XXI (1961)
January 1, 1960 - December 31, 1968	Vol XXII (1969)

Data from July 1957 through December 1958 published in "Cosmic-Ray Intensity During the International Geophysical Year", No. 5, National Commmittee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, July 1961.

Operating Ionization Chambers

Station Name	KOENJI, JAPAN
Alternate Name	Mabashi
Geographic Coordinates	35°42.4'N, 139°38.7'E
Vertical Cutoff Rigidity	11.58 GV
Altitude	42 meters
Start of Observations	May 15, 1959
Principal Investigator	Dr. M. Kitamura Meteorological Research Institute 35-8, Koenji-Kita-4, Suginami Tokyo, Japan

Comments:

Data routinely submitted to the World Data Centers approximately 3 months after observations.

Data published in the Japanese Cosmic-Ray Intensity data books as follows:

May 15, 1959 - December 31, 1959	Book No. 7, March 1963
January 1, 1960 - December 31, 1960	Book No. 6, March 1962
February 8, 1961 - December 31, 1961	Book No. 8, October 1963
August 24, 1962 - December 31, 1962	Book No. 9, October 1964

Station Name	MT. NORIKURA, JAPAN
Geographic Coordinates	36°07'N, 137°33'E
Vertical Cutoff Rigidity	11.39 GV
Altitude	2770 meters
Start of Observations	August 1955
Principal Investigator	Dr. M. Wada Cosmic Ray Laboratory The Institute of Physical and Chemical Research 7-13, Kaga-1, Itabashi-ku Tokyo, Japan

Comments:

Data routinely submitted to the World Data Centers approximately 3 months after observation.

Data published in the Japanese Cosmic-Ray Intensity data books as follows:

July 1, 1957 - December 31, 1958	Book No. 4, March 1961
January 1, 1959 - December 31, 1959	Book No. 7, March 1963
January 1, 1960 - December 31, 1960	Book No. 6, March 1962
January 1, 1961 - December 31, 1961	Book No. 8, October 1963
January 1, 1962 - December 31, 1962	Book No. 9, October 1964

Operating Ionization Chambers

Station Name	SAPPORO, JAPAN
Geographic Coordinates	43°02'N, 141°21'E
Vertical Cutoff Rigidity	8.22 GV
Altitude	54 meters
Period of Observations	July 1, 1957 - December 31, 1961 December 9, 1967 - present
Principal Investigator	Prof. Y. Nakano Sapporo Branch Hokkaido University of Education Sapporo, Hokkaido, Japan

Comments:

Data routinely submitted to the World Data Centers approximately 6 months after observations.

Data published in the Japanese Cosmic-Ray Intensity data books as follows:

July 1, 1957 - December 31, 1958	Book No. 4, March 1961
January 1, 1959 - December 31, 1959	Book No. 7, March 1963
January 1, 1960 - December 31, 1960	Book No. 6, March 1962
January 1, 1961 - December 31, 1961	Book No. 8, October 1963

Station Name	SCHAUINSLAND, F. R. G.
Alternate Name	Freiburg
Geographic Coordinates	47°55'N, 7°45'E
Vertical Cutoff Rigidity	4.10 GV
Altitude	1200 meters
Start of Observations	January 1, 1957
Principal Investigator	Dr. A. Sittkus Max Planck-Institut für Kernphysik Katharinenstr. 25 78 Freiburg (Breisgau), F. R. G.

Comments:

Data for the period January 1, 1957 - December 31, 1959 deposited in the World Data Centers.

Operating Ionization Chambers

Station Name	SVERDLOVSK, U. S. S. R.
Geographic Coordinates	56°44'N, 61°04'E
Vertical Cutoff Rigidity	2.30 GV
Altitude	290 meters
Start of Observations	March 1952 - present
Principal Investigator	Dr. L. Ya Kheminchuk Institute of Geophysics Pervomajskaya Street, 91 Sverdlovsk, K-49, U. S. S. R.

Comments:

Data routinely submitted to the World Data Centers approximately 6 months after observations.

Station Name	TIXIE BAY, U. S. S. R.
Geographic Coordinates	71°35'N, 129°00'E
Vertical Cutoff Rigidity	0.53 GV
Altitude	Sea level
Start of Observations	December 1957
Principal Investigators	Dr. N. P. Chirkov and Dr. V. I. Ipatev Institute of Cosmophysical Investigations and Aeronomy Lenin Avenue, 61 Yakutsk, Siberia, U. S. S. R.

Comments:

Data for selected periods submitted to the World Data Centers. Persons wishing data for other periods are asked to write to the principal investigator.

Operating Ionization Chambers

Station Name	TOKYO-ITABASHI, JAPAN
Geographic Coordinates	35°45'N, 139°43'E
Vertical Cutoff Rigidity	11.61 GV
Altitude	20 meters
Start of Observations	January 1948
Principal Investigator	Dr. Y. Miyazaki Cosmic Ray Laboratory The Institute of Physical and Chemical Research 7-13, Kaga-1, Itabashi-ku Tokyo, Japan

Comments:

Data routinely submitted to the World Data Centers approximately 3 to 6 months after observation.

Data published in the Japanese Cosmic-Ray Intensity data books as follows:

July 1, 1957 - December 31, 1958	Book No. 4, March 1961
January 1, 1959 - December 31, 1959	Book No. 7, March 1963
January 1, 1960 - December 31, 1960	Book No. 6, March 1962
January 1, 1961 - December 31, 1961	Book No. 8, October 1963
January 1, 1962 - December 21, 1962	Book No. 9, October 1964

Station Name	YAKUTSK, U.S.S.R.
Geographic Coordinates	62°01'N, 129°43'E
Vertical Cutoff Rigidity	1.70 GV
Altitude	105 meters
Start of Observations	July 1953
Principal Investigator	Dr. A. I. Kuzmin Institute of Cosmophysical Investigations and Aeronomy Lenin Avenue, 61 Yakutsk, Siberia, U.S.S.R.

Comments:

Data routinely submitted to the World Data Centers approximately 6 months after publication.

Data from July 1957 through December 1958 published in "Cosmic-Ray Intensity During the International Geophysical Year", No. 5, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, July 1961.

Section A6

Miscellaneous Equipment

Operating detectors not included in the previous sections are listed under miscellaneous equipment. The air shower experiments are not included in this listing since their data generally are not applicable to solar-terrestrial physics. The information for the miscellaneous detector in operation on December 31, 1971 is given on the following page.

Miscellaneous Equipment in Operation

Station Name	UNIVERSITY OF ARIZONA, U.S.A.
Alternate Name	Mt. Lemmon Cosmic-Ray Laboratory
Geographic Coordinates	$32^{o}27'$N, $110^{o}47'$W
Vertical Cutoff Rigidity	5.48 GV
Altitude	2750 meters
Type of Equipment	Large area scintillation counters, wide gap spark chambers, and range chamber (1.4 m^2sr) telescope (one unit); wire spark chamber, super-conducting magnet momentum spectrometer (one unit).
Start of Observations	March 1, 1969
Principal Investigator	Dr. T. Bowen Department of Physics University of Arizona Tucson, Arizona 85721, U.S.A.

Comments:

No present plans to submit the data to the World Data Centers.

Appendix B

Closed Cosmic-Ray Detectors

Section B1

IGY-type Neutron Monitors

The following listings contain the pertinent information on the IGY-type neutron monitors which have terminated operation. The locations of these detectors are shown in Figure B1. These monitors were the standard design adopted by the IGY and described by Simpson (1957). At the request of the principal investigators, the IGY-type neutron monitors at Beirut, Lebanon and Durham, U.S.A. (both of which have ceased operating), are not included in this listing.

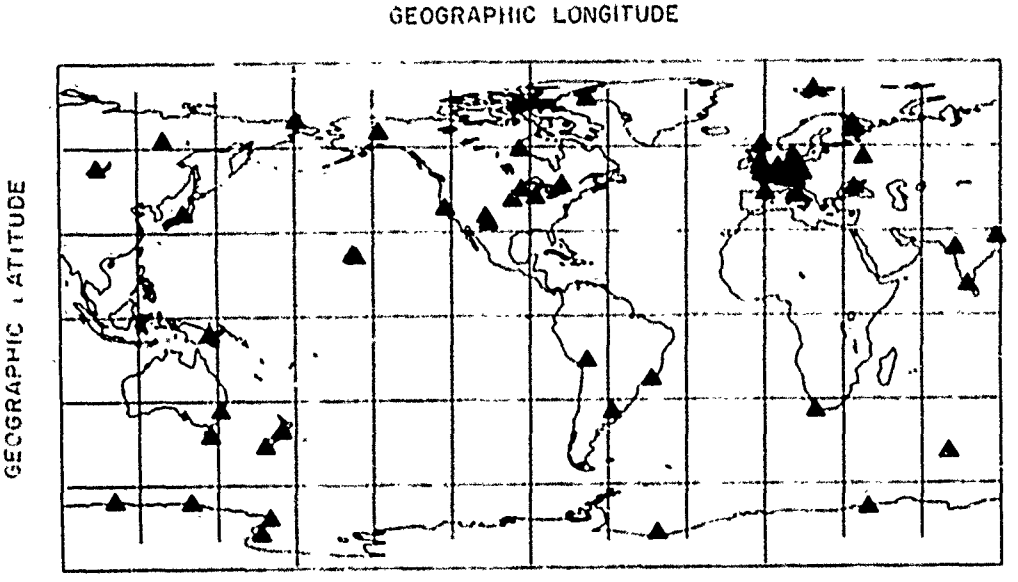

Figure B1. World Map Showing Locations of Closed IGY-type Neutron Monitors

Closed IGY-Type Neutron Monitors

Station Name	AHMEDABAD, INDIA
Geographic Coordinates	23°01' N, 72°36' E
Vertical Cutoff Rigidity	15.94 GV
Altitude	Sea level
Period of Operation	July 1957-June 1964
Principal Investigator	Professor V. Sarabhai (deceased)
Name and Address of Person to Contact for Information	Prof. U. R. Rao Physical Research Laboratory Ahmedabad 9, India

Comments:

Data deposited in the World Data Centers

Data during IGY published in "Cosmic-Ray Intensity During the International Geophysical Year", National Committee for the International Geophysical Year, Science Council of Japan, Ueno Park, Tokyo, Japan as follows:

July-December 1957	Book No. 1, March 1959
January-June 1958	Book No. 2, December 1959
July-December 1958	Book No. 3, April 1960

Data for January through June 1964 published in "Cosmic-Ray Intensity During the International Years of the Quiet Sun", No. 10, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1967.

Station Name	ALBUQUERQUE, U.S.A.
Geographic Coordinates	35.03°N, 106.70°W
Vertical Cutoff Rigidity	4.47 GV
Altitude	1575 meters
Periods of Operation	January 1964-January 1965 July 1965-December 1965
Principal Investigator	Dr. V. H. Regener Dept. of Physics and Astronomy The University of New Mexico 800 Yale Boulevard, N.E. Albuquerque, New Mexico 87106, U.S.A.

Comments:

Data deposited in the World Data Centers

Data for January, February and April through December 1964 published in "Cosmic-Ray Intensity During the International Years of the Quiet Sun", No. 10, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1967.

Closed-IGY-Type Neutron Monitors

Station Name	APATITY, U.S.S.R.
Geographic Coordinates	67°33' N, 33°20' E
Vertical Cutoff Rigidity	0.65 GV
Altitude	182 Meters
Periods of Operation	January 1962-August 1968
Principal Investigator	Dr. L. L. Lazutin Polar Geophysical Institute Akademgorodok, Apatity Murmansk Region, U.S.S.R.

Comments:

Data deposited in the World Data Centers.

Data for 1964 published in "Cosmic-Ray Intensity During the International Years of the Quiet Sun", No. 10, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1967.

Station Name	BERKELEY, U.S.A.
Geographic Coordinates	37°52' N, 122°18' W
Vertical Cutoff Rigidity	4.54 GV
Altitude	Sea level
Principal Investigator	July 1, 1957-September 1960 Prof. Robert B. Brode (retired)
Name and Address of Person to Contact for Information	Prof. Robert R. Brown Department of Physics University of California Berkeley, California 94720, U.S.A.

Comments:

Data from July 1, 1957-December 31, 1959 deposited in the World Data Centers.

Data during IGY published in "Cosmic-Ray Intensity During the International Geophysical Year", National Committee for the International Geophysical Year, Science Council of Japan, Ueno Park, Tokyo, Japan, as follows:

July-December 1957	Book No. 1, March 1959
January-June 1958	Book No. 2, December 1959
July-December 1958	Book No. 3, April 1960

Closed IGY-Type Neutron Monitors

Station Name	BUENOS AIRES, ARGENTINA
Geographic Coordinates	34°36' S, 58°29' W
Vertical Cutoff Rigidity	10.63 GV
Altitude	Sea level
Period of Operation	July 1, 1957-December 15, 1966
Principal Investigator	Dr. Horacio S. Ghielmetti Centro Nacional de Radiación Cósmica Perú 272 Buenos Aires, Argentina

Comments:

Data deposited in the World Data Centers.

Data during IGY publisned in "Cosmic-Ray Intensity During the International Geophysical Year", National Committee for the International Geophysical Year, Science Council of Japan, Ueno Park, Tokyo, Japan, as follows:

July-December 1957	Book No. 1, March 1959
January-June 1958	Book No. 2, December 1959
July-September 1958	Book No. 3, April 1960

Station Name	CAPE HALLETT, ANTARCTICA
Geographic Coordinates	72.3°S, 170.2° E
Vertical Cutoff Rigidity	0.04 GV
Altitude	Sea level
Period of Operation	October 1961-December 1962 (see comments)
Principal Investigator	Dr. S. Fred Singer Prof. of Environmental Science University of Virginia Charlottesville, Virginia 22903, U.S.A.

Comments:

It was not possible to determine the exact period of operation. These dates are derived from the data which have been deposited in the World Data Centers.

Closed IGY-Type Neutron Monitors

Station Name	CAPE SCHMIDT, U.S.S.R.
Geographic Coordinates	64°55' N, 179°29' W
Vertical Cutoff Rigidity	0.60 GV
Altitude	Sea level
Period of Operation	May 1967-May 1969
Principal Investigators	Dr. N. P. Chirkov and Dr. M. L. Basalaev Institute of Cosmophysical Investigations and Aeronomy Lenin Avenue, 61 Yakutsk, Siberia U.S.S.R.

Comments:

Data deposited in the World Data Centers.

Data published in monthly reviews of "Cosmical Data" (Kosmycheskiye danniye), Publishing office "Nauka", Moscow, U.S.S.R.

Station Name	CASEY, ANTARCTICA
Geographic Coordinates	66°17' S, 110°32' E
Vertical Cutoff Rigidity	0.01 GV
Altitude	Sea level
Period of Operation	April 12, 1969-December 31, 1970
Principal Investigator	Dr. A. G. Fenton Physics Department University of Tasmania Box 252 C, G.P.O. Hobart, Tasmania 7001, Australia

Comments:

This instrument was transferred from Wilkes, Antarctica.

Data to be deposited in the World Data Centers.

Data to be published in "ANARE Data Reports", Antarctic Division, 568 St. Kilda Road, Melbourne, Victoria 3004, Australia.

Closed IGY-Type Neutron Monitors

Station Name	CHACALTAYA, BOLIVIA
Alternate Names	Bolivia
Geographic Coordinates	16°19' S, 68°9' W
Vertical Cutoff Rigidity	13.10 GV
Altitude	5220 meters
Period of Operation	July 1960-August 14, 1969
Principal Investigator	Dr. I. Escobar Director General for Science, Education and Culture Inter-American Development Bank 808 17th Street, NW Washington, D.C. 20006, U.S.A.

Comments:

Data for the following periods deposited in the World Data Centers:

September-December 1961
July, August, November 1962
January-December 1963

Station Name	CHICAGO, U.S.A.
Geographic Coordinates	41.83° N, 87.67° W
Vertical Cutoff Rigidity	1.72 GV
Altitude	200 meters
Period of Operation	March 1951-June 30, 1971
Principal Investigator	Prof. J. A. Simpson LASR-EFI University of Chicago 933 E. 56th Street Chicago, Illinois 60637, U.S.A.

Comments:

This equipment was in operation for short periods from 1948 to March 1951 with changes in design.

Data deposited in the World Data Centers.

Data during IGY published in "Cosmic-Ray Intensity During the International Geophysical Year", National Committee for the International Geophysical Year, Science Council of Japan, Ueno Park, Tokyo, Japan, as follows:

July-December 1957	Book No. 1, March 1959
January-June 1958	Book No. 2, December 1959
July-December 1958	Book No. 3, April 1960

Data for 1964 published in "Cosmic-Ray Intensity During the International Years of the Quiet Sun", No. 10, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1967.

Hourly data from January 1964 through June 1971 published in the AFCRL Geophysics and Space Data Bulletin, AFCRL, L. G. Hanscom Field, Bedford, Massachusetts 01730, U.S.A. (Published quarterly.)

Closed IGY-Type Neutron Monitors

Station Name	CHURCHILL, CANADA
Alternate Names	Fort Churchill
Geographic Coordinates	58°48' N, 94°6' W
Vertical Cutoff Rigidity	0.21 GV
Altitude	39 meters
Period of Operation	May 1, 1957-December 31, 1964
Principal Investigator	Dr. J. Katzman (retired)
Name and Address of Person to Contact for Information	Dr. M. Bercovitch Division of Physics National Research Council of Canada Sussex Drive Ottawa, Ontario, Canada

Comments:

Data deposited in the World Data Centers.

Data during IGY published in "Cosmic-Ray Intensity During the International Geophysical Year", National Committee for the International Geophysical Year, Science Council of Japan, Ueno Park, Tokyo, Japan, as follows:

July-December 1957	Book No. 1, March 1959
January-June 1958	Book No. 2, December 1959
July-December 1958	Book No. 3, April 1960

Data for 1964 published in "Cosmic-Ray Intensity During the International Years of the Quiet Sun", No. 10, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1967.

Closed IGY-Type Neutron Monitors

Station Name	COLLEGE, U.S.A.
Alternate Name	Fairbanks, Alaska
Geographic Coordinates	64°51' N, 147°50' W
Vertical Cutoff Rigidity	0.54 GV
Altitude	91 meters
Period of Operation	July 1957-February 1, 1968
Principal Investigator	Dr. Serge A. Korff New York University University Heights New York, N.Y. 10453, U.S.A.

Comments:

Data deposited in the World Data Centers.

Data during IGY published in "Cosmic-Ray Intensity During the International Geophysical Year", National Committee for the International Geophysical Year, Science Council of Japan, Ueno Park, Tokyo, Japan, as follows:

August, October, November 1957	Book No. 1, March 1959
January-June 1958	Book No. 2, December 1959
July, September-December 4, 1958	Book No. 3, April 1960

Data for 1964 published in "Cosmic-Ray Intensity During the International Years of the Quiet Sun", No. 10, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1967.

Closed IGY-Type Neutron Monitors

Station Name	DARJEELING, INDIA
Geographic Coordinates	27°3' N, 88°16' E
Vertical Cutoff Rigidity	15.35 GV
Altitude	Approximately 2200 meters
Period of Operation	July 1957-November 1959
Principal Investigator	Dr. Indralal Chakraborty (deceased)
Address to Contact for Information	Director Bose Institute 93/1, Acharya Prafulla Chandr Road Calcutta 9, India

Comments:

Data not deposited in the World Data Centers.

Station Name	DEEP RIVER, CANADA
Geographic Coordinates	46°06' N, 77°30' W
Vertical Cutoff Rigidity	1.02 GV
Altitude	145 meters
Period of Operation	July 25, 1957-December 19, 1963
Principal Investigator	Dr. Hugh Carmichael Atomic Energy of Canada, Ltd. Chalk River, Ontario, Canada

Comments:

The monitor was enlarged between December 4 and December 28, 1957.

Data to April 30, 1962 deposited in the World Data Centers.

Data to be published in the Atomic Energy of Canada, Ltd., neutron monitor series of reports.

Data during IGY published in "Cosmic-Ray Intensity During the International Geophysical Year", National Committee for the International Geophysical Year, Science Council of Japan, Ueno Park, Tokyo, Japan, as follows:

July 25-December 1957	Book No. 1, March 1959
January-June 1958	Book No. 2, December 1959
July-December 1958	Book No. 3, April 1960

Closed IGY-Type Neutron Monitors

Station Name	DOURBES, BELGIUM
Geographic Coordinates	50°06' N, 4°36' E
Vertical Cutoff Rigidity	3.24 GV
Altitude	225 meters
Period of Operation	January 1, 1969 - February 1970
Principal Investigators	Prof. L. Bossy with Dr. J. C. Jodogne Géophysique externe Institut royal météorologique 3 Avenue Circulaire Bruxelles 18, Belgium

Comments:

Data deposited in the World Data Centers.

Data published in the Institut royal météorologique, Bulletin mensuel, Observations ionospheriques et du rayonnement cosmique.

This detector was in operation for specific short periods of time during 1968.

Station Name	DUMONT d'URVILLE, ANTARCTICA
Alternate Names	Terra Adélie
Geographic Coordinates	66°40' S, 140°01' E
Vertical Cutoff Rigidity	0.01 GV
Altitude	45 meters
Period of Operation	September 1, 1967-May 9, 1968
Principal Investigator	Dr. A. Freon (deceased)
Name and Address of Person to Contact for Information	Dr. M. G. Milleret Laboratoire de Physique Cosmique Fort de Verrieres Route de Gatines 91 Verrieres-Le-Buisson, France

Comments:

Data deposited in the World Data Centers.

Closed IGY-Type Neutron Monitors

Station Name	ELLSWORTH, ANTARCTICA
Geographic Coordinates	77°43' S, 41°08' W
Vertical Cutoff Rigidity	0.79 GV
Altitude	Sea level
Period of Operation	March 1957-December 1962
Principal Investigators	From March 1957-December 1958 Prof. Robert B. Brode (retired) For information contact: Prof. Robert R. Brown Department of Physics University of California Berkeley, California 94720, U.S.A. From January 1959 to December 1962: Dr. Horacio S. Ghielmetti Centro Nacional de Radiación Cósmica Perú 272, Bureno Aires, Argentina

Comments:

Data for 1959-1961 to be published by the Instituto Antárctico Argentino.

Station Name	GOTTINGEN, F.R.G.
Geographic Coordinates	51.52° N, 9.93° E
Vertical Cutoff Rigidity	3.00 GV
Altitude	273 meters
Period of Operation	July 1957-February 1959
Principal Investigator	Dr. Bernhard Meyer Max Planck Institut für extraterrestrische Physik 8046 Garching, München, F.R.G.

Comments:

Data deposited in the World Data Centers.

Data during IGY published in "Cosmic-Ray Intensity During the International Geophysical Year", National Committee for the International Geophysical Year, Science Council of Japan, Ueno Park, Tokyo, Japan, as follows:

July-December 1957	Book No. 1, March 1959
January-June 1958	Book No. 2, December 1959
July-December 1958	Book No. 3, April 1960

Closed IGY-Type Neutron Monitors

Station Name	HAFELEKAR, AUSTRIA
Geographic Coordinates	47°19' N, 11°23' E
Vertical Cutoff Rigidity	4.37 GV
Altitude	2290 meters
Period of Operation	October 1, 1956-March 31, 1959
Principal Investigator	Prof. Dr. A. Ehmert (deceased)
Name and Address of Person to Contact for Information	Dr. V. J. Kisselbach Institut für Stratosphären-Physik Max Planck Institut für Aeronomie 3411 Lindau/Harz PB 40, F.R.G.

Comments:

Data not deposited in the World Data Centers.

Station Name	HALEAKALA, U.S.A.
Alternate Names	Hawaii
Geographic Coordinates	20°43' N, 156°16' W
Vertical Cutoff Rigidity	13.30 GV
Altitude	3052 meters
Period of Operation	July 15, 1963-April 11, 1967
Principal Investigator	Dr. Walter R. Steiger Department of Physics and Astronomy 2565 The Mall University of Hawaii Honolulu, Hawaii 96822, U.S.A.

Comments:

Data deposited in the World Data Centers.

Data for 1964 published in "Cosmic-Ray Intensity During the International Years of the Quiet Sun", No. 10, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1967.

Closed IGY-Type Neutron-Monitors

Station Name	HALLE, G.D.R.
Geographic Coordinates	51°29' N, 11°58' E
Vertical Cutoff Rigidity	3.07 GV
Altitude	100 meters
Period of Operation	August 1, 1960-March 31, 1971
Principal Investigators	From 1960 to 1968: Prof. Dr. W. Messerschmidt Sektion Physik der Universität Friedemann-Bach-Platz 6 402 Halle (Saale), G.D.R. From 1968 to 1971: Dr. R. Knuth Observatory Neustrelitz 208 Neustrelitz 5 Kalkhorstweg, G.D.R.

Comments:

Data deposited in the World Data Centers.

Data published in the Geophysical Data Bulletins (Ionosphere, Atmospheric Noise, Cosmic Rays), Heinrich-Hertz Institut, 1199 Berlin- Adlershof, G.D.R.

Data for 1964 published in "Cosmic-Ray Intensity During the International Years of the Quiet Sun", No. 10, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1967.

Closed IGY-Type Neutron Monitors

Station Name	HERMANUS, SOUTH AFRICA
Geographic Coordinates	$34^{o}25.5'$ S, $19^{o}13.5'$ E
Vertical Cutoff Rigidity	4.90 GV
Altitude	26 meters
Period of Operation	June 1, 1957-May 31, 1964
Principal Investigator	Mr. A. M. VanWijk Magnetic Observatory Hermanus, Republic of South Africa

Comments:

Data deposited in the World Data Centers.

Data were published in the Hermanus Cosmic-Ray Bulletins.

Data during IGY published in "Cosmic-Ray Intensity During the International Geophysical Year", National Committee for the International Geophysical Year, Science Council of Japan, Ueno Park, Tokyo, Japan, as follows:

July-December 1957	Book No. 1, March 1959
January-June 1958	Book No. 2, December 1959
July-December 1958	Book No. 3, April 1960

Data for January through May 1964 published in "Cosmic-Ray Intensity During the International Years of the Quiet Sun", No. 10, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1967.

Closed IGY-Type Neutron Monitors

Station Name	HERSTMONCEUX, ENGLAND
Geographic Coordinates	50°52' N, 0°20' E
Vertical Cutoff Rigidity	2.92 GV
Altitude	23 meters
Period of Operation	April 1, 1957-June 30, 1960
Principal Investigators	From April 1957 to December 1959: Mr. D. R. Palmer R.G.O. Herstmonceux Castle Herstmonceux, Sussex, U.K. From January 1960 to June 1960: Prof. H. Elliot Department of Physics Imperial College London SW7, U.K.

Comments:

Data deposited in the World Data Centers.

Data during IGY published in "Cosmic-Ray Intensity During the International Geophysical Year", National Committee for the International Geophysical Year, Science Council of Japan, Ueno Park, Tokyo, Japan, as follows:

July-December 1957	Book No. 1, March 1959
January-June 1958	Book No. 2, December 1959
July-December 1958	Book No. 3, April 1960

Closed IGY-Type Neutron Monitors

Station Name	INVERCARGILL, NEW ZEALAND
Alternate Names	Awarua
Geographic Coordinates	46.60° S, 168.40° E
Vertical Cutoff Rigidity	1.86 GV
Altitude	Sea level
Period of Operation	October 1957-March 1960
Principal Investigator	C. A. Roper DSIR Geophysical Observatory P.O. Box 231 Christchurch, New Zealand

Comments:

Data deposited in the World Data Centers.

Data during IGY published in "Cosmic-Ray Intensity During the International Geophysical Year", National Committee for the International Geophysical Year, Science Council of Japan, Ueno Park, Tokyo, Japan, as follows:

January-June 1958	Book No. 2, December 1959
July-December 1958	Book No. 3, April 1960

Station Name	IRKUTSK, U.S.S.R.
Geographic Coordinates	52°28' N, 104°02' E
Vertical Cutoff Rigidity	3.66 GV
Altitude	433 meters
Periods of Operation	December 1957-January 1958 May 1958-November 1960 March 1961-May 1962 October 1962-December 1966
Principal Investigator	Dr. A. A. Luzov Siberian IZMIRAN Lenin Street, 5 Irkutsk, U.S.S.R.

Comments:

Data deposited in the World Data Centers.

Data during IGY published in "Cosmic-Ray Intensity During the International Geophysical Year", National Committee for the International Geophysical Year, Science Council of Japan, Ueno Park, Tokyo, Japan, as follows.

January, May, June 1958	Book No. 2, December 1959
July, August, 1958	Book No. 3, April 1960

Data for 1964 published in "Cosmic-Ray Intensity During the International Years of the Quiet Sun", No. 11, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1968.

Closed IGY-Type Neutron Monitors

Station Name	KERGUELEN
Alternate Names	Port aux Francais
Geographic Coordinates	49°21' S, 70°13' E
Vertical Cutoff Rigidity	1.19 GV
Altitude	Sea level
Period of Operation	July 9, 1957-January 31, 1964
Principal Investigator	Dr. A. Freon (deceased)
Name and Address of Person to Contact for Information	Dr. M. G. Milleret Laboratoire de Physique Cosmique Fort de Verrieres Route de Gatines 91 Verrieres-Le-Buisson, France

Comments:

Data deposited in the World Data Centers.

Station Name	KIEL, F.R.G.
Geographic Coordinates	54.3° N, 10.1° E
Vertical Cutoff Rigidity	2.29 GV
Altitude	54 meters
Period of Operation	July 1, 1957-December 31, 1964
Principal Investigator	Prof. Dr. E. Bagge Institut für Reine und Angewandte Kernphysik der Christian-Albrechts-Universität 23 Kiel, F.R.G.

Comments:

Data deposited in the World Data Centers.

Data for 1964 published in "Cosmic-Ray Intensity During the International Years of the Quiet Sun", No. 11, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1968.

Closed IGY-Type Neutron Monitors

Station Name	KODAIKANAL, INDIA
Geographic Coordinates	10°14' N, 77°29' E
Vertical Cutoff Rigidity	17.47 GV
Altitude	2443 meters
Period of Operation	July 1957-June 1964
Principal Investigator	Prof. V. Sarabhai (deceased)
Name and Address of Person to Contact for Information	Prof. U. R. Rao Physical Research Laboratory Ahmedabad 9, India

Comments:

Data deposited in the World Data Centers.

Data during IGY published in "Cosmic-Ray Intensity During the International Geophysical Year", National Committee for the International Geophysical Year, Science Council of Japan, Ueno Park, Tokyo, Japan as follows:

July-December 1957	Book No. 1, March 1959
January-June 1958	Book No. 2, December 1959
July-December 1958	Book No. 3, April 1960

Data for January through June 1964 published in "Cosmic-Ray Intensity During the International Years of the Quiet Sun", No. 11, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1968.

Station Name	KÜHLUNGSBORN, G.D.R.
Geographic Coordinates	54°07' N, 11°46' E
Vertical Cutoff Rigidity	2.43 GV
Altitude	70 meters
Period of Operation	January 1, 1964-December 31, 1967
Principal Investigator	Dr. R. Knuth Observatory Neustrelitz 208 Neustrelitz 5, Kalkhorstweg, G.D.R.

Comments:

Data deposited in the World Data Centers.

Data published in "Geophysikalische Messreihan des Observatoriums für Ionosphärenforschung Kühlungsborn".

Data for 1964 published in "Cosmic-Ray Intensity During the International Years of the Quiet Sun", No. 11, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1968.

Closed IGY-Type Neutron Monitors

Station Name	LAE, NEW GUINEA
Geographic Coordinates	$6^{o}44'$ S, $147^{o}00'$ E
Vertical Cutoff Rigidity	15.52 GV
Altitude	Sea level
Periods of Operation	July 1, 1957-November 30, 1960 December 1, 1962-November 1969
Principal Investigator	Dr. A. G. Fenton Physics Department University of Tasmania Box 252 C, G.P.O. Hobart, Tasmania 7001, Australia

Comments:

Data until February 1966 deposited in the World Data Centers. There are no present plans to submit the remaining data.

Data during IGY published in "Cosmic-Ray Intensity During the International Geophysical Year", National Committee for the International Geophysical Year, Science Council of Japan, Ueno Park, Tokyo, Japan, as follows:

July-December 1957	Book No. 1, March 1959
January-June 1958	Book No. 2, December 1959
July-December 1958	Book No. 3, April 1960

Data for 1964 published in "Cosmic-Ray Intensity During the International Years of the Quiet Sun", No. 11, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1968.

Closed IGY-Type Neutron Monitors

Station Name	LEEDS, ENGLAND
Alternate Names	University of Leeds
Geographic Coordinates	53°50' N, 1°35' W
Vertical Cutoff Rigidity	2.20 GV
Altitude	100 meters
Period of Operation	May 1957-December 1966
Principal Investigator	Prof. P. L. Marsden Physics Department University of Leeds Leeds 2, England

Comments:

Data were deposited in the World Data Centers.

Data during IGY published in "Cosmic-Ray Intensity During the International Geophysical Year", National Committee for the International Geophysical Year, Science Council of Japan, Ueno Park, Tokyo, Japan, as follows:

July-December 1957	Book No. 1, March 1959
January-June 1958	Book No. 2, December 1959
July-December 1958	Book No. 3, April 1960

Data for 1964 published in "Cosmic-Ray Intensity During the International Years of the Quiet Sun", No. 11, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1968.

Station Name	LERWICK, SCOTLAND
Geographic Coordinates	60.15° N, 1.15° W
Vertical Cutoff Rigidity	1.09 GV
Altitude	83 meters
Period of Operation	January 1965 - January 1967

Comments:

For information contact:

Dr. Stig Lindgren
WDC-C1
Cosmic Ray Group
Observatorieparken
Uppsala, Sweden

Data deposited in the World Data Centers.

Closed IGY-Type Neutron Monitors

Station Name	LIMEIL, FRANCE
Geographic Coordinates	48°44' N, 2°25' E
Vertical Cutoff Rigidity	3.64 GV
Altitude	50 meters
Period of Operation	February 1959-November 1960
Principal Investigator	Dr. J. P. Legrand Groupe de Recherches Ionosphériques 4 rue Neptune 94 Saint-Maur, France

Comments:

Data deposited in the World Data Centers.

Station Name	LINCOLN, U.S.A.
Geographic Coordinates	40°49' N, 96°41' W
Vertical Cutoff Rigidity	2.22 GV
Altitude	350 meters
Period of Operations	May 1957-May 1962
Principal Investigator	Prof. R. L. Chasson Department of Physics University of Denver Denver, Colorado 80210, U.S.A.

Comments:

Data deposited in the World Data Centers.

Data during IGY published in "Cosmic-Ray Intensity During the International Geophysical Year", National Committee for the International Geophysical Year, Science Council of Japan, Ueno Park, Tokyo, Japan, as follows:

July-December 1957	Book No. 1, March 1959
January-June 1958	Book No. 2, December 1959
July-December 1958	Book No. 3, April 1960

Closed IGY-Type Neutron Monitors

Station Name	LONDON, ENGLAND
Geographic Coordinates	51°32' N, 0°06' W
Vertical Cutoff Rigidity	2.73 GV
Altitude and Periods of Operation	12.2 meters (July 1, 1957-June 30, 1959) 45.4 meters (July 15, 1960-May 31, 1965)
Principal Investigator	Prof. H. Elliot Department of Physics Imperial College London SW7, U.K.

Comments:

The data obtained from July 15, 1960 to May 31, 1965 were from the monitor which operated earlier at Herstmonceux and are believed to be substantially more reliable than the earlier data from London.

Data deposited in the World Data Centers.

Data during IGY published in "Cosmic-Ray Intensity During the International Geophysical Year", National Committee for the International Geophysical Year, Science Council of Japan, Ueno Park, Tokyo, Japan, as follows:

July, August, October - December 1957	Book No. 1, March 1959
January-June 1958	Book No. 2, December 1959
July-December 1958	Book No. 3, April 1960

Data for 1964 published in "Cosmic-Ray Intensity During the International Years of the Quiet Sun", No. 11, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1968.

Closed IGY-Type Neutron Monitors

Station Name	MAKAPUU POINT, U.S.A.
Alternate Names	Makapuu Point Solar Observatory Hawaii
Geographic Coordinates	21°18' N, 157°39' W
Vertical Cutoff Rigidity	13.23 GV
Altitude	91 meters
Period of Operation	July 1, 1957-June 1963
Principal Investigators	From January 1, 1959 through June 1963: Dr. Walter R. Steiger Dept. of Physics and Astronomy 2565 The Mall University of Hawaii Honolulu, Hawaii 96822, U.S.A.
Name and Address of Person to Contact for Information	From July 1, 1957 through December 31, 1958: Prof. Robert B. Brode (retired) Prof. Robert R. Brown Dept. of Physics University of California Berkeley, California 94720, U.S.A.

Comments:

Data deposited in the World Data Centers.

Data during IGY published in "Cosmic-Ray Intensity During the International Geophysical Year", National Committee for the International Geophysical Year, Science Council of Japan, Ueno Park, Tokyo, Japan, as follows:

July-December 1957	Book No. 1, March 1959
January-June 1958	Book No. 2, December 1959
July-December 1958	Book No. 3, April 1960

Station Name	McMURDO, ANTARCTICA
Geographic Coordinates	77°51' S, 166°43' E
Vertical Cutoff Rigidity	0.01 GV
Altitude	48 meters
Period of Operation	May 1960-June 1964
Principal Investigator	Dr. Martin A. Pomerantz Bartol Research Foundation Swarthmore, Pennsylvania 19081, U.S.A.

Comments:

Data deposited in the World Data Centers.

Closed IGY-Type Neutron Monitors

Station Name	MOSCOW, U.S.S.R.
Alternate Names	IZMIRAN
Geographic Coordinates	55°28' N, 37°19' E
Vertical Cutoff Rigidity	2.46 GV
Altitude	200 meters
Periods of Operation	January 1958-September 1958 November 1958 January 1959-October 1959 December 1959-March 1960 August 1960-February 1961 May 1961-June 1966
Principal Investigator	Dr. N. S. Kaminer IZMIRAN Institute of Terrestrial Magnetism Ionosphere and Radiowave Propagation Academy of Sciences of the U.S.S.R. p/o Akademgorodok, Moscow Region, U.S.S.R.

Comments:

Data deposited in the World Data Centers.

Data for 1964 published in "Cosmic-Ray Intensity During the International Years of the Quiet Sun", No. 11, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1968.

Closed IGY-Type Neutron Monitors

Station Name	MT. NORIKURA, JAPAN
Geographic Coordinates	36°07' N, 137°33' E
Vertical Cutoff Rigidity	11.39 GV
Altitude	2770 meters
Period of Operation	November 1956-August 1968
Principal Investigator	Dr. Y. Miyazaki Cosmic Ray Laboratory The Institute of Physical and Chemical Research 7-13, Kaga-1, Itabashi-ku Tokyo, Japan

Comments:

This monitor had 12 BF_3 counters. A smaller preliminary detector with 4 BF_3 tubes was placed in operation in August 1955 with some overlapping of observing period with the larger detector.

Data deposited in the World Data Centers.

Data published in the Japanese Cosmic-Ray Intensity data books as follows:

July-December 1957	Book No. 1, March 1959
January-June 1958	Book No. 2, December 1957
July-December 1958	Book No. 3, April 1960
January-December 1959	Book No. 7, March 1963
January-December 1960	Book No. 6, March 1962
January-December 1961	Book No. 8, October 1963
January-December 1962	Book No. 9, October 1964
January-December 1964	Book No. 11, March 1968

Closed IGY-Type Neutron Monitors

Station Name	MT. WELLINGTON, AUSTRALIA
Alternate Names	Mt. Wellington (Hobart) Hobart (This is incorrect)
Geographic Coordinates	42°55' S, 147°14' E
Vertical Cutoff Rigidity	1.89 GV
Altitude	725 meters
Period of Operation	July 19, 1956-January 31, 1967
Principal Investigator	Dr. A. G. Fenton Physics Department University of Tasmania Box 252 C, G.P.O. Hobart, Tasmania 7001, Australia

Comments:

The name Hobart has often been applied to the Mt. Wellington neutron monitor. This is definitely incorrect as there are separate cosmic-ray detectors located at Hobart. The city of Hobart, Tasmania lies at the foot of Mt. Wellington.

Data deposited in the World Data Centers.

Data during IGY published in "Cosmic-Ray Intensity During the International Geophysical Year", National Committee for the International Geophysical Year, Science Council of Japan, Ueno Park, Tokyo, Japan, as follows:

July-December 1957	Book No. 1, March 1959
January-June 1958	Book No. 2, December 1959
July-December 1958	Book No. 3, April 1960

Data for 1964 published in "Cosmic-Ray Intensity During the International Years of the Quiet Sun", No. 11, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1968.

Station Name	MUNICH, F.R.G.
Geographic Coordinates	48°12' N, 11°36' E
Vertical Cutoff Rigidity	4.14 GV
Altitude	500 meters
Period of Operation	April 1, 1959-December 31, 1969
Principal Investigator	Dr. Bernhard Meyer Max Planck Institut für Extraterrestrische Physik 8046 Garching, München, F.R.G.

Comments:

Data deposited in the World Data Centers.

Closed IGY-Type Neutron Monitors

Station Name	MURCHISON BAY
Geographic Coordinates	80°03' N, 18°15' E
Vertical Cutoff Rigidity	0.06 GV
Altitude	Sea level
Period of Operation	August 27, 1957-April 30, 1959
Principal Investigator	Prof. A. E. Sandström Uppsala University Box 516 751 20 Uppsala 1, Sweden

Comments:

Data deposited in the World Data Centers.

Data during IGY published in "Cosmic-Ray Intensity During the International Geophysical Year", National Committee for the International Geophysical Year, Science Council of Japan, Ueno Park, Tokyo, Japan, as follows:

August 27, 1957-December 1957	Book No. 1, March 1959
January-June 1958	Book No. 2, December 1959
July-December 1958	Book No. 3, April 1960

Station Name	MURMANSK, U.S.S.R.
Alternate Names	Laparskaya
Geographic Coordinates	68°15' N, 33°05' E
Vertical Cutoff Rigidity	0.50 GV
Altitude	Sea level
Period of Operation	December 1, 1958-December 1, 1961
Principal Investigators	Dr. K. K. Fedchenko and Dr. L. L. Lazutin Polar Geophysical Institute Akademgorodok Apatity, Murmansk Region, U.S.S.R.

Comments:

Data deposited in the World Data Centers.

Data for December 1958 published in "Cosmic-Ray Intensity During the International Geophysical Year", No. 3, National Committee for the International Geophysical Year, Science Council of Japan, Ueno Park, Tokyo, Japan, April 1960.

Closed IGY-Type Neutron Monitors

Station Name	NERA, THE NETHERLANDS
Alternate Names	Nederhorst den Berg
Geographic Coordinates	52°14' N, 5°5' E
Vertical Cutoff Rigidity	2.76 GV
Altitude	-2 meters
Period of Operation	July 1, 1958-January 1, 1965
Principal Investigator	Dr. L. D. de Feiter Space Research Laboratory Beneluxlaan 21 Utrecht, The Netherlands

Comments:

Data deposited in the World Data Centers.

Data were published in the Monthly Bulletin, Royal Meteorological Institute, De Bilt, The Netherlands.

Data for July through December 1958 published in "Cosmic-Ray Intensity During the International Geophysical Year", No. 3, National Committee for the International Geophysical Year, Science Council of Japan, Ueno Park, Tokyo, Japan, April 1960.

Data for 1964 published in "Cosmic-Ray Intensity During the International Years of the Quiet Sun", No. 11, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1968.

Station Name	NORTHFIELD, U.S.A.
Geographic Coordinates	44°28' N, 93°15' W
Vertical Cutoff Rigidity	1.43 GV
Altitude	287 meters
Period of Operation	September 1, 1957-August 31, 1959
Principal Investigator	Dr. Ian G. Barbour Carleton College Northfield, Minnesota 55057, U.S.A.

Comments:

Data for 1958 deposited in the World Data Centers.

Closed IGY-Type Neutron Monitors

Station Name	PIC DU MIDI, FRANCE
Geographic Coordinates	42°56' N, 00°15' E
Vertical Cutoff Rigidity	5.36 GV
Altitude	2860 meters
Period of Operation	August 13, 1957-September 18, 1964
Principal Investigator	Dr. A. Freon (deceased)
Name and Address of Person to Contact for Information	Dr. M. G. Milleret Laboratoire de Physique Cosmique Fort de Verrieres Route de Gatines 91 Verrieres-Le-Buisson, France

Comments:

Data deposited in the World Data Centers.

Data during IGY published in "Cosmic-Ray Intensity During the International Geophysical Year", National Committee for the International Geophysical Year, Science Council of Japan, Ueno Park, Tokyo, Japan, as follows:

August 13 - December 31, 1957	Book No. 1, March 1959
January-February 1958	Book No. 2, December 1959
March-July 1958	Book No. 3, April 1960

Data for January through September 18, 1964 published in "Cosmic-Ray Intensity During the International Years of the Quiet Sun", No. 12, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1968.

Station Name	PRAGUE, CZECHOSLOVAKIA
Geographic Coordinates	50°05' N, 14°25' E
Vertical Cutoff Rigidity	3.53 GV
Altitude	215 meters
Period of Operation	February 1959-September 1962
Principal Investigator	Dr. Jaroslav Pernegr
Address to Contact for Information	Institut of Experimental Physics Cosmic Ray Laboratory Lomnický Štít p. Tatranská Lomnica, Czechoslovakia

Comments:

Data deposited in the World Data Centers.

Closed IGY-Type Neutron Monitors

Station Name	RESOLUTE, CANADA
Geographic Coordinates	74°43' N, 94°59' W
Vertical Cutoff Rigidity	0.00 GV
Altitude	17 meters
Period of Operation	October 1, 1956-July 31, 1966
Principal Investigator	Dr. J. Katzman (retired)
Name and Address of Person to Contact for Information	Dr. M. Bercovitch Division of Physics National Research Council of Canada Sussex Drive Ottawa, Ontario, Canada

Comments:

Data deposited in the World Data Centers.

Data during IGY published in "Cosmic-Ray Intensity During the International Geophysical Year", National Committee for the International Geophysical Year, Science Council of Japan, Ueno Park, Tokyo, Japan, as follows:

July-December 1957	Book No. 1, March 1959
January-June 1958	Book No. 2, December 1959
July-December 1958	Book No. 3, April 1960

Data for 1964 published in "Cosmic-Ray Intensity During the International Years of the Quiet Sun", No. 12, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1968.

Station Name	RIO DE JANEIRO, BRAZIL
Geographic Coordinates	22°57' S, 43°10' W
Vertical Cutoff Rigidity	11.73 GV
Altitude	Sea level
Period of Operation	September 1957-December 1962
Principal Investigator	Dr. Georges Schwachheim Centro Brasileiro Pesquisas Fisicas Av. Wenceslau Braz. 71 Rio de Janeiro, GB ZC82, Brazil

Comments:

Data deposited in the World Data Centers.

Data during IGY published in "Cosmic-Ray Intensity During the International Geophysical Year", National Committee for the International Geophysical Year, Science Council of Japan, Ueno Park, Tokyo, Japan, as follows:

November-December 1957	Book No. 1, March 1959
January-June 1958	Book No. 2, December 1959
July-December 1958	Book No. 3, April 1960

Closed IGY-Type Neutron Monitors

Station Name	ROME, ITALY
Alternate Names	Station SVIRCO - Rome
Geographic Coordinates	41°54' N, 12°31' E
Vertical Cutoff Rigidity	6.32 GV
Altitude	60 meters
Period of Operation	July 1, 1957 - December 1, 1966
Principal Investigators	Prof. Francesca Bachelet and Prof. A. Maria Conforto Istituto di Fisica dell'Universita Rome, Italy

Comments:

Data deposited in the World Data Centers.

Data during IGY published in "Cosmic-Ray Intensity During the International Geophysical Year", National Committee for the International Geophysical Year, Science Council of Japan, Ueno Park, Tokyo, Japan, as follows:

July-December 1957	Book No. 1, March 1959
January-June 1958	Book No. 2, December 1959
July-December 1958	Book No. 3, April 1960

Data for 1964 published in "Cosmic-Ray Intensity During the International Years of the Quiet Sun", No. 12, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1968.

Station Name	SACRAMENTO PEAK, U.S.A.
Geographic Coordinates	32.72° N, 105.75°W
Vertical Cutoff Rigidity	4.98 GV
Altitude	3000 meters
Period of Operation	May 1951-June 30, 1968
Principal Investigator	Prof. J. A. Simpson LASR-EFI University of Chicago 933 E. 56th Street Chicago, Illinois 60637, U.S.A.

Comments:

This was a two-counter pile as originally designed in 1949.

Data not deposited in the World Data Centers.

Closed IGY-Type Neutron Monitors

Station Name	SAINT MAUR, FRANCE
Geographic Coordinates	48°45' N, 2°17' E
Vertical Cutoff Rigidity	3.63 GV
Altitude	35 meters
Period of Operation	1961-1966
Principal Investigator	Dr. J. P. Legrand Groupe de Recherches Ionosphériques 4 rue Neptune 94 Saint-Maur, France

Comments:

Data not deposited in the World Data Centers.

Station Name	SCHAUINSLAND, F.R.G.
Alternate Names	Freiburg
Geographic Coordinates	47°55' N, 7°45' E
Vertical Cutoff Rigidity	4.10 GV
Altitude	1200 meters
Period of Operation	April 1, 1957-April 30, 1966
Principal Investigator	Dr. A. Sittkus Max Planck-Institut für Kernphysik Katharinenstr. 25 78 Freiburg (Breisgau), F. R. G.

Comments:

Data for the period July 1, 1957-December 31, 1960 deposited in the World Data Centers.

Closed IGY-Type Neutron Monitors

Station Name	SIMFEROPOL, U.S.S.R.
Geographic Coordinates	44°44' N, 34°00' E
Vertical Cutoff Rigidity	5.51 GV
Altitude	570 meters
Periods of Operation	January 1, 1961-October 1, 1961 February 1, 1964-January 1, 1965
Principal Investigator	Dr. A. Stepanjan Krimskaya Astrofisichiskaya Observatoria p/o Nauchny, Bahchisaray, Krimsky Region, U.S.S.R.

Comments:

Data deposited in the World Data Centers.

Data for February and April through December 1964 published in "Cosmic-Ray Intensity During the International Years of the Quiet Sun", No. 12, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1968.

Station Name	SYDNEY, AUSTRALIA
Geographic Coordinates	33°53'27" S, 151°11'23" E
Vertical Cutoff Rigidity	4.69 GV
Altitude	43 meters
Period of Operation	January 1957-December 1959
Principal Investigator	Dr. M. M. Winn School of Physics Sydney University Sydney, N.S.W. 2006, Australia

Comments:

Data deposited in the World Data Centers.

This instrument was transferred to Brisbane.

Data during IGY published in "Cosmic-Ray Intensity During the International Geophysical Year", National Committee for the International Geophysical Year, Science Council of Japan, Ueno Park, Tokyo, Japan, as follows:

January-June 1958	Book No. 2, December 1959
July-December 1958	Book No. 3, April 1960

Closed IGY-Type Neutron Monitors

Station Name	SYOWA, ANTARCTICA
Alternate Names	Syowa Base Syowa Station
Geographic Coordinates	69°00' S, 39°36' E
Vertical Cutoff Rigidity	0.42 GV
Altitude	15 meters
Period of Operation	March 1, 1960-December 31, 1961
Principal Investigator	Dr. Y. Miyazaki Cosmic Ray Laboratory The Institute of Physical and Chemical Research 7-13, Kaga-1, Itabashi Tokyo, Japan

Comments:

Data deposited in the World Data Centers.

Data published in the Japanese Cosmic-Ray Intensity data books as follows:

March-December 1960	Book No. 6, March 1962
January-December 1961	Book No. 8, October 1963

Station Name	THULE, GREENLAND
Alternate Names	Geopole Station
Geographic Coordinates	76°35' N, 68°25' W
Vertical Cutoff Rigidity	0.00 GV
Altitude	260 meters
Period of Operation	August 13, 1957-September 20, 1964
Principal Investigator	Dr. Martin A. Pomerantz Bartol Research Foundation Swarthmore, Pennsylvania 19081, U.S.A.

Comments:

Data deposited in the World Data Centers.

Data during IGY published in "Cosmic-Ray Intensity During the International Geophysical Year", National Committee for the International Geophysical Year, Science Council of Japan, Ueno Park, Tokyo, Japan, as follows:

August 13-December 31, 1957	Book No. 1, March 1959
January-June 1958	Book No. 2, December 1959
July-December 1958	Book No. 3, April 1960

Data for January 1 through September 20, 1964 published in "Cosmic-Ray Intensity During the International Years of the Quiet Sun", No. 12, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1968.

Closed IGY-Type Neutron Monitors

Station Name	WEISSENAU, F.R.G.
Geographic Coordinates	47°48' N, 9°30' E
Vertical Cutoff Rigidity	4.16 GV
Altitude	427 meters
Period of Operation	October 1, 1956-March 31, 1959
Principal Investigator	Prof. Dr. A. Ehmert (deceased)
Name and Address of Person to Contact for Information:	Prof. Dr. V. J. Kisselbach Institut für Stratosphären-Physik Max Planck Institut für Aeronomie 3411 Lindau/Harz PB 40, F.R.G.

Comments:

Data deposited in the World Data Centers.

Data during IGY published in "Cosmic-Ray Intensity During the International Geophysical Year", National Committee for the International Geophysical Year, Science Council of Japan, Ueno Park, Tokyo, Japan, as follows:

July-December 1957	Book No. 1, March 1959
January-June 1958	Book No. 2, December 1959
July-December 1958	Book No. 3, April 1960

Station Name	WELLINGTON, NEW ZEALAND
Geographic Coordinates	41°17' S, 174°46' E
Vertical Cutoff Rigidity	3.42 GV
Altitude	125 meters
Period of Operation	July 1957-June 1958
Principal Investigator	Dr. N. V. Ryder (deceased)
Name and Address of Person to Contact for Information	Mr. H. S. Jansen c/o Institute of Nuclear Sciences Private Bag Lower Hutt, New Zealand

Comments:

Data deposited in the World Data Centers.

Data for July through December 1957 published in "Cosmic-Ray Intensity During the International Geophysical Year", No. 1, National Committee for the International Geophysical Year, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1959.

Closed IGY-Type Neutron Monitors

Station Name	WELLINGTON, NEW ZEALAND
Alternate Names	Lower Hutt
Geographic Coordinates	41°13' S, 174°55' E
Vertical Cutoff Rigidity	3.42 GV
Altitude	Sea level
Period of Operation	November 1964-June 1965 (see comments)
Principal Investigator	Mr. H. S. Jansen c/o Institute of Nuclear Sciences Private Bag Lower Hutt, New Zealand

Comments:

The operation of this monitor was not continuous throughout this period. Whatever data are available (November 1964, February, March and June 1965) have been deposited in the World Data Centers.

Neutron monitor consisted of 2 tubes in paraffin and lead.

Station Name	WILKES, ANTARCTICA
Geographic Coordinates	66°15' S, 110°31' E
Vertical Cutoff Rigidity	0.01 GV
Altitude	Sea level
Period of Operation	March 5, 1962-April 9, 1969
Principal Investigator	Dr. A. G. Fenton Physics Department University of Tasmania Box 252 C, G.P.O. Hobart, Tasmania 7001, Australia

Comments:

This instrument was transferred to Casey, Antarctica.

Data deposited in the World Data Centers.

Data are published in "ANARE Data Reports", Antarctic Division, Department of Supply, 568 St. Kilda Road, Melbourne, Victoria 3004, Australia.

Data for 1964 published in "Cosmic-Ray Intensity During the International Years of the Quiet Sun", No. 12, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1968.

Closed IGY-Type Neutron Monitors

Station Name	YAKUTSK, U.S.S.R.
Geographic Coordinates	$62^{\circ}01'$ N, $129^{\circ}43'$ E
Vertical Cutoff Rigidity	1.70 GV
Altitude	105 meters
Period of Operation	July 20, 1957-November 1969
Principal Investigator	Dr. A. I. Kuzmin Institute of Cosmophysical Investigations and Aeronomy Lenin Avenue, 61 Yakutsk, Siberia, U.S.S.R.

Comments:

Data submitted to the World Data Centers.

Data published in monthly review of "Cosmical Data" (Kosmycheskiye danniye), Publishing Office "Nauka", Moscow, U.S.S.R.

Data during IGY published in "Cosmic-Ray Intensity During the International Geophysical Year", National Committee for the International Geophysical Year, Science Council of Japan, Ueno Park, Tokyo, Japan, as follows:

July 20, 1957-December 31, 1957	Book No. 1, March 1959
January-June 1958	Book No. 2, December 1959
July-December 1958	Book No. 3, April 1960

Data for 1964 published in "Cosmic-Ray Intensity During the International Years of the Quiet Sun", No. 12, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1968.

Section B2

Muon Detectors

The following listings contain the pertinent information on the various muon detectors, not including those operating underground, for which operation has terminated. The locations of these detectors are shown in Figure B2. A separate listing is given for each detector even though there may be more than one detector operating at the same location.

There is no standard description for the many muon detectors in existance, and many variations exist. For the IGY there was a standard cubical design described by Elliot (1957). Whenever possible a description of the detector or an appropriate reference has been included in the detector listing.

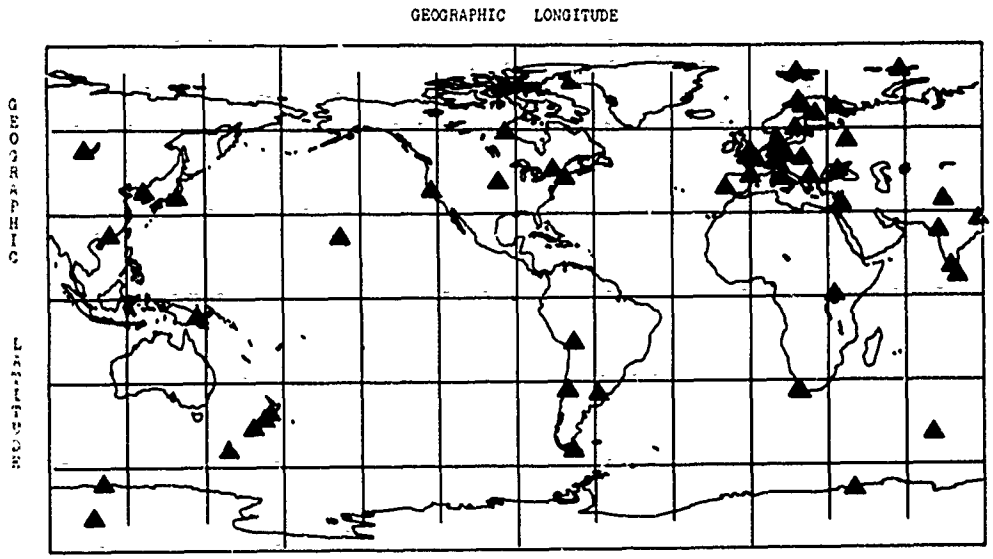

Figure B2. World Map Showing Locations of Closed Muon Detectors

Closed Muon Detectors

Station Name	AHMEDABAD, INDIA
Geographic Coordinates	23°01' N, 72°36' E
Vertical Cutoff Rigidity	15.94 GV
Altitude	Sea level
Period of Operation	July 1957-December 1962
Principal Investigator	Prof. V. Sarabhai (deceased) Prof. U. R. Rao
Name and Address of Person to Contact for Information	Physical Research Laboratory Ahmedabad 9, India

Comments:

Data deposited in the World Data Centers.

Station Name	APATITY, U.S.S.R.
Geographic Coordinates	67°33' N, 33°20' E
Vertical Cutoff Rigidity	0.65 GV
Altitude	182 meters
Type of Equipment and Configuration	Cubical muon telescope
Periods of Operation	April 1965-September 1966 November 1966-September 1, 1967
Principal Investigator	Dr. L. L. Lazutin Polar Geophysical Institute Akademgorodok, Apatity Murmansk Region, U.S.S.R.

Comments:

Data deposited in the World Data Centers.

Closed Muon Detectors

Station Name	BERKELEY, U.S.A.
Geographic Coordinates	37°52' N, 122°18' W
Vertical Cutoff Rigidity	4.54 GV
Altitude	Sea level
Type of Equipment and Configuration	Cubical muon telescope
Period of Operation	July 1, 1957-September 1960
Principal Investigator	Prof. Robert B. Brode (retired)
Name and Address of Person to Contact for Information	Prof. Robert R. Brown Department of Physics University of California Berkeley, California 94720, U.S.A.

Comments:

Data from July 1, 1957 to December 31, 1959 deposited in the World Data Centers.

Data from July 1, 1957 to December 31, 1958 published in "Cosmic-Ray Intensity During the International Geophysical Year", No. 5, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, July 1961.

Station Name	BUENOS AIRES, ARGENTINA
Geographic Coordinates	34°36' S, 58°29' W
Vertical Cutoff Rigidity	10.63 GV
Altitude	Sea level
Type of Equipment and Configuration	Muon telescope system consisting of 2 cubical telescopes, 2 vertical narrow angle telescopes and 2 inclined narrow angle telescopes. The direction of maximum sensitivity of the inclined telescopes was 45°. The entire system was mounted on a rotating platform. Initially, the system was rotated weekly with the inclined telescopes pointed North-South one week, and East-West the second week. Later the interval between rotations was lengthened to 6 months.
Period of Operation	November 1957-December 1961
Principal Investigator	Dr. Horacio S. Ghielmetti Centro Nacional de Radiación Cósmica Perú 272 Buenos Aires, Argentina

Comments:

Data not deposited in the World Data Centers.

Barometric coefficients on file at the World Data Centers.

Closed Muon Detectors

Station Name	CAPE TOWN, SOUTH AFRICA
Geographic Coordinates	33°57' S, 18°28' E
Vertical Cutoff Rigidity	4.96 GV
Altitude	103 meters
Type of Equipment and Configuration	Two inclined counter telescopes, without lead shielding, directed to North and South at 45° angles. Each telescope consists of 3 equal trays of 10 counters.
Period of Operation	October 7, 1957-November 3, 1958
Principal Investigator	Mr. J. W. F. Juritz Physics Department University of Cape Town Private Bay Rondebosch, Cape Town, South Africa

Comments:

Data deposited in the World Data Centers.

Station Name	CHACALTAYA, BOLIVIA
Alternate Names	Bolivia
Geographic Coordinates	16°19' S, 68°9' W
Vertical Cutoff Rigidity	13.10 GV
Altitude	5220 meters
Type of Equipment and Configuration	Cubical muon telescope
Period of Operation	August 1957-January 1960
Principal Investigator	Prof. Narayan Nerurkar c/o Prof. M.G.K. Menon Tata Institute of Fundamental Research Homi-Bhaba Route Colaba, Bombay 5, India

Comments:

Data for the following periods deposited in the World Data Centers:

November 1957-October 1958
February-April 1959

Closed Muon Detectors

Station Name	CHACALTAYA, BOLIVIA
Alternate Names	Bolivia
Geographic Coordinates	16°19' S, 68°9' W
Vertical Cutoff Rigidity	13.10 GV
Altitude	5220 meters
Type of Equipment and Configuration	Narrow angle muon telescope
Period of Operation	August 1957-January 1960
Principal Investigator	Prof. Narayan Nerurkar c/o Prof. M.G.K. Menon Tata Institute of Fundamental Research Homi-Bhaba Route Colaba, Bombay 5, India

Comments:

Data deposited in the World Data Centers as follows:

Oblique muon telescope (west):	November 1957-October 1958
Vertical muon telescope:	March-May 1958 August-December 1958

Station Name	CHACALTAYA, BOLIVIA
Alternate Names	Bolivia
Geographic Coordinates	16°19' S, 68°9' W
Vertical Cutoff Rigidity	13.10 GV
Altitude	5243 meters
Type of Equipment and Configuration	Vertical GM counter telescope and East, West pointing scintillation coincidence telescopes (see below)
Period of Operation	1959-1961 (see below)
Principal Investigator	Dr. V. H. Regener Dept. of Physics and Astronomy The University of New Mexico 800 Yale Boulevard, N.E. Albuquerque, New Mexico 87106, U.S.A.

Comments:

The vertical GM counter telescope operated for 110 days (not continuous) in 1959.

The East-West pointing telescopes operated for 140 days (not continuous) in 1960-61.

Closed Muon Detectors

Station Name	CHRISTCHURCH, NEW ZEALAND
Geographic Coordinates	43.55° S, 172.60° E
Vertical Cutoff Rigidity	2.71 GV
Altitude	8 meters
Type of Equipment and Configuration	Cubical muon telescope
Period of Operation	October 1957-March 1959
Principal Investigator	C. A. Roper DSIR Geophysical Observatory Box 231 Christchurch, New Zealand

Comments:

Data deposited in the World Data Centers.

Station Name	CHURCHILL, CANADA
Alternate Names	Fort Churchill
Geographic Coordinates	58°48' N, 94°6' W
Vertical Cutoff Rigidity	0.21 GV
Altitude	39 meters
Period of Operation	May 1, 1957-December 31, 1964
Principal Investigator	Dr. J. Katzman (retired)
Name and Address of Person to Contact for Information	Dr. M. Bercovitch Division of Physics National Research Council of Canada Sussex Drive, Ontario, Canada

Comments:

Data deposited in the World Data Centers.

Data from July 1, 1957 to December 31, 1958 published in "Cosmic-Ray Intensity During the International Geophysical Year", No. 5, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, July 1961.

Closed Muon Detectors

Station Name	COLOMBO, CEYLON
Geographic Coordinates	$6^{o}54'$ N, $79^{o}52'$ E
Vertical Cutoff Rigidity	17.46 GV
Altitude	Sea level
Type of Equipment and Configuration	Cubical muon telescope with 10 cm lead filter
Period of Operation	July 1, 1957-December 31, 1958
Principal Investigator	Dr. T. Thambyahpillai Department of Physics Imperial College London SW7, U.K.

Comments:

Data for July 1 to December 31, 1957 deposited in the World Data Centers.

Station Name	DARJEELING, INDIA
Geographic Coordinates	$27^{o}3'$ N, $88^{o}16'$ E
Vertical Cutoff Rigidity	15.35 GV
Altitude	Approximately 2200 meters
Type of Equipment and Configuration	Two cubical muon telescopes
Period of Operation	July 1957-November 1959
Principal Investigator	Dr. Indralal Chakraborty (deceased)
Person and Address to Contact for Information	Director Bose Institute 93/1, Acharya Prafulla Chandr Road Calcutta 9, India

Comments:

Data deposited in the World Data Centers.

Closed Muon Detectors

Station Name	EL INFIERNILLO, CHILE
Geographic Coordinates	33°10' S, 70°17' W
Vertical Cutoff Rigidity	11.45 GV
Altitude	4343 meters
Type of Equipment and Configuration	Narrow angle muon telescope
Periods of Operation	June 16, 1964-December 1964 June 1966-May 1967
Principal Investigator	Prof. Gabriel Alvial Centro de Radiación Cósmica (Facultad de Ciencias Físicas y Matemáticas) Universidad de Chile Casilla 1314, Santiago de Chile, Chile

Comments:

Data to be deposited in the World Data Centers.

Station Name	GULMARG, INDIA
Geographic Coordinates	34.07° N, 74.42° .
Vertical Cutoff Rigidity	11.91 GV
Altitude	2742 meters
Type of Equipment and Configuration	Cubical on telescope
Period of Operation	January-March 1958
Principal Investigator	Dr. K ra Ob vatory arg, Kashmir, India

Comments:

Data deposited in the World Data Centers.

Closed Muon Detectors

Station Name	HAIFA, ISRAEL
Geographic Coordinates	32.82° N, 34.98° E
Vertical Cutoff Rigidity	10.96 GV
Altitude	193 meters
Type of Equipment and Configuration	Cubical muon telescope
Period of Operation	1957-1960 (see comments)
Principal Investigator	Prof. Kurt Sitte Department of Physics University of Freiburg Hermann-Herder Strasse 3 78 Freiburg I. BR, F.R.G.

Comments:

It was not possible to obtain the exact period of operation.

Data have been deposited in the World Data Centers for the period March 1958 to February 1959.

Station Name	HEISS ISLAND, U.S.S.R.
Geographic Coordinates	80°37' N, 58°03' E
Vertical Cutoff Rigidity	0.10 GV
Altitude	20 meters
Periods of Operation	March 1, 1958-October 1, 1963 December 1, 1963-June 1, 1965 July 1, 1965-January 1, 1967
Principal Investigator	Dr. L. L. Lazutin Polar Geophysical Institute Akademgorodok, Apatity Murmansk Region, U.S.S.R.

Comments:

Data deposited in the World Data Centers.

Closed Muon Detectors

Station Name	HERMANUS, SOUTH AFRICA
Geographic Coordinates	$34^{\circ}25.5'$ S, $19^{\circ}13.5'$ E
Vertical Cutoff Rigidity	4.90 GV
Altitude	26 meters
Type of Equipment and Configuration	Duplicate standard muon telescopes as recommended in CSAGI Bulletin No. 6, 1956
Period of Operation	June 1, 1957-May 27, 1962
Principal Investigator	Mr. A. M. van Wijk Magnetic Observatory Hermanus, Republic of South Africa

Comments:

Data published in the Monthly Hermanus Cosmic Ray Bulletin

Data from July 1, 1957 to December 31, 1958 published in "Cosmic-Ray Intensity During the International Geophysical Year", No. 5, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, July 1961.

Station Name	HERSTMONCEUX, ENGLAND
Geographic Coordinates	$50^{\circ}52'$ N, $0^{\circ}20'$ E
Vertical Cutoff Rigidity	2.92 GV
Altitude	23 meters
Type of Equipment and Configuration	Cubical muon telescope with 10 cm. lead filter
Period of Operation	April 1, 1957-December 31, 1959
Principal Investigator	Mr. D. R. Palmer R. G. O. Herstmonceux Castle Herstmonceux, Sussex, U.K.

Comments:

Data deposited in the World Data Centers.

Closed Muon Detectors

Station Name	INVERCARGILL, NEW ZEALAND
Alternate Names	Awarua
Geographic Coordinates	46.60° S, 168.40° E
Vertical Cutoff Rigidity	1.86 GV
Altitude	Sea level
Type of Equipment and Configuration	Cubical muon telescope
Period of Operation	July 1958-December 1958
Principal Investigator	C. A. Roper DSIR Geophysical Observatory P.O. Box 231 Christchurch, New Zealand

Comments:

Data deposited in the World Data Centers.

Station Name	IRKUTSK, U.S.S.R.
Geographic Coordinates	52°28' N, 104°02' E
Vertical Cutoff Rigidity	3.66 GV
Altitude	433 meters
Periods of Operation	November 1957-October 1959 December 1959-November 1960 March 1961-May 1962 October 1962-September 1968
Principal Investigator	Dr. A. A. Luzov Sib. IZMIRAN Lenin Street, 5 Irkutsk, U.S.S.R.

Comments:

Data deposited in the World Data Centers.

Station Name	KERGUELEN
Alternate Names	Port aux Francais
Geographic Coordinates	49°21' S, 70°13' E
Vertical Cutoff Rigidity	1.19 GV
Altitude	Sea level
Period of Operation	July 13, 1957-June 30, 1962
Principal Investigator	Dr. A. Freon (deceased)
Person and Address to Contact for Information	Dr. M. G. Milleret Laboratoire de Physique Cosmique Fort de Verrieres Route des Gatines 91 Verrieres-Le-Buisson, France

Comments:

Data deposited in the World Data Centers.

Closed Muon Detectors

Station Name	KIEL, F.R.G.
Geographic Coordinates	54.3° N, 10.1° E
Vertical Cutoff Rigidity	2.29 GV
Altitude	54 meters
Type of Equipment and Configuration	Cubical counter telescope with 10 cm lead
Period of Operation	July 1, 1957-January 31, 1970
Principal Investigator	Prof. Dr. E. Bagge Institut für Reine und Angewandte Kernphysik der Christian-Albrechts-Universität 23 Kiel, F.R.G.

Comments:

Data deposited in the World Data Centers.

Station Name	KIRUNA, SWEDEN
Geographic Coordinates	67°50' N, 20°26' E
Vertical Cutoff Rigidity	0.54 GV
Altitude	390 meters
Type of Equipment and Configuration	Vertical muon telescope with GM counters and cubical geometry
Period of Operation	November 27, 1956-August 31, 1967
Principal Investigator	Prof. A. E. Sandström Uppsala University Box 516 751 20 Uppsala 1, Sweden

Comments:

Data deposited in the World Data Centers.

Data from July 1, 1957 to December 31, 1958 published in "Cosmic-Ray Intensity During the International Geophysical Year", No. 5, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, July 1961.

Closed Muon Detectors

Station Name	KIRUNA, SWEDEN
Geographic Coordinates	67°50' N, 20°26' E
Vertical Cutoff Rigidity	0.54 GV
Altitude	390 meters
Type of Equipment and Configuration	Inclined muon telescopes (North and South) with GM counters (see Tellus, 14, 19-32, 1962).
Periods of Operation	July 13, 1957-August 31, 1968 (South) August 10, 1957-August 31, 1968 (North)
Principal Investigator	Prof. A. E. Sandström Uppsala University Box 516 751 20 Uppsala 1, Sweden

Comments:

For data, apply to the principal investigator; data not deposited in the World Data Centers.

Station Name	KODAIKANAL, INDIA
Geographic Coordinates	10°14' N, 77°29' E
Vertical Cutoff Rigidity	17.47 GV
Altitude	2443 meters
Period of Operation	July 1957-December 1963
Principal Investigator	Prof. V. Sarabhai (deceased)
Name and Address of Person to contact for information	Prof. U. R. Rao Physical Research Laboratory Ahmedabad 9, India

Comments:

Data deposited in the World Data Centers.

Data from July 1, 1957 to December 31, 1958 published in "Cosmic-Ray Intensity During the International Geophysical Year" No. 5, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, July 1961.

Closed Muon Detectors

Station Name	KOENJI, JAPAN
Alternate Names	Mabashi
Geographic Coordinates	35°42.4' N, 139°38.7' E
Vertical Cutoff Rigidity	11.58 GV
Altitude	42 meters
Period of Operation	October 1, 1956-October 31, 1959
Principal Investigator	Dr. M. Kitamura Meteorological Research Institute 35-8, Koenji-Kita-4, Suginami Tokyo, Japan

Comments:

Data deposited in the World Data Centers.

Station Name	KÜHLUNGSBORN, G.D.R.
Geographic Coordinates	54°07' N, 11°46' E
Vertical Cutoff Rigidity	2.43 GV
Altitude	70 meters
Period of Operation	July 1, 1957-December 31, 1967
Principal Investigator	Dr. R. Knuth Observatory Neustrelitz 208 Neustrelitz 5 Kalkhorstweg, G.D.R.

Comments:

Data deposited in the World Data Centers.

Data published in "Geophysikalische Messreihen des Observatoriums für Ionosphärenforschung Kühlungsborn".

Closed Muon Detectors

Station Name	LAE, NEW GUINEA
Geographic Coordinates	$6^{\circ}44'$ S, $147^{\circ}00'$ E
Vertical Cutoff Rigidity	15.52 GV
Altitude	Sea level
Type of Equipment and Configuration	Vertical muon telescope
Period of Operation	July 1, 1957-November 1969
Principal Investigator	Dr. A. G. Fenton Physics Department University of Tasmania Box 252C, G.P.O. Hobart, Tasmania 7001, Australia

Comments:

Equipment was in operation over 2 time intervals:

July 1, 1957-November 30, 1960
September 1, 1962-November 1969

Data until February 1966 deposited in the World Data Centers. There are no present plans to submit the remaining data.

Data from July 1, 1957 to December 31, 1958 published in "Cosmic-Ray Intensity During the International Geophysical Year", No. 5, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, July 1961.

Station Name	LIMEIL, FRANCE
Geographic Coordinates	$48^{\circ}44'$ N, $2^{\circ}25'$ E
Vertical Cutoff Rigidity	3.64 GV
Altitude	50 meters
Period of Operation	November 1957-December 1960
Principal Investigator	Dr. J. P. Legrand Groupe de Recherches Ionosphériques 4 rue Neptune 94 Saint-Maur, France

Comments:

Data deposited in the World Data Centers.

Closed Muon Detectors

Station Name	LINCOLN, U.S.A.
Geographic Coordinates	40°49' N, 96°41' W
Vertical Cutoff Rigidity	2.22 GV
Altitude	350 meters
Type of Equipment and Configuration	Cubical muon Telescope. Vertical narrow angle muon telescope.
Period of Operation	May 1957-May 1962
Principal Investigator	Prof. R. L. Chasson Department of Physics University of Denver Denver, Colorado 80210, U.S.A.

Comments:

Data deposited in the World Data Centers.

Station Name	LINDAU/HARZ, F.R.G.
Geographic Coordinates	51°36' N, 10°6' E
Vertical Cutoff Rigidity	3.00 GV
Altitude	140 meters
Type of Equipment and Configuration	Muon telescope counter
Period of Operation	May 1, 1959-July 31, 1967
Principal Investigator	Prof. Dr. A. Ehmert (deceased)
Person and Address to Contact for Information	Dr. V. J. Kisselbach Institut für Stratosphären-Physik Max Planck Institut für Aeronomie 3411 Lindau/Harz PB 40, F.R.G.

Comments:

Data deposited in the World Data Centers.

Station Name	LISBON, PORTUGAL
Geographic Coordinates	38°48' N, 9°09' W
Vertical Cutoff Rigidity	6.65 GV
Altitude	81 meters
Type of Equipment and Configuration	Cubical muon telescope with GM tubes
Period of Operation	January 1, 1958-April 30, 1961
Address for Information	Servico Meteorologico Nacional Rua Saraiva de Carvalho, 2 Lisbon 3, Portugal

Comments:

Data for 1958 and 1959 deposited in the World Data Centers.

Data published in "Boletim Geoelectrico", Servico Meteorologico Nacional, Rua Saraiva de Carvalho, 2, Lisboa 3, Portugal.

Closed Muon Detectors

Station Name	LOMNICKÝ ŠTÍT, CZECHOSLOVAKIA
Geographic Coordinates	49.20° N, 20.22° E
Vertical Cutoff Rigidity	4.00 GV
Altitude	2632 meters
Periods of Operation	January 1958-December 1960 January 1964-August 1967
Principal Investigator Name and Address of Person to Contact for Information	Dr. Pavel Chaloupka Dr. S. Fischer Institut of Experimental Physics of the Slovak Academy of Sciences Cosmic Ray Laboratory Lomnický Štít p. Tatranská Lomnica, Czechoslovakia

Comments:

Data deposited in the World Data Centers.

Station Name	LONDON, ENGLAND
Geographic Coordinates	51°32' N, 00°06' W
Vertical Cutoff Rigidity	2.73 GV
Altitude	12 meters
Type of Equipment and Configuration	Wide-angle total ionizing intensity telescope
Period of Operation	July 1, 1957-December 31, 1958
Principal Investigator	Prof. H. Elliot Department of Physics Imperial College London SW7, U.K.

Comments:

Data deposited in the World Data Centers.

Closed Muon Detectors

Station Name	MACAU
Alternate Names	Servico Meteorológico de Macau
Geographic Coordinates	22°12' N, 113°33' E
Vertical Cutoff Rigidity	16.28 GV
Altitude	65 meters
Type of Equipment and Configuration	Cubical muon telescope
Period of Operation	July 1, 1957 - October 18, 1964
Principal Investigator	Dr. Bento Rodriques
Name and Address of Person to Contact for Information	Dr. Fernando Vidal Lima, Director Servico Meteorológico de Macau Caixa Postal 467 Provincia Portuguesa de Macau SE Asia

Comments:

Data from July 1, 1957 to March 1960 deposited in the World Data Centers.

Station Name	MACQUARIE ISLAND
Geographic Coordinates	54°29' S, 158°58' E
Vertical Cutoff Rigidity	0.55 GV
Altitude	Sea level
Type of Equipment and Configuration	Vertical muon telescope
Period of Operation	December 13, 1956-February 28, 1959
Principal Investigator	Dr. A. G. Fenton Physics Department University of Tasmania Box 252 C, G.P.O. Hobart, Tasmania 7001, Australia

Comments:

The instrument was arranged so that count rates of particles passing through 10 cm and 20 cm of lead were obtained separately.

All data deposited in the World Data Centers.

Data were published in "ANARE Data Reports", Antarctic Division, 568 St. Kilda Road, Melbourne, Victoria 3004, Australia.

Data from July 1, 1957 to December 31, 1958 published in "Cosmic-Ray Intensity During the International Geophysical Year", No. 5, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, July 1961.

Closed Muon Detectors

Station Name	MACUL STATION, CHILE
Alternate Names	Santiago
Geographic Coordinates	33°27' S, 70°36' W
Vertical Cutoff Rigidity	11.41 GV
Altitude	570 meters
Type of Equipment and Configuration	Narrow angle muon telescope (see below)
Period of Operation	February 1, 1958-February 1967
Principal Investigator	Prof. Gabriel Alvial Centro de Radiación Cósmica (Facultad de Ciencias Físicas y Matemáticas) Universidad de Chile Casilla 1314, Santiago de Chile, Chile

Comments:

From February 1, 1958 to April 1, 1965, the telescope was operated with 10 cm of lead; from April 1, 1965 until February 1967, it was unshielded.

Data from July 1958 until December 1961 were deposited in the World Data Centers. The remaining data will be submitted to the World Data Centers.

Station Name	MAKAPUU POINT, U.S.A.
Alternate Names	Makapuu Point Solar Observatory Hawaii
Geographic Coordinates	21°18' N, 157°39' W
Vertical Cutoff Rigidity	13.23 GV
Altitude	91 meters
Period of Operation	July 1, 1957-December 31, 1958
Principal Investigator	Dr. Robert B. Brode (retired)
Name and Address of Person to Contact for Information	Prof. Robert R. Brown Department of Physics University of California Berkeley, California 94720, U.S.A.

Comments:

Data deposited in the World Data Centers.

Data from July 1, 1957 to December 31, 1958 published in "Cosmic-Ray Intensity During the International Geophysical Year", No. 5, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, July 1961.

Closed Muon Detectors

Station Name	MAKERERE, UGANDA
Alternate Names	Kampala
Geographic Coordinates	0°20.2' N, 32°33.8' E
Vertical Cutoff Rigidity	14.98 GV
Altitude	1196 meters
Type of Equipment and Configuration	Cubical muon telescope
Period of Operation	July 15, 1957-December 1959
Principal Investigator	Prof. D. M. Thomson Physics Department Makerere University College P.O. Box 7062 Kampala, Uganda, E. Africa

Comments:

Data deposited in the World Data Centers.

Data from July 15, 1957 to December 31, 1958 published in "Cosmic-Ray Intensity During the International Geophysical Year", No. 5, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, July 1961.

Station Name	MAKERERE, UGANDA
Alternate Names	Kampala
Geographic Coordinates	0°20.2' N, 32°33.8' E
Vertical Cutoff Rigidity	14.98 GV
Altitude	1196 meters
Type of Equipment and Configuration	East-west muon telescope
Period of Operation	February 1965-June 1969
Principal Investigator	Prof. D. M. Thomson Physics Department Makerere University College P.O. Box 7062 Kampala, Uganda, E. Africa

Comments:

No current plans to deposit the data in the World Data Centers.

Closed Muon Detectors

Station Name	MEUDON, FRANCE
Alternate Names	Chalais-Meudon, France
Geographic Coordinates	48°49' N, 2°15' E
Vertical Cutoff Rigidity	3.60 GV
Altitude	110 meters
Period of Operation	February 1961-March 1964
Principal Investigator	Dr. J. P. Legrand Groupe de Recherches Ionosphériques 4 rue Neptune 94 Saint-Maur, France

Comments:

Data deposited in the World Data Centers.

Station Name	MIT, U.S.A.
Alternate Names	Massachusetts Institute of Technology
Geographic Coordinates	42.37° N, 71.10° W
Vertical Cutoff Rigidity	1.52 GV
Altitude	Sea level
Period of Operation	1959-1964 (see comments)
Principal Investigators	Prof. K. G. McCracken Division of Mineral Physics CSIRO P.O. Box 136 North Ryde, N.S.W. 2113, Australia Dr. Ricardo A.R. Palmeira The University of Texas at Dallas Box 30365 Dallas, Texas 75230 U.S.A. Prof. U. R. Rao Physical Research Laboratory Navrangpura Ahmedabad 9, India Dr. M. S. Dhanju Willow Run Laboratories Building 2041 University of Michigan Ann Arbor, Michigan 48104 U.S.A.

Comments:

This experimental equipment was operated intermittently between approximately 1959 and 1964 by a number of investigators.

The data have not been deposited in the World Data Centers and are not on file at MIT. The only data available, if any, would have been retained by the principal investigators.

Closed Muon Detectors

Station Name	MOSCOW, U.S.S.R.
Alternate Names	IZMIRAN
Geographic Coordinates	55°28' N, 37°19' E
Vertical Cutoff Rigidity	2.46 GV
Altitude	200 meters
Type of Equipment and Configuration	Narrow-angle crossed telescope
Periods of Observations	February 1955-October 1955 February 1960-April 1961 July 1963-August 1964
Principal Investigator	Dr. O. I. Inosemtseva IZMIRAN Institute of Terrestrial Magnetism Ionosphere and Radiowave Propagation Academy of Sciences of The U.S.S.R. p/o Akademgorodok, Moscow Region, U.S.S.R.

Comments:

Data not deposited in the World Data Centers.

Station Name	MOSCOW, U.S.S.R.
Alternate Names	IZMIRAN
Geographic Coordinates	55°28' N, 37°19' E
Vertical Cutoff Rigidity	2.46 GV
Altitude	200 meters
Periods of Operation	June 1957-December 1961 March 1962-May 1966 July 1966-October 1967 December 1967-January 1968
Principal Investigator	Dr. Y. L. Blokh IZMIRAN Institute of Terrestrial Magnetism Ionosphere and Radiowave Propagation Academy of Sciences of The U.S.S.R. p/o Akademgorodok, Moscow Region, U.S.S.R.

Comments:

Data deposited in the World Data Centers.

Closed Muon Detectors

Station Name	MURCHISON BAY
Geographic Coordinates	$80^{\circ}03'$ N, $18^{\circ}15'$ E
Vertical Cutoff Rigidity	0.06 GV
Altitude	Sea level
Type of Equipment and Configuration	Vertical muon telescope with GM counters and cubical geometry
Period of Operation	August 23, 1957-April 30, 1959
Principal Investigator	Prof. A. E. Sandström Uppsala University Box 516 751 20 Uppsala 1, Sweden

Comments:

Data deposited in the World Data Centers.

Station Name	MURCHISON BAY
Geographic Coordinates	$80^{\circ}03'$ N, $18^{\circ}15'$ E
Vertical Cutoff Rigidity	0.06 GV
Altitude	Sea level
Type of Equipment and Configuration	Inclined muon telescopes (East and West) with GM counters (see Tellus, 14, 19-32, 1962).
Period of Operation	September 1, 1957-April 30, 1959
Principal Investigator	Prof. A. E. Sandström Uppsala University Box 516 751 20 Uppsala 1, Sweden

Comments:

For data, apply to principal investigator; data not deposited in the World Data Centers.

Closed Muon Detectors

Station Name	OTTAWA, CANADA
Geographic Coordinates	45°24' N, 75°36' W
Vertical Cutoff Rigidity	1.08 GV
Altitudes	101 meters (December 1954-August 1960) 57 meters (August 1960-September 30, 1971)
Type of Equipment and Configuration	Cubical telescope (see comments)
Period of Operation	December 1, 1954-September 30, 1971
Principal Investigators	From December 1954 to August 1971: Dr. J. Katzman (retired) From August 1971 to October 1971: Dr. M. Bercovitch Division of Physics National Research Council of Canada Sussex Drive Ottawa, Ontario, Canada

Comments:

In late 1960 the telescope was moved to a new site. Normalization factors for this time period are on file at World Data Center A.

On January 1, 1970 the geiger counter telescope was replaced by 2 cubical scintillator telescopes, each with an area of one square meter.

Data deposited in the World Data Centers.

Station Name	OULU, FINLAND
Alternate Names	University of Oulu
Geographic Coordinates	65°1' N, 25°30' E
Vertical Cutoff Rigidity	0.81 GV
Altitude	15 meters
Type of Equipment and Configuration	Crossed muon telescope
Period of Operation	April 1, 1964-May 1966
Principal Investigator	Dr. Pekka Tanskanen Department of Physics University of Oulu Kontinkangas, Oulu, Finland

Comments:

Data deposited in the World Data Centers.

Closed Muon Detectors

Station Name	PIC DU MIDI, FRANCE
Geographic Coordinates	42°56' N, 00°15' E
Vertical Cutoff Rigidity	5.36 GV
Altitude	2860 meters
Period of Operation	December 20, 1957-December 31, 1965
Principal Investigator	Dr. A. Freon (deceased)
Person and Address to Contact for Information	Dr. M. G. Milleret Laboratoire de Physique Cosmique Fort de Verrieres Route des Gatines 91 Verrieres-Le-Buisson, France

Comments:

Data deposited in the World Data Centers.

Station Name	PRAGUE, CZECHOSLOVAKIA
Geographic Coordinates	50°05' N, 14°25' E
Vertical Cutoff Rigidity	3.53 GV
Altitude	215 meters
Period of Operation	January 1958-December 1961
Principal Investigator	Dr. Jaroslav Pernegr
Address for Information	Institut of Experimental Physics Cosmic Ray Laboratory Lomnický Štít p. Tatranská Lomnica, Czechoslovakia

Comments:

Data deposited in the World Data Centers.

Closed Muon Detectors

Station Name	RESOLUTE, CANADA
Geographic Coordinates	74°43' N, 94°59' W
Vertical Cutoff Rigidity	0.00 GV
Altitude	17 meters
Period of Operation	October 1, 1956-July 31, 1966
Principal Investigator	Dr. J. Katzman (retired)
Name and Address of Person to Contact for Information	Dr. M. Bercovitch Division of Physics National Research Council of Canada Sussex Drive Ottawa, Ontario, Canada

Comments:

Data deposited in the World Data Centers.

Data from July 1, 1957 to December 31, 1958 published in "Cosmic-Ray Intensity During the International Geophysical Year", No. 5, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, July 1961.

Station Name	ROME, ITALY
Alternate Names	Station SVIRCO, Roma
Geographic Coordinates	41°54' N, 12°31' E
Vertical Cutoff Rigidity	6.32 GV
Altitude	60 meters
Type of Equipment and Configuration	Semi-cubical GM telescopes (for details please contact the principal investigator)
Period of Operation	January 1, 1958-November 30, 1964
Principal Investigators	Prof. Francesca Bachelet and Prof. A. Maria Conforto Istituto di Fisica dell'Università Rome, Italy

Comments:

Data deposited in the World Data Centers.

Closed Muon Detectors

Station Name	SEOUL, KOREA
Geographic Coordinates	37°35' N, 127°03' E
Vertical Cutoff Rigidity	10.79 GV
Altitude	50 meters
Period of Operation	February 1964-December 1965
Principal Investigator	Dr. Nyong D. Kwon Department of Physics College of Liberal Arts and Sciences Seoul National University Seoul, Korea

Comments:

Data deposited in the World Data Centers.

Data published by the Korean National Committee for the International Years of the Quiet Sun in "IQSY Reports in Korea, Meteorology Geomagnetism, Solar Activity, Cosmic Rays".

Station Name	SIMFEROPOL, U.S.S.R.
Geographic Coordinates	44°44' N, 34°00' E
Vertical Cutoff Rigidity	5.51 GV
Altitude	570 meters
Periods of Operation	February 1, 1958-June 1, 1958 September 1, 1958-January 1, 1960 February 1, 1961-October 1, 1961 January 1, 1964-January 1, 1965
Principal Investigator	Dr. A. Stepanjan Krimskaya Astrofisichiskaya Observatoria p/o Nauchny Bahchisaray, Krimsky Region. U.S.S.R.

Comments:

Data deposited in the World Data Centers.

Closed Muon Detectors

Station Name	SOFIA, BULGARIA
Geographic Coordinates	42.67° N, 23.30° E
Vertical Cutoff Rigidity	6.15 GV
Altitude	518 meters (see comments)
Type of Equipment and Configuration	Oblique muon telescope pointing North and South.
Period of Operation	August 1957-December 1958 (see comments)
Principal Investigator	Not available

Comments:

It was not possible to obtain any information on the status of this station beyond that which is available at the World Data Centers. Since neither WDCA nor WDC-C2 has received any data from the Sofia muon detector since December 1958, it was decided to consider that the operation of this detector had ceased. The dates of operation were derived from the data deposited in the data centers for the following periods:

August 1957-August 1958
December 1958

It is assumed that the altitude of the muon detector was the same as the altitude of Sofia which is approximately 518 meters.

Station Name	SYOWA, ANTARCTICA
Alternate Names	Syowa Base Syowa Station
Geographic Coordinates	69°00' S, 39°36' E
Vertical Cutoff Rigidity	0.42 GV
Altitude	15 meters
Periods of Operation	March 1, 1959-June 30, 1959 July 1, 1961-December 31, 1961
Principal Investigator	Dr. Y. Miyazaki Cosmic Ray Laboratory The Institute of Physical and Chemical Research 7-13, Kaga-1, Itabashi Tokyo, Japan

Comments:

Data deposited in the World Data Centers.

Data for July 9, 1961 through December 31, 1961 published in "Cosmic-Ray Intensity During the Post International Geophysical Cooperation", No. 8, IGY World Data Center C2, Institute of Physical and Chemical Research, Itabashi, Tokyo, Japan, October 1963.

Closed Muon Detectors

Station Name	THULE, GREENLAND
Alternate Names	Geopole Station
Geographic Coordinates	76°35' N, 68°25' W
Vertical Cutoff Rigidity	0.00 GV
Altitude	260 meters
Type of Equipment and Configuration	Cubical muon telescope
Period of Operation	January 1958-June 1962
Principal Investigator	Dr. S. Fred Singer Prof. of Environmental Service University of Virginia Charlottesville, Virginia 22903, U.S.A.

Comments:

It was not possible to determine the exact dates of operation. These dates are derived from the data which have been deposited in the World Data Centers.

Station Name	TOKYO-ITABASHI, JAPAN
Geographic Coordinates	35°45' N, 139°43' E
Vertical Cutoff Rigidity	11.61 GV
Altitude	20 meters
Period of Operation	July 1957-December 1971
Principal Investigator	Dr. Y. Miyazaki Cosmic Ray Laboratory The Institute of Physical and Chemical Research 7-13, Kaga-1, Itabashi-ku Tokyo, Japan

Comments:

Data deposited in the World Data Centers.

Data published in the Japanese Cosmic-Ray Intensity data books as follows:

July 1, 1957-December 31, 1958	Book No. 4, March 1961
January 1, 1959-December 31, 1959	Book No. 7, March 1963
January 1, 1960-December 31, 1960	Book No. 6, March 1962
January 1, 1961-December 31, 1961	Book No. 8, October 1963
January 1, 1962-December 31, 1962	Book No. 9, October 1964

The data for the narrow angle vertical and inclined telescopes, which were assembled as part of the telescope system, have not been processed for general use except the data published in these data books. See the individual data books for specific details.

Closed Muon Detectors

Station Name	TROMSO, NORWAY
Geographic Coordinates	69°42' N, 18°54' E
Vertical Cutoff Rigidity	0.41 GV
Altitude	Sea level
Period of Operation	September 1957-March 1960
Principal Investigator	Prof. Dr. B. Trumpy Department of Physics University of Bergen Allegt. 53-55, Bergen, Norway

Comments:

Data not deposited in the World Data Centers.

Station Name	UPPSALA, SWEDEN
Geographic Coordinates	59°51' N, 17°35' E
Vertical Cutoff Rigidity	1.45 GV
Altitude	Sea level
Type of Equipment and Configuration	Inclined muon telescopes with GM counters, looking North, South, East and West (see Tellus, 14, 19-32 1962)
Periods of Operation	September 1, 1956-September 18, 1968 (E and W) January 18, 1961-September 18, 1968 (N and S)
Principal Investigator	Prof. A. E. Sandstrom Uppsala University Box 516 751 20 Uppsala 1, Sweden

Comments:

For data contact principal investigator; data not deposited in the World Data Centers.

Closed Muon Detectors

Station Name	UPPSALA, SWEDEN
Geographic Coordinates	59°51' N, 17°35' E
Vertical Cutoff Rigidity	1.43 GV
Altitude	Sea level
Type of Equipment and Configuration	Vertical muon telescope with GM counters and cubical geometry.
Period of Operation	June 1, 1957-February 17, 1966
Principal Investigator	Prof. A. E. Sandström Uppsala University Box 516 751 20 Uppsala 1, Sweden

Comments:

Data deposited in the World Data Centers.

Station Name	USHUAIA, ARGENTINA
Geographic Coordinates	54°48' S, 68°19' W
Vertical Cutoff Rigidity	5.68 GV
Altitude	Sea level
Type of Equipment and Configuration	Muon telescope system consisting of 2 cubical telescopes, 2 vertical narrow angle telescopes and 2 inclined narrow angle telescopes. The direction of maximum sensitivity of the inclined telescopes was 45°. The entire system was mounted on a rotating platform. Initially, the system was rotated weekly with the inclined telescopes pointed North-South one week and East-West the second week. Later the interval between rotations was lengthened to 6 months.
Period of Operation	November 1957-November 1960
Principal Investigator	Dr. Horacio S. Ghielmetti Centro Nacional de Radiación Cósmica Perú 272 Buenos Aires, Argentina

Comments:

Barometric coefficients on file at the World Data Centers.

Data not deposited in the World Data Centers.

Closed Muon Detectors

Station Name	VOSTOK, ANTARCTICA
Geographic Coordinates	78°27' S, 106°52' E
Vertical Cutoff Rigidity	0.00 GV
Altitude	3400 meters
Type of Equipment and Configuration	Crossed muon telescope
Periods of Operation	September 1, 1965-April 1966 June 1966 August 1966-December 1966
Principal Investigator	Dr. N. S. Kaminer IZMIRAN Institute of Terrestrial Magnetism Ionosphere and Radiowave Propagation Academy of Sciences of The U.S.S.R. p/o Akademgorodok, Moscow Region, U.S.S.R.

Comments:

Data not deposited in the World Data Centers.

Station Name	WEISSENAU, F.R.G.
Geographic Coordinates	47°48' N, 9°30' E
Vertical Cutoff Rigidity	4.16 GV
Altitude	427 meters
Period of Operation	June 1, 1957-March 31, 1959
Principal Investigator	Prof. Dr. A. Ehmert (deceased)
Person and Address to Contact for Information	Dr. V. J. Kisselbach Institut für Stratosphären-Physik Max Planck Institut für Aeronomie 3411 Lindau/Harz PB 40, F. R. G.

Comments:

Data deposited in the World Data Centers.

Data from July 1, 1957 to December 31, 1958 published in "Cosmic-Ray Intensity During the International Geophysical Year", No. 5, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, July 1961.

Closed Muon Detectors

Station Name	WELLINGTON, NEW ZEALAND
Alternate Names	Lower Hutt
Geographic Coordinates	41°13' S, 174°55' E
Vertical Cutoff Rigidity	3.42 GV
Altitude	Sea level
Type of Equipment and Configuration	Narrow angle vertical, East and West muon telescopes
Periods of Operation	Vertical telescope: December 1963 through May 1964 July 1964 November 1964 February 1965 through May 1965 East telescope: December 1963 through May 1964 July 1964 September 1964 February 1965 through June 1965 West telescope: December 1963 through May 1964 July 1964 November 1964 February 1965 through June 1965
Principal Investigator	Mr. H. S. Jansen c/o Institute of Nuclear Sciences Private Bag Lower Hutt, New Zealand

Comments:

Data deposited in the World Data Centers.

Closed Muon Detectors

Station Name	WILKES, ANTARCTICA
Geographic Coordinates	66°15' S, 110°31' E
Vertical Cutoff Rigidity	0.01 GV
Altitude	Sea level
Type of Equipment and Configuration	Cubical muon telescope
Period of Operation	August 1957- . . ember 1958 (see comments)
Principal Investigator	Dr. S. Fred Singer Prof. of Environmental Science University of Virginia Charlottesville, Virginia 22903, U.S.A.

Comments:

It was not possible to determine the exact period of operation. These dates are derived from the data which have been deposited in the World Data Centers for the following periods:

August-October 1957
January-March 1958
May-December 1958

Station Name	ZUGSPITZE, F.R.G.
Geographic Coordinates	47°25' N, 10°59' E
Vertical Cutoff Rigidity	4.24 GV
Altitude	2966 meters
Type of Equipment and Configuration	Cubical muon telescope
Period of Operation	July 4, 1957-February 28, 1960
Principal Investigator	Dr. B. Beckmann FTZ D33 Am Kavalleriesand 3 61 Darmstadt, F.R.G.

Comments:

Data deposited in the World Data Centers.

Data from July 4, 1957 to December 31, 1958 published in "Cosmic-Ray Intensity During the International Geophysical Year", No. 5, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, 1961.

Section B3

Underground Muon Detectors

The following listings contain the pertinent information on the underground muon detectors which have terminated operation. In all cases the underground depth in meters water equivalent (m.w.e.) has been specified. The meters water equivalent are also included in the listing of the calendar of operations for underground muon detectors given in Appendix D.

Closed Underground Muon Detectors

Station Name	CAMBRIDGE TUNNEL, AUSTRALIA
Alternate Names	Cambridge Tunnel (Hobart) Hobart
Geographic Coordinates	42°51' S, 147°25' E
Vertical Cutoff Rigidity	1.91 GV
Altitude	110 meters
Type of Equipment and Configuration	Underground inclined muon telesc ›e; 36 m.w.e. Azimuth = south; zenit' angle = 45°. Wide angle telescope, dimension 1 m^3.
Period of Operation	November 2, 1960 - June 19, 1966
Principal Investigator	Dr. A. G. Fenton Physics Department University of Tasmania Box 252C, G.P.O. Hobart, Tasmania 7001, Aust.alia

Comments:

This observatory is about 6 miles from Hobart and is the only underground site in the area.

Equipment was situated below approximately 36 meters water equivalent of shale (this corrects earlier estimates of 40 m.w.e.).

Data were not submitted to the World Data Centers.

Closed Underground Muon Detectors

Station Name	CAMBRIDGE TUNNEL, AUSTRALIA
Alternate Names	Cambridge Tunnel (Hobart) Hobart
Geographic Coordinates	42°51' S, 147°25' E
Vertical Cutoff Rigidity	1.91 GV
Altitude	110 meters
Type of Equipment and Configuration	Underground inclined muon telescope; 36 m.w.e. Azimuth = north; zenith angle = 30°. Wide angle telescope, dimension 1 m^3.
Period of Operation	January 1, 1961 - April 30, 1963
Principal Investigator	Dr. A. G. Fenton Department of Physics University of Tasmania Box 252C, G.P.O. Hobart, Tasmania 7001, Australia

Comments:

This observatory is about 6 miles from Hobart and is the only underground site in the area.

Equipment was situated below approximately 36 meters water equivalent of shale (this corrects earlier estimates of 40 m.w.e.).

Data were not submitted to the World Data Centers.

Closed Underground Muon Detectors

Station Name	CAMBRIDGE TUNNEL, AUSTRALIA
Alternate Names	Cambridge Tunnel (Hobart) Hobart
Geographic Coordinates	42°51' S, 147°25' E
Vertical Cutoff Rigidity	1.91 GV
Altitude	110 meters
Type of Equipment and Configuration	Underground inclined muon telescope; 36 m.w.e. Azimuth = north; zenith angle = 70°. Narrow angle telescope dimensions 3m X 1m^2.
Period of Operation	December 28, 1964 - April 27, 1967
Principal Investigator	Dr. A. G. Fenton Physics Department University of Tasmania Box 252C, G.P.O. Hobart, Tasmania 7001, Australia

Comments:

This observatory is about 6 miles from Hobart and is the only underground site in the area.

Equipment was situated below approximately 36 meters water equivalent of shale (this corrects earlier estimates of 40 m.w.e.).

Data were not submitted to the World Data Centers.

Station Name	MOSCOW UNIVERSITY, U.S.S.R.
Alternate Names	Moscow, U.S.S.R.
Geographic Coordinates	55°44' N, 37°38' E
Vertical Cutoff Rigidity	2.46 GV
Altitude	200 meters
Type of Equipment and Configuration	Underground telescope, 40 m.w.e.
Periods of Operation	June 1957-December 1957 February 1958-July 1964 October 1964-August 1965 January 1966-July 1966
Principal Investigator	Dr. Y. L. Blokh IZMIRAN Institute of Terrestrial Magnetism Ionosphere and Radiowave Propagation Academy of Sciences of The U.S.S.R. p/o Akademgorodok, Moscow Region, U.S.S.R.

Comments:

Data deposited in the World Data Centers.

Section B4

Ionization Chambers

The following listings contain the pertinent information on the ionization chambers which have terminated operation. The locations of these ionization chambers are shown in Figure B3.

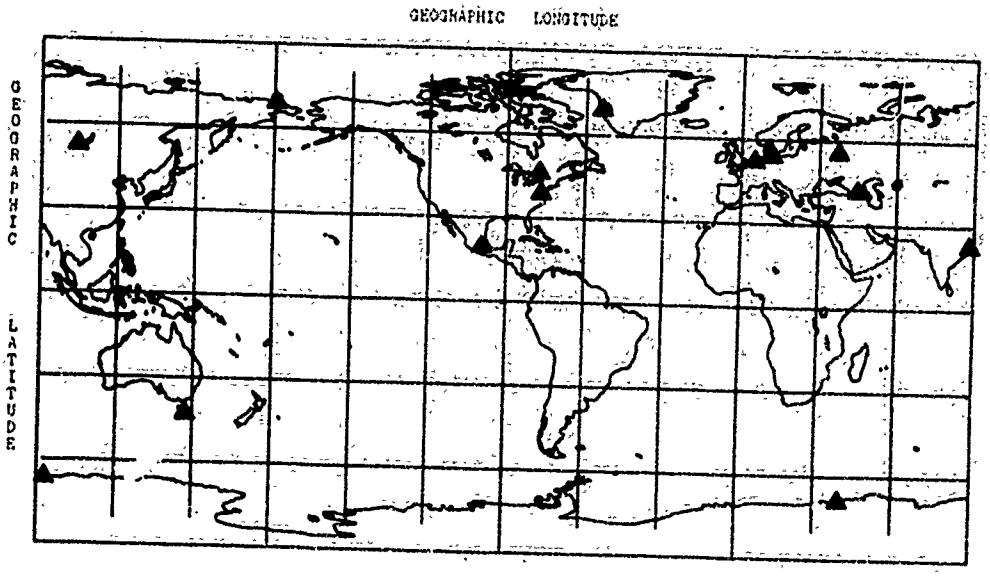

Figure B3. World Map Showing Locations of Closed Ionization Chambers

Closed Ionization Chambers

Station Name	AMSTERDAM, THE NETHERLANDS
Geographic Coordinates	52°13' N, 4°55' E
Vertical Cutoff Rigidity	2.69 GV
Altitude	Sea level
Period of Observations	June 1952-November 26, 1962
Principal Investigator	Dr. H.F. Jongen Natuurkundig Laboratorium Universiteit van Amsterdam Valckenierstraat 65 Amsterdam, The Netherlands

Comments:

Unshielded ionization chamber (32 liters Argon; 39 Atm.)

Data deposited in the World Data Centers

Station Name	CAPE SCHMIDT, U.S.S.R.
Geographic Coordinates	68°55' N, 179°29' W
Vertical Cutoff Rigidity	0.60 GV
Altitude	Sea level
Periods of Operation	November 1958-December 1959 January 1964-May 1969
Principal Investigators	Dr. N.P. Chirkov and Dr. M.L. Basalaev Institute of Cosmophysical Investigations and Aeronomy Lenin Avenue, 61 Yakutsk, Siberia, U.S.S.R.

Comments:

Data deposited in the World Data Centers.

Closed Ionization Chambers

Station Name	CHELTENHAM, U.S.A.
Geographic Coordinates	38.7°N, 76.8° W
Vertical Cutoff Rigidity	2.09 GV
Altitude	72 meters
Period of Observations	March 1, 1937-October 4, 1956
Principal Investigator	Dr. Scott E. Forbush Department of Terrestrial Magnetism Carnegie Institution of Washington 1530 P Street NW Washington, D.C. 20005, U.S.A.

Comments:

Data not deposited in the World Data Centers.

This station preceded the operation of similar equipment at Fredericksburg, U.S.A.

Data published in the "Researches of the Department of Terrestrial Magnetism" Carnegie Institution of Washington Publication 175, Washington, D.C. as follows:

March 1, 1937-December 31, 1955	Vol XX (1957)
January 1, 1956 - October 4, 1956	Vol XXI (1961)

Station Name	DEEP RIVER, CANADA
Geographic Coordinates	46°06' N, 77°30' W
Vertical Cutoff Rigidity	1.02 GV
Altitude	145 meters
Period of Operation	July 1, 1957-December 31, 1958
Principal Investigator	Dr. Hugh Carmichael Atomic Energy of Canada, Ltd. Chalk River, Ontario, Canada

Comments:

Pulse ion chamber, 30 inch diameter with 10 atmospheres argon (Phys. Rev., 99, 1542, 1955). This large ion-chamber was adapted to record ionization bursts due to extensive showers, individual protons, and stars. The number of protons and stars depositing more than 316,000 ion-pairs in the chamber are listed. Approximately 87% are protons.

Data deposited in the World Data Centers.

The data for the above period are published in "Annals of IGY", Vol XXVI, 279, 1963.

Closed Ionization Chambers

Station Name	DEEP RIVER, CANADA
Geographic Coordinates	46° 06' N, 77° 30' W
Vertical Cutoff Rigidity	1.02 GV
Altitude	145 meters
Period of Operation	June 15, 1958-December 31, 1958
Principal Investigator	Dr. Hugh Carmichael Atomic Energy of Canada, Ltd. Chalk River, Ontario, Canada

Comments:

Pulse ion-chamber, 30-inch diameter with 10 atmosphere's argon (see Phys. Rev. 99, 1542, 1955) and 2 cm lead shield. This large ion-chamber was adapted to record ionization bursts due to electron showers generated in a 2 cm thick lead shield. The numbers of electron showers depositing more than 400 Mev in the chamber are listed.

Data deposited in the World Data Centers.

The data for the above period are published in "Annals of IGY" Vol XXVI, 275, 1963.

Station Name	GODHAVN, GREENLAND
Geographic Coordinates	69.2° N, 53.5° W
Vertical Cutoff Rigidity	0.03 GV
Altitude	9 meters
Period of Operation	October 6, 1938-September 21, 1971
Principal Investigators	From Oct. 6, 1938 to June 30, 1959: Dr. Scott E. Forbush Dept. of Terrestrial Magnetism Carnegie Institution of Washington 1530 P Street, NW Washington, D.C. 20005, U.S.A. From July 1, 1959 to September 21, 1971: The Director Danish Meteorological Institute Charlottenlund, Denmark

Comments:

Data for 1957-1959 deposited in the World Data Centers.

Data published in the "Researches of the Department of Terrestrial Magnetism", Carnegie Institution of Washington Publication 175, Washington, D.C. as follows:

October 6, 1938-December 31, 1946	Vol XIV (1948)
January 1, 1947-December 31, 1950	Vol XX (1957)
January 1, 1951-December 31, 1953	Vol XXII (1969)
January 1, 1954-July 31, 1959	Vol XXI (1961)

Closed Ionization Chambers

Station Name	HOBART, AUSTRALIA
Geographic Coordinates	42°54' S, 147°20' E
Vertical Cutoff Rigidity	1.88 GV
Altitude	Sea level
Period of Operation	July 16, 1955 - November 5, 1959
Principal Investigator	Dr. A.G. Fenton Physics Department University of Tasmania Box 252C, G.P.O. Hobart, Tasmania 7001, Australia

Comments:

Data not deposited in the World Data Centers.

Station Name	HOWRAH, INDIA
Geographic Coordinates	22.66° N, 88.32° E
Vertical Cutoff Rigidity	16.43 GV
Altitude	Sea level
Period of Operation	July 1957-December 1958
Principal Investigator	Prof. S. K. Chakrabarty Bengal Engineering College Howrah, India

Comments:

Data deposited in the World Data Centers.

Station Name	IRKUTSK, U.S.S.R.
Geographic Coordinates	52°28' N, 104°02' E
Vertical Cutoff Rigidity	3.66 GV
Altitude	433 meters
Periods of Operation	June 1953-September 1955 April 1958-December 1960
Principal Investigator	Dr. A. A. Luzov Sib. IZMIRAN Lenin Street, 5 Irkutsk, U.S.S.R.

Comments.

Data deposited in the World Data Centers.

Closed Ionization Chambers

Station Name	KÜHLUNGSBORN, G.D.R.
Geographic Coordinates	54°07' N, 11°46' E
Vertical Cutoff Rigidity	2.43 GV
Altitude	70 meters
Period of Operation	January 1, 1957-December 31, 1967
Principal Investigator	Dr. R. Knuth Observatory Neustrelitz 208 Neustrelitz 5 Kalkhorstweg, G.D.R.

Comments:

Data deposited in the World Data Centers.

Data published in "Geophysikalische Messreihen des Observatoriums für Ionosphärenforschung Kühlungsborn".

Station Name	MEXICO CITY, MEXICO
Alternate Names	C.U. (Ciudad Universitaria) Universidad Nacional de Mexico
Geographic Coordinates	19°20' N, 99°11' W
Vertical Cutoff Rigidity	9.53 GV
Altitude	2267 meters
Period of Operation	July 1, 1957-December 31, 1962
Principal Investigators	From July 1957-June 30, 1959: Dr. Scott E. Forbush Dept. of Terrestrial Magnetism Carnegie Institution of Washington 1530 P Street, NW Washington, D.C. 20005, U.S.A. From July 1, 1959-December 31, 1962: Instituto de Geofísica Torre de Ciencias Ciudad Universitaria Mexico 20, D. F., Mexico

Comments:

Data for 1957 and 1958 deposited in the World Data Centers.

Data from July 1957 to December 31, 1958 published in the "Researches of the Department of Terrestrial Magnetism", Carnegie Institution of Washington Publication 175, Vol XXI, Washington, D. C., 1961.

Closed Ionization Chambers

Station Name	MIRNY, ANTARCTICA
Geographic Coordinates	66°33' S, 93°01' E
Vertical Cutoff Rigidity	0.04 GV
Altitude	30 meters
Period of Operation	July 1957-January 1967
Principal Investigator	Dr. N.S. Kaminer IZMIRAN Institute of Terrestrial Magnetism Ionosphere and Radiowave Propagation Academy of Sciences of The U.S.S.R. p/o Akademgorodok, Moscow Region, U.S.S.R.

Comments:

Data deposited in the World Data Centers.

Station Name	MOSCOW, U.S.S.R.
Alternate Name	IZMIRAN
Geographic Coordinates	55°28' N, 37°19' E
Vertical Cutoff Rigidity	2.46 GV
Altitude	200 meters
Periods of Operation	January 1952-November 1952 January 1953-June 1958 August 1958-December 1958 February 1959-June 1966 November 1966-1970
Principal Investigator	Dr. N. S. Kaminer IZMIRAN Institute of Terrestrial Magnetism Ionosphere and Radiowave Propagation Academy of Sciences of The U.S.S.R. p/o Akademgorodok, Moscow Region, U.S.S.R.

Comments:

Data deposited in the World Data Centers.

Closed Ionization Chambers

Station Name	SYOWA, ANTARCTICA
Alternate Names	Syowa Base Syowa Station
Geographic Coordinates	69°00' S, 39°36' E
Vertical Cutoff Rigidity	0.42 GV
Altitude	15 meters
Period of Operation	July 1957-January 31, 1958
Principal Investigator	Dr. Y. Miyazaki Cosmic Ray Laboratory The Institute of Physical and Chemical Research 7-13, Kaga-1, Itabashi Tokyo, Japan

Comments:

Data deposited in the World Data Centers.

Data published in "Cosmic-Ray Intensity During the International Geophysical Year," No. 4, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1961.

Station Name	TBILISI, U.S.S.R.
Geographic Coordinates	41°43' N, 44°48' E
Vertical Cutoff Rigidity	6.91 GV
Altitude	510 meters
Periods of Operation	April 1953-February 1958 January 1959-May 1959 November 1959-May 1961 January 1963-September 1963 December 1963-July 1965 November 1965-August 1967 November 1967-March 1968
Principal Investigator	Dr. T. V. Kebuladze Institute of Geophysics Academy of Sciences Georgian SSR L. Rukhadze Street, 1 Tbilisi 15, U.S.S.R.

Comments:

Data deposited in the World Data Centers.

Section B5

Miscellaneous Equipment

Detectors no longer in operation and not included in the previous sections are listed under miscellaneous equipment. The air shower experiments are not included in this listing since their data generally are not applicable to solar-terrestrial physics. The information for the miscellaneous detectors which have terminated operation is given on the following page.

Closed Miscellaneous Equipment

Station Name	LEEDS, ENGLAND
Alternate Name	University of Leeds
Geographic Coordinates	53°50' N, 1°35' W
Vertical Cutoff Rigidity	2.20 GV
Altitude	100 meters
Type of Equipment	Non-standard cubical neutron monitor - 2 units of 4 neutron counters, surrounded by 6 inches lead and wax shield.
Period of Operation	January 1955-March 1957
Principal Investigator	Professor P. L. Marsden Physics Department University of Leeds Leeds 2, England

Comments:

Data deposited in the World Data Centers.

Station Name	WHITE MOUNTAIN, U.S.A.
Alternate Names	Lockheed Neutron Multiplicity Monitor LMSC Neutron Multiplicity Monitor
Geographic Coordinates	37.58° N, 118.25° W
Vertical Cutoff Rigidity	4.48 GV
Altitude	3800 meters
Type of Equipment	Neutron multiplicity monitor
Period of Operation	August 18, 1965-November 4, 1970
Principal Investigator	Dr. Ralph A. Nobles Lockheed Research Laboratory Department 52-10, Building 202 3251 Hanover Street Palo Alto, California 94304, U.S.A.

Comments:

Data deposited in the World Data Centers.

Appendix C

Proposed Detectors

The following page contains the pertinent information for the two cosmic-ray detectors for which operation was scheduled to start in early 1972.

Proposed Muon Detectors

Station Name	DOURBES, BELGIUM
Geographic Coordinates	50°06' N, 4°36' E
Vertical Cutoff Rigidity	3.24 GV
Altitude	225 meters
Type of Equipment and Configuration	Two standard cubical telescopes
Expected Start of Operation	April 1972
Principal Investigators	Professor L. Bossy and Dr. J. C. Jodogne Géophysique externe Institut royal météorologique 3, Avenue Circulaire Bruxelles 18, Belgium

Comments:

Data will be routinely published and submitted to the World Data Centers.

Station Name	TRIVANDRUM, INDIA
Geographic Coordinates	8.48° N, 76.95° E
Vertical Cutoff Rigidity	17.44 GV
Altitude	Sea level
Type of Equipment and Configuration	Cosmic-ray scintillator
Expected Start of Operation	March 1972
Principal Investigator	Director, Physical Research Laboratory Ahmedabad, India

Comments:

Data will be submitted to the World Data Centers.

Appendix D

Calendars of Operation

The following listings, Tables D1-D5, contain calendar of operation summaries for IQSY neutron monitors, IGY-type neutron monitors, muon detectors, underground muon detectors and ionization chambers. Each listing contains all detectors of the specified type regardless of present status. A separate entry is given for each detector since more than one detector of the same type may have been in operation at the same location. More precise dates are given under the individual listings in Appendixes A and B.

Table D1. IQSY-NM-64 Neutron Monitors, Calendar of Operations

Station Name	Year 196- 01234	Year 196- 56789	Year 197- 01234
Ahmedabad, India		PO	OO
Alert, Canada		POOOO	OO
Apatity, USSR		PO	OO
Athens, Greece			PO
Belfast, N. Ireland		POOO	OO
Buenos Aires, Argentina		OOO	OO
Calgary, Canada	O	OOOOO	OO
Chacaltaya, Bolivia		POOO	OO
Churchill, Canada	P	OOOOO	OO
Dallas, USA	P	OOOOO	OO
Deep River, Canada	POO	OOOOO	OO
Denver, USA		O	OO
Dourbes, Belgium		O	OO
Dumont d'Urville, Antarctica		PO	OO
Durham, USA	P	OOOOO	OO
Fukushima, Japan			P
General Belgrano, Antarctica			O
Gif Sur Yvette, France		POOO	OO
Goose Bay, Canada	P	OOOOO	OO
Hafelekar, Austria		PO	OO
Hermanus, South Africa	P	OOOOO	OO
Inuvik, Canada	P	OOOOO	OO
Irkutsk, USSR		POO	OO
Kerguelen Island	P	OOOOO	OO
Kiel, FRG	P	OOOOO	OO
Kiev, USSR		P	OO
Kiruna, Sweden			OO
Kula, USA		POOO	OO
Leeds, England		OOOOO	OO
Lindau/Harz, FRG	P	OOOOO	OO
Magadan, USSR			??
McMurdo, Antarctica	O	OOOOO	OO
Mexico City, Mexico			PO
Moscow, USSR		POPO	OO
Mount Norikura, Japan		PO	OO
Mount Wellington, Australia			PO
Norilsk, USSR			?O
Oulu, Finland	P	OOOOO	OO
Pic Du Midi, France	P	OOOOO	OO
Predigtstuhl, FRG		O	OO
Resolute, Canada		POOO	OO
Rome, Italy		POOO	OO
Sanae, Antarctica	P	OOOOO	OO
Sulphur Mountain, Canada	PO	OOOOO	OO
Swarthmore, USA	PO	OOOOO	OO
Syowa, Antarctica		POO	OO
Tehran, Iran		P	OO

Table D2 (Contd.) IGY-type Neutron Monitors, Calendar of Operations

Station Name	Year 195- 01234	Year 195- 56789	Year 196- 01234	Year 196- 56789	Year 197- 01234
Hafelekar, Austria		POOP			
Haleakala, USA			PO	OOP	
Halle, GDR			POOOO	OOOOO	OP
Heiss Island, USSR		OO	OOOOO	OOPPO	PP
Hermanus, South Africa		POO	OOOOP		
Herstmonoeux, England		POO	P		
Hobart, Australia				POO	OO
Huancayo, Peru	OOO	OOOOO	OOOOO	OOOOO	OO
Invercargill, New Zealand		POO	P		
Irkutsk, USSR		PPO	PPPOO	OO	
Jungfraujoch, Switzerland		PO	OOOOO	OOOOO	OO
Kerguelen Island		POO	OOOOP		
Kiel, FRG		POO	OOOOO		
Kodaikanal, India		POO	OOOOP		
Kühlungsborn, GDR			O	OOO	
Lae, New Guinea		POO	P POO	OOOOP	
Leeds, England		POO	OOOOO	OO	
Lerwick, Scotland				OOP	
Limeil, France		P	P		
Lincoln, USA		POO	OOP		
Lindau/Harz, FRG		P	OOOOO	OOOOO	OO
Lomnický Štít, Czechoslovakia		OO	P P	OOOOO	OO
London, England		POP	POOOO	P	
Makapuu Point, USA		POO	OOOP		
Makerere, Uganda		POO	OOOOO	OOOOO	OO
Mawson, Antarctica		POO	OOOOO	OOOOO	OO
McMurdo, Antarctica			POOOP		
Mexico City, Mexico	P	OOOOO	OOOOO	OOOOO	OO
Mina Aguilar, Argentina		POO	OOOOO	OOOOO	OO
Mirny, Antarctica		PO	OOOOO	OOOOO	OO
Morioka, Japan					PO
Moscow, USSR		PP	PPOOO	OP	
Mount Norikura, Japan		POOO	OOOOO	OOOP	
Mount Washington, USA	P	OOOOO	OOOOO	OOOOO	OO
Mount Wellington, Australia		POOO	OOOOO	OOP	
Munich, FRG		P	OOOOO	OOOOO	
Murchison Bay		POP			
Murmansk, USSR		PO	OP		
Mussala, Bulgaria			P	OOOOO	OO
Nera, The Netherlands		PO	OOOOO		
Northfield, USA		POP			
Ottawa, Canada	P	OOOOO	OOOOO	OOOOO	OO
Pic Du Midi, France		POO	OOOOP		
Potchefstroom, South Africa					P
Prague, Czechoslovakia		P	OOP		
Resolute, Canada		POOO	OOOOO	OP	
Rio de Janeiro, Brazil		POO	OOO		
Rome, Italy		POO	OOOOO	OO	
Sacramento Peak, USA	POOO	OOOOO	OOOOO	OOOP	
Saint Maur, France			OOOO	OO	
Schauinsland, FRG		POO	OOOOO	OP	

Table D2 (Contd.) IGY-type Neutron Monitors, Calendar of Operations

Station Name	Year 195- 01234	Year 195- 56789	Year 196- 01234	Year 196- 56789	Year 197- 01234
Simferopol, USSR			P P		
South Pole, Antarctica			P	OOOOO	OO
Sulphur Mountain, Canada		POO	OOOOO	OOOOO	OO
Sydney, Australia		OOO			
Syowa, Antarctica			PO		
Tbilisi, USSR		OO	OP PO	OOOOO	OO
Thule, Greenland		POO	OOOOP		
Uppsala, Sweden		POOO	OOOOO	OOOOO	OO
Ushuaia, Argentina		POO	OOOOO	OOOOO	OO
Vostok, Antarctica			PO	OOOOO	OO
Weissenau, FRG		POOP			
Wellington, New Zealand		PP			
Wellington, New Zealand			P	P	
Wilkes, Antarctica			POO	OOOOP	
Yakutsk, USSR		POO	OOOOO	OOOOP	
Zugspitze, FRG		OOO	OOOOO	OOOOO	OO

Notation -

O - Detector in operation for entire year
P - Detector in operation for a portion of the year

Table D3. Muon Detectors, Calendar of Operations

Station Name	Year 195- 01234	Year 195- 56789	Year 196- 01234	Year 196- 56789	Year 197- 01234
Ahmedabad, India				PO	OO
Ahmedabad, India		POO	OOO		
Alert, Canada				POOOO	OO
Alma-Ata, USSR			POOO	OOOOO	OO
Alma-Ata, USSR			P O	OOOOO	OO
Alma-Ata, USSR			PO	OOOOO	OO
Apatity, USSR				POO	OO
Apatity, USSR				PPP	
Belfast, N. Ireland				POOO	OO
Belsk, Poland				POOO	OO
Bergen, Norway		POOO	OOOOO	OOOOO	OO
Berkeley, USA		POO	P		
Bologna, Italy				OOOOO	OO
Buenos Aires, Argentina		POO	OO		
Cape Town, South Africa		PP			
Chacaltaya, Bolivia		PPP	PPPPP	PPPPO	OO
Chacaltaya, Bolivia		POO	P		
Chacaltaya, Bolivia		POO	P		
Chacaltaya, Bolivia		P	PP		
Chacaltaya, Bolivia					PO

Table D3 (Contd.) Muon Detectors, Calendar of Operations

Station Name	Year 195- 01234	Year 195- 56789	Year 196- 01234	Year 196- 56789	Year 197- 01234
Christchurch, New Zealand		POP			
Churchill, Canada		POO	OOOOO		
College Station, USA				PP	PP
Colombo, Ceylon		PO			
Dacca, Bangdalesh				POOO	OI
Darjeeling, India		POP			
Deep River, Canada			POO	OOOOO	OO
Deep River, Canada				POOOO	OO
Denver, USA				OOO	OO
Dourbes, Belgium				O	OO
El Infiernillo, Chile			P	PP	
Goose Bay, Canada			P	OOOOO	OO
Gulmarg, India		P			
Hafelekar, Austria		POO	OOOOO	OOOOO	OO
Haifa, Israel		PPP	P		
Heiss Island, USSR		PO	OOOPO	PO	
Heiss Island, USSR					PO
Hermanus, South Africa		POO	OOP		
Herstmonceux, England		POO			
Hobart, Australia	PO	OOOOO	OOOOO	OOOOO	OO
Hobart, Australia		POOOO	OOOOO	OOOOO	OO
Inuvik, Canada			P	OOOOO	OO
Invercargill, New Zealand		P			
Irkutsk, USSR				PO	OO
Irkutsk, USSR				PO	OO
Irkutsk, USSR		POP	PPPOO	OOOP	
Kerguelen Island		POO	OOP		
Kiel, FRG		POO	OOOOO	OOOOO	P
Kiruna, Sweden		POOO	OOOOO	OOP	
Kiruna, Sweden		POO	OOOOO	OOOP	
Kodaikanal, India		POO	OOOO		
Koenji, Japan		POOP			
Kühlungsborn, GDR		POO	OOOOO	OOO	
Kula, USA				POOO	OO
Lae, New Guinea		POO	OOOOO	OOOOP	
Limeil, France		POO	O		
Lincoln, USA		POO	OOP		
Lindau/Harz, FRG					OO
Lindau/Harz, FRG		P	OOOOO	OOP	
Lisbon, Portugal		OO	OP		
Lomnický Štít, Czechoslovakia				OO	OO
Lomnický Štít, Czechoslovakia		OO	O O	OOP	
London, England		PO			
Los Cerrillos Station, Chile				OOO	OO
Macau		POO	OOOOP		
Macquarie Island		POOP			
Macul Station, Chile		PO	OOOOO	OOP	
Makapuu Point, USA		PO			
Makerere, Uganda		POO			
Makerere, Uganda				POOOP	
Mawson, Antarctica		POOOO	OOOOO	OOOOO	OO

Table D3 (Contd.). Muon Detectors, Calendar of Operations

Station Name	Year 195- 01234	Year 195- 56789	Year 196- 01234	Year 196- 56789	Year 197- 01234
Mawson, Antarctica		POOOO	OOOOO	OOOOO	OO
Mawson, Antarctica				PO	OO
McMurdo, Antarctica			POOO	OOOOO	OO
Mexico City, Mexico					P
Meudon, France			POOP		
MIT, USA		P	PPPPP		
Moscow, USSR				PO	OO
Moscow, USSR				PO	OO
Moscow, USSR		P	PP PP		
Moscow, USSR		POO	OOPOO	OPPP	
Mt. Norikura, Japan				PO	OO
Murchison Bay		POP			
Murchison Bay		POP			
Nagoya, Japan					PO
Ottawa, Canada	P	OOOOO	OOOOO	OOOOO	OP
Oulu, Finland			P	OP	
Oulu, Finland				PO	OO
Pic Du Midi, France		POO	OOOOO	O	
Prague, Czechoslovakia		OO	OO		
Predigtstuhl, FRG				POOO	OO
Resolute, Canada		POOO	OOOOO	OP	
Rome, Italy		OO	OOOOP		
Schauinsland, FRG		O	OOOOO	OOOOO	OO
Schauinsland, FRG				P	OO
Seoul, Korea			P	O	
Simferopol, USSR		PO	P	O	
Sofia, Bulgaria		PO			
South Pole, Antarctica			P	OOOOO	OO
Sulphur Mountain, Canada		POO	OOOOP	PO	OO
Swarthmore, USA			P	OOOOO	OO
Syowa, Antarctica		P	P		
Syowa, Antarctica					PO
Tbilisi, USSR			PP OP	PPPPO	OO
Thule, Greenland		OO	OOP		
Thule, Greenland			OOO	OOOOO	OO
Tokyo-Itabashi, Japan		POO	OOOOO	OOOOO	OO
Tromso, Norway		POO	P		
Uppsala, Sweden			PO	OOOOO	OO
Uppsala, Sweden		POOO	OOOOO	OOOP	
Uppsala, Sweden		POO	OOOOO	OP	
Ushuaia, Argentina		POO	P		
Utrecht, The Netherlands				POO	OO
Vostok, Antarctica				PP	
Weissenau, FRG		POP			
Wellington, New Zealand			PP	P	
Wilkes, Antarctica		PO			
Yakutsk, USSR		PO	OOOOO	OOOOO	OO
Zugspitze, FRG		POO	P		

Notation -

O - Detector in operation for entire year
P - Detector in operation for a portion of the year

Table D4. Underground Muon Detectors, Calendar of Operations

Station Name	MWE	Year 195- 56789	Year 196- 01234	Year 196- 56789	Year 197- 01234
Budapest, Hungary	40	PO	OOOP	POOO	OO
Cambridge Tunnel, Australia	36	POO	OOOOO	OOOOO	OO
Cambridge Tunnel, Australia	36		POOOO	OP	
Cambridge Tunnel, Australia	36		OOP		
Cambridge Tunnel, Australia	36		P	OOP	
Chacaltaya, Bolivia	30		P	OOOOO	OO
Embudo, USA	40		P	OPOOO	OO
Embudo, USA	20			P	OO
Makerere (Kilembe), Uganda	40			P	OO
Matsumoto, Japan	*				P
Mont Blanc Tunnel, France	*			PP	PP
Moscow University, USSR	40				O
Moscow University, USSR	40	PPO	OOOOP	PP	
Socorro, USA	80			PO	OO
Takeyama, Japan	54				OO
Torino, Italy	70			POO	OO
Yakutsk, USSR	7	PO	OOOOO	OOOOO	OO
Yakutsk, USSR	20	PO	OOOOO	OOOOO	OO
Yakutsk, USSR	60	POO	O OOP	OOOOO	OO
Yakutsk, USSR	60	PO	OOOOO	OOOOO	OO

Notation -

MWE - Meters water equivalent
O - Detector in operation for entire year
P - Detector in operation for a portion of the year
* - See individual description

Table D5. Ionization Chambers, Calendar of Operations

Station Name	Year 193- 01234	Year 193- 56789	Year 194- 01234	Year 194- 56789	Year 195- 01234	Year 195- 56789	Year 196- 01234	Year 196- 56789	Year 197- 01234
Amsterdam, The Netherlands									
Cape Schmidt, USSR					POO	OOOOO	OOP		
Cheltenham, USA						PO		O OOOOP	
Christchurch, New Zealand		POO	OOOOO	OOOOO	OOOOO	OP			
Deep River, Canada		POOO	OOOOO	OOOOO	OOOOO	OOOOO	OO	PO	OO
Deep River, Canada						PO			
Fredericksburg, USA						P			
Godhavn, Greenland		PO	OOOOO	OOOOO	OOOOO	POOO	OOOOO	OOOOO	OO
Hafelekar, Austria	OOO	POOP				OOOOO	OOOOO	OOOOO	OP
Halle, GDR			PO	P	POO	OOOOO	OOOOO	OOOOO	OO
Hallc, GDR						POOO	OOOOO	OOOOO	OO
Hobart, Australia						POOO	OOOOO	OOOOO	OO
Hong Kong						POOOP			
Howrah, India									PO
Huancayo, Peru						PO			
Irkutsk, USSR		POOO	OOOOO	OOOOO	OOOOO	OOOOO	OOOOO	OOOOO	OO
Koenji, Japan					PO	P PO	O		
Kühlungsborn, GDR						P	OOOOO	OOOOO	OO
Mexico City, Mexico						OOO	OOOOO	OOO	
Mirny, Antarctica						POO	OOO		
Moscow, USSR						POO	OOOOO	OOP	
Mount Norikura, Japan					POO	OOOPP	OOOOO	OPOOO	P
Sapporo, Japan						POOOO	OOOOO	OOOOO	OO
Schauinsland, FRG						POO	OO	POO	OO
Sverdlovsk, USSR						OOO	OOOOO	OOOOO	OO
Syowa, Antarctica					POO	OOOOO	OOOOO	OOOOO	OO
Tbilisi, USSR						PP			
Tixie Bay, USSR					PO	OOOPP	OP PO	POPP	
Tokyo-Itabashi, Japan						POO	OOOOO	OOOOO	OO
Yakutsk, USSR				OO	OOOOO	OOOOO	OOOOO	OOOOO	OO
					PO	OOOOO	OOOOO	OOOOO	OO

Notation -

O - Detector in operation for entire year
P - Detector in operation for a portion of a year

Appendix E

Listing of Japanese Cosmic-Ray Intensity Data Books

The Japanese have published several catalogs of cosmic-ray intensity data since 1957. In the compilation of this listing of cosmic-ray stations, we have often referred to these publications as the "Japanese Cosmic-Ray Intensity Data Books." A listing, Table E1, of these data books and a summary of the contents of each is given in this appendix.

Table E1. Listing of Data Books and Summary of Contents

Title and Reference	Summary of Contents
1. "Cosmic-Ray Intensity during the International Geophysical Year", No. 1, National Committee for the International Geophysical Year, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1959.	Bihourly neutron monitor intensity data for 39 neutron monitors for the period July 1 through December 31, 1957.
2. "Cosmic-Ray Intensity during the International Geophysical Year", No. 2, National Committee for the International Geophysical Year, Science Council of Japan, Ueno Park, Tokyo, Japan, December 1959.	Bihourly neutron monitor intensity data for 44 neutron monitors for the period January 1 through June 30, 1958.
3. "Cosmic-Ray Intensity during the International Geophysical Year", No. 3, National Committee for the International Geophysical Year, Science Council of Japan, Ueno Park, Tokyo, Japan, April 1960.	Bihourly neutron monitor intensity data for 48 neutron monitors for the period July 1 through December 31, 1958. Also graphs of daily mean and monthly mean values and monthly mean diurnal variations for the period July 1, 1957 through December 31, 1958.
4. "Cosmic-Ray Intensity during the International Geophysical Year", No. 4, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1961.	Bihourly intensity data for meson (muon) detectors and ionization chambers at 5 Japanese stations for the period July 1, 1957 through December 31, 1958.
5. "Cosmic-Ray Intensity during the International Geophysical Year", No. 5, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, July 1961.	Bihourly intensities observed by standard meson (muon) detectors and ionization chambers at 17 selected stations for the period July 1, 1957 through December 31, 1958.
6. "Cosmic-Ray Intensity during the Post International Geophysical Cooperation", No. 6, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1962.	Bihourly intensity data observed by neutron monitors, meson (muon) detectors and ionization chambers at 5 Japanese stations during 1960.

Table E1 (Contd.). Listing of Data Books and Summary of Contents

Title and Reference	Summary of Contents
7. "Cosmic-Ray Intensity during the Post International Geophysical Cooperation", No. 7, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1963.	Bihourly intensity data observed by neutron monitors, meson (muon) detectors and ionization chambers at 4 Japanese stations during 1959.
8. "Cosmic-Ray Intensity during the Post International Geophysical Cooperation", No. 8, IGY World Data Center C2, Institute of Physical and Chemical Research, Itabashi, Tokyo, Japan, October 1963.	Bihourly intensity data observed by neutron monitors, meson (muon) detectors and ionization chambers at 5 Japanese stations during 1961.
9. "Cosmic-Ray Intensity during the Post International Geophysical Cooperation", No. 9, IGY World Data Center C2, Institute of Physical and Chemical Research, Itabashi, Tokyo, Japan, October 1964.	Bihourly intensity data observed by neutron monitors, meson (muon) detectors and ionization chambers at 3 Japanese stations during 1962.
10. "Cosmic-Ray Intensity during the International Years of the Quiet Sun", No. 10, National Committee for the International Years of the Quiet Sun, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1967.	Neutron intensity data observed by 23 neutron monitors (in alphabetical order of station name from A through H) during 1964.
11. "Cosmic-Ray Intensity during the International Years of the Quiet Sun", No. 11, National Committee for the International Years of the Quiet Sun, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1968.	Neutron intensity data observed by 26 neutron monitors (in alphabetical order of station name from I through O) during 1964.

Table E1 (Contd.). Listing of Data Books and Summary of Contents

Title and Reference	Summary of Contents
7. "Cosmic-Ray Intensity during the Post International Geophysical Cooperation", No. 7, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1963.	Bihourly intensity data observed by neutron monitors, meson (muon) detectors and ionization chambers at 4 Japanese stations during 1959.
8. "Cosmic-Ray Intensity during the Post International Geophysical Cooperation", No. 8, IGY World Data Center C2, Institute of Physical and Chemical Research, Itabashi, Tokyo, Japan, October 1963.	Bihourly intensity data observed by neutron monitors, meson (muon) detectors and ionization chambers at 5 Japanese stations during 1961.
9. "Cosmic-Ray Intensity during the Post International Geophysical Cooperation", No. 9, IGY World Data Center C2, Institute of Physical and Chemical Research, Itabashi, Tokyo, Japan, October 1964.	Bihourly intensity data observed by neutron monitors, meson (muon) detectors and ionization chambers at 3 Japanese stations during 1962.
10. "Cosmic-Ray Intensity during the International Years of the Quiet Sun", No. 10, National Committee for the International Years of the Quiet Sun, National Committee for the International Geophysical Coordination, Science Council of Japan, Ueno Park, Tokyo, Japan, March 1967.	Neutron intensity data observed by 23 neutron monitors (in alphabetical order of station name from A through H) during 1964.
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