

Hematological Studies on the Atomic Bomb Survivors in Nagasaki

(The 4th Report)*¹

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From February to March of 1956 a mass medical examination was conducted on the A-bomb exposed. Comparing the A-bomb survivors groups with the control groups, and also comparing with the results of the examination in 1953 we reached the following conclusions: 1) In comparison with the year of 1953 the exposed groups showed a marked restoration of anemia and a marked decrease of eosinophilia in 1956. 2) In 1956, WBC count, Hb. level, eosinophilia above 5%, percentage of monocyte and lymphocyte showed no significant variation between the exposed and control groups. Only for eosinophilia above 10% the exposed groups showed a more significant high rate than the control groups. 3) Accordingly, so far as concerned with the peripheral blood, it may be duly said that hematopoietic dysfunction returned to an almost normal condition in 1956, eleven years after exposure.

The 2nd Department of Internal Medicine has conducted hematological investigations on the A-bomb survivors on several occasions since 1946^{1), 2), 7), 8)}. Recently a general medical examination for the A-bomb exposed was performed by Nagasaki University School of Medicine. The 5th hematological investigation was conducted as a part of the examination.

MATERIALS AND METHODS

The general medical examination was conducted from February 1 to March 3, 1956. The total number of examined survivors were 6,732, from which those who had an unknown or unclear past history at the time of A-bomb; those who had been exposed in Hiroshima; and those whose examination was incomplete, were excluded. The remaining 4,841 survivors, that had reliable past history and reliable examination results were the subject of this investigation. They were classified as illustrated in Table 1 into 3 groups, A, B and C, according to presence or absence of acute radiation symptoms (epilation, hemorrhagic tendency, stomatitis), and were further divided into 18 smaller groups by sex and age. Group C consisting of those persons who were exposed at over 2500m from the hypocenter and showed no radiation symptoms, was tentatively regarded as a control group, and the differences among A, B and C was compared and investigated. The items of investigation were the same as in 1953, *i. e.*, WBC count, Hb. level and WBC differential.

As for the method of investigation, incidence of deviation from the usually

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normal values which were shown in each item of investigation was compared by the chi square analysis with each other and total of 18 groups divided as mentioned above. In addition, the results of investigation in 1953 were compared by the chi square analysis with the results of this investigation, and a close examination was made as to what changes had occurred for the past three years in the groups under the same condition. The chi square values obtained through this investigation are shown in Table 8.

TABLE 1.
The Number of Persons Examined

1956								1953							
Sex Age Group	M			F			T	Sex Age Group	M			F			T
	Y ₁	Y ₂	Y ₃	Y ₁	Y ₂	Y ₃			Y ₁	Y ₂	Y ₃	Y ₁	Y ₂	Y ₃	
A	102	505	86	132	576	76	1477	A	125	248	44	132	484	54	1087
B	307	472	97	310	485	86	1757	B	227	307	111	346	767	127	1885
C	185	416	146	205	522	133	1607	C	78	91	22	80	83	7	361
T	594	1393	329	647	1583	295		T	430	646	177	558	1334	188	
Total	2316			2525			4841	Total	1263			2080			3333

A = Exposed under 2000m with major radiation symptoms. B = Exposed under 2000m without major radiation symptoms. C = Control.
Y₁ = 8-23 years. Y₂ = 24-58 years. Y₃ = 59 years over.

RESULTS

I. WBC count

The distribution of WBC count of the subjects is as shown in Table 2. WBC count over 10,000 or below 5,000 were considered abnormal and a comparison was made.

1) *Leukocytosis.* a) In 1953: Both MBY1 and MCY1 showed a significant increase ($p < 0.01$) more than MAY1. In the total groups (referred to as T hereinafter), C showed a more significant increase than A and B ($p < 0.001$); B showed more significant increase than A ($p < 0.001$).

b) In 1956: Among A, B and C there was no significant difference in respective age and total groups.

c) Comparison between 1953 and 1956: MAY1, MAY2, MBY2, FAY2 and FBY3 showed a significant increase respectively in 1956 ($p < 0.01$), but no significant difference in C between these two years.

2) *Leukopenia.* a) In 1953: FCY2 showed a significant increase than FBY2 ($p < 0.01$).

b) In 1956: Among A, B and C no significant difference was noticed with each age group and total group.

c) Comparison between 1953 and 1956: MAY2, AT and BT showed a significant decrease in 1956 than 1953 ($p < 0.01$, $p < 0.01$, $p < 0.05$).

Brief summary. In 1953 WBC count of A and B when compared with C tended to be smaller, but in 1956 both A and B did not vary much from C, as those with leukopenia having decreased.

TABLE 2.
Leukocytesnumber

G	Sex	Age	No.	<1.999	2.000~	3 000~	4.000~	5 000~	6 000~	7 000~	8.000~	9.000~	10 000~	11 000~	12.000~	13.00~	14 000~	15.000~ 20.000	20.000--	
A	M	Y ₁	102			2 (1.96)	1 (0.99)	13 (12.74)	14 (13.72)	14 (13.72)	18 (17.64)	10 (9.90)	10 (9.90)	9 (8.82)	3 (2.94)	4 (3.92)	4 (3.92)			
		Y ₂	505			7 (1.38)	29 (5.74)	52 (10.29)	82 (16.23)	102 (20.19)	92 (18.21)	49 (9.70)	34 (6.72)	24 (4.75)	18 (3.66)	13 (2.57)	3 (0.59)			
		Y ₃	86			2 (2.32)	7 (8.13)	9 (10.46)	14 (16.28)	16 (18.60)	17 (19.76)	3 (3.48)	6 (6.96)	8 (9.30)	2 (2.32)	1 (1.16)	1 (1.16)			
	F	Y ₁	132			2 (1.90)	6 (7.29)	19 (10.41)	22 (19.96)	26 (17.18)	19 (15.45)	10 (9.02)	12 (9.02)	6 (4.68)	6 (2.77)	4 (1.21)	0 (1.04)	0 (1.04)		
		Y ₂	576			11 (1.90)	42 (7.29)	60 (10.41)	115 (19.96)	99 (17.18)	89 (15.45)	52 (9.02)	52 (9.02)	27 (4.68)	16 (2.77)	7 (1.21)	6 (1.04)			
		Y ₃	76			1 (1.31)	3 (3.94)	11 (14.47)	15 (19.73)	14 (18.42)	13 (17.11)	8 (10.52)	4 (5.26)	4 (5.26)	2 (2.63)	1 (1.31)	0 (0)			
	T	1477			25 (1.69)	88 (5.95)	164 (11.10)	262 (17.73)	271 (18.34)	248 (16.79)	132 (8.93)	118 (7.98)	78 (5.28)	47 (3.18)	30 (2.03)	14 (0.94)	1			
	B	M	Y ₁	307			6 (1.95)	12 (3.90)	24 (7.80)	43 (14.00)	49 (15.96)	52 (16.93)	35 (11.40)	32 (10.42)	21 (6.84)	15 (4.88)	16 (5.20)	1 (0.32)	1 (0.32)	
			Y ₂	472		1 (0.21)	7 (1.48)	38 (8.05)	60 (12.71)	72 (15.25)	95 (20.12)	75 (15.88)	51 (10.80)	23 (4.87)	19 (4.02)	17 (3.60)	9 (1.90)	5 (1.05)		
			Y ₃	97			4 (4.12)	5 (5.15)	10 (70.30)	10 (10.30)	12 (12.37)	17 (17.52)	17 (17.52)	6 (6.18)	7 (7.24)	5 (5.15)	3 (3.09)	1 (1.03)		
F		Y ₁	310			2 (0.64)	12 (3.87)	29 (9.35)	55 (17.73)	57 (18.38)	50 (16.12)	35 (11.28)	28 (9.03)	21 (6.77)	12 (3.87)	4 (1.29)	5 (1.61)			
		Y ₂	485			9 (1.85)	26 (5.36)	54 (11.13)	91 (18.76)	90 (18.55)	74 (15.25)	49 (10.10)	46 (9.48)	20 (4.12)	17 (3.50)	5 (1.03)	4 (0.82)			
		Y ₃	86			1 (1.16)	7 (8.13)	11 (12.78)	15 (17.44)	14 (16.27)	11 (12.78)	9 (10.46)	7 (8.13)	2 (2.32)	5 (5.81)	3 (3.48)	1 (1.16)			
T	1757		1 (0.056)	29 (1.65)	101 (5.69)	188 (10.69)	286 (16.27)	317 (18.03)	279 (15.81)	196 (11.15)	142 (8.08)	90 (5.12)	71 (4.04)	40 (2.27)	17 (0.96)	1 (0.056)				
C	M	Y ₁	185			3 (1.63)	13 (7.03)	19 (10.28)	29 (15.68)	32 (17.30)	33 (17.84)	18 (9.73)	14 (7.57)	8 (4.33)	8 (4.33)	6 (3.25)	2 (1.09)			
		Y ₂	416		1 (0.24)	8 (1.92)	21 (5.04)	53 (12.74)	76 (18.26)	75 (18.02)	72 (17.30)	41 (9.85)	29 (6.97)	19 (4.56)	11 (2.64)	6 (1.44)	4 (0.96)			
		Y ₃	146			5 (3.42)	8 (5.47)	15 (10.27)	27 (18.49)	30 (20.54)	18 (12.32)	19 (13.01)	8 (5.47)	3 (2.05)	7 (4.79)	4 (2.73)	2 (1.36)			
	F	Y ₁	205			7 (3.41)	13 (6.34)	21 (10.24)	36 (17.56)	33 (16.09)	32 (15.60)	21 (10.24)	19 (9.26)	11 (5.36)	5 (2.43)	6 (2.92)	1 (0.48)			
		Y ₂	522			11 (2.10)	36 (6.89)	73 (13.97)	106 (20.28)	102 (19.53)	61 (11.68)	52 (9.95)	38 (7.27)	13 (2.48)	17 (3.25)	9 (1.72)	4 (0.76)			
		Y ₃	133			2 (1.50)	8 (6.01)	24 (18.04)	29 (21.80)	30 (22.55)	19 (14.28)	5 (3.75)	6 (4.51)	4 (3.00)	2 (1.50)	2 (1.50)	2 (1.50)			
T	1607		1 (0.062)	36 (2.23)	99 (6.15)	205 (12.75)	303 (18.85)	302 (18.79)	235 (14.62)	156 (9.70)	114 (7.09)	58 (3.60)	33 (3.11)	15 (2.05)	15 (0.93)					
T	4841																			

)=%

TABLE 3.
Hemoglobin (Sahli)

G	Sex	Age	No.	← 30	30 - 49	50 - 69	70 - 79	80 - 89	90 - 99	100 →	
A	M	Y ₁	102			1(0.98)	5(4.90)	23(22.54)	38(37.25)	35(34.31)	
		Y ₂	505		1(0.19)	3(0.59)	14(2.77)	68(13.46)	20(39.99)	218(43.16)	
		Y ₃	86		2(2.32)	4(4.65)	1(1.16)	23(26.74)	31(36.05)	25(29.07)	
	F	Y ₁	132		1(0.75)	6(4.54)	10(7.57)	57(37.17)	44(33.32)	14(10.60)	
		Y ₂	576		2(0.34)	24(4.16)	115(19.96)	225(39.06)	152(26.38)	58(10.86)	
		Y ₃	76		1(1.31)	2(2.63)	6(7.89)	30(34.45)	26(34.19)	11(14.46)	
	T		1477		7(0.47)	40(2.70)	15(10.22)	426(28.43)	792(33.30)	361(24.43)	
	B	M	Y ₁	307		2(0.65)	1(0.33)	14(4.56)	73(23.78)	142(46.25)	75(24.43)
			Y ₂	472		1(0.21)	4(0.85)	19(4.03)	67(14.19)	182(38.56)	199(42.16)
Y ₃			97				5(5.15)	25(25.77)	47(48.45)	20(20.62)	
F		Y ₁	310			4(1.29)	19(6.13)	95(30.65)	120(38.70)	72(23.23)	
		Y ₂	485		2(0.41)	27(5.57)	84(17.32)	19(39.38)	140(28.89)	41(8.45)	
		Y ₃	86			5(8.81)	14(16.28)	25(29.07)	31(36.05)	11(12.79)	
T			1757		5(0.28)	41(2.33)	155(8.82)	476(27.09)	662(37.68)	418(23.79)	
C		M	Y ₁	185		1(0.54)	1(0.54)	10(5.41)	48(25.95)	78(42.17)	47(25.41)
			Y ₂	416		1(0.24)	5(1.20)	12(2.88)	71(17.07)	147(35.36)	180(43.27)
	Y ₃		146		2(1.37)	4(2.74)	12(8.22)	34(23.29)	52(35.62)	42(28.77)	
	F	Y ₁	205			6(2.93)	13(6.34)	60(29.27)	81(39.51)	45(21.95)	
		Y ₂	522	1(0.19)	5(0.96)	27(5.17)	90(17.24)	179(34.29)	155(29.69)	65(12.45)	
		Y ₃	133			2(1.50)	21(15.79)	34(25.56)	53(39.85)	23(17.29)	
	T		1607	1(0.062)	9(0.56)	45(8.80)	158(9.83)	426(26.51)	566(35.22)	402(25.01)	
	T		4841								

() = %

II. Anemia

The distribution of Hb. level is illustrated in Table 3. A comparison was made by considering Hb. level below 80% as abnormal.

a) In 1953: FAY1 and FBY1 showed a significant increase of persons with anemia than FCY1 ($p < 0.01$), and also AT and BT showed a significant increase than CT ($p < 0.01$).

b) In 1956: There was no significant difference between A, B and C.

c) Comparison between 1953 and 1956: MAY1, MAY3, MBY3, each age group in A and B or F, AT and BT showed a significant decrease in 1956 than in

1953 ($p < 0.001$). On the other hand C showed no significant difference in these two years in each age group and T.

Brief summary. In 1953 the A-bomb exposed in A and B obviously showed a tendency toward anemia than the control group. In 1956 both in A and B there was a marked restoration of anemia, and hardly any difference from C was noted.

III. Lymphocytes

The percentage of lymphocytes in WBC differential is distributed as shown in

TABLE 4.
Lymphocyte Counts

G	Sex	Age	No.	← 10.0	10.1-2.00	20.1-40.0	40.1-60.0	60.1 →	
A	M	Y ₁	102	2(1.96)	13(12.74)	80(78.47)	7(6.86)		
		Y ₂	505	5(0.99)	103(20.39)	357(70.68)	40(7.92)		
		Y ₃	86	1(1.61)	28(32.56)	52(60.47)	4(4.65)	1(1.16)	
	F	Y ₁	132	1(0.75)	17(12.87)	98(74.22)	16(12.11)		
		Y ₂	576	4(0.69)	100(7.36)	42(73.08)	50(8.86)	1(0.17)	
		Y ₃	76		12(15.78)	55(72.32)	9(11.83)		
	T		1477	13(0.88)	273(18.48)	1063(11.96)	126(8.53)	2(0.13)	
	B	M	Y ₁	307	5(1.62)	53(17.24)	213(67.37)	36(11.70)	
			Y ₂	472	8(1.68)	79(16.73)	328(6.97)	57(12.07)	
Y ₃			97	4(4.12)	22(22.67)	64(65.97)	6(6.18)	1(1.03)	
F		Y ₁	310	1(0.32)	29(9.35)	230(13.17)	47(15.14)	3(0.96)	
		Y ₂	485	3(0.61)	89(18.34)	335(69.04)	57(11.74)	1(0.20)	
		Y ₃	86	2(2.32)	22(25.57)	54(62.78)	8(9.30)		
T			1757	23(1.31)	294(16.73)	1224(69.66)	211(12.01)	5(0.28)	
C		M	Y ₁	185	3(1.62)	22(11.89)	139(75.13)	20(10.81)	1(0.54)
			Y ₂	416	2(0.48)	83(19.95)	292(70.19)	37(8.89)	2(0.48)
	Y ₃		146	3(2.05)	43(29.45)	92(63.01)	8(5.48)		
	F	Y ₁	205	1(0.49)	15(7.32)	158(77.07)	30(14.63)	1(0.49)	
		Y ₂	522	4(0.77)	81(15.51)	(71.62)	62(11.87)	0(1.19)	
		Y ₃	133	3(2.25)	20(15.05)	88(66.15)	22(16.53)		
	T		1607	16(0.99)	264(16.42)	1143(71.11)	179(11.19)	5(0.31)	
	T		4841						

() = %

Table 4. An investigation was done, considering those that are over 40% as an abnormal increase and those below 20% as abnormal decrease; however, no significant difference was found between A, B and C in each year of 1953 and 1956 and a also between these two years.

IV. Monocytes

The distribution of the monocyte percentage is shown in Table 5. An investigation was made considering those over 7% as abnormal.

TABLE 5.
Monocyte Counts

G	Sex	Age	No.	0 - 2.0	2.1 - 7.0	7.1 - 10.0	10.1-15.0	15.1-20.0	20.1 →	
A	M	Y ₁	102	13(12.74)	61(59.79)	17(16.66)	8(7.84)	1(0.98)	2(1.96)	
		Y ₂	505	78(15.44)	293(58.01)	90(17.82)	38(7.52)	4(0.79)	2(0.99)	
		Y ₃	86	10(11.63)	52(60.49)	16(18.60)	7(8.14)	1(1.16)		
	F	Y ₁	132	18(13.63)	80(60.59)	27(20.44)	6(4.54)	1(0.75)		
		Y ₂	576	66(11.45)	382(66.31)	91(15.79)	35(6.07)	2(0.34)		
		Y ₃	76	7(9.20)	51(67.06)	11(14.46)	5(6.57)	2(2.63)	*	
	T	1477	192(12.99)	919(62.21)	252(17.06)	99(6.70)	11(0.74)	4(0.27)		
	B	M	Y ₁	307	21(6.83)	197(64.16)	58(18.85)	22(7.15)	5(1.62)	4(1.30)
			Y ₂	472	66(13.97)	282(59.78)	89(18.85)	32(6.77)	2(0.42)	1(0.21)
Y ₃			97	9(9.27)	63(64.94)	21(21.64)	4(4.12)	0		
F		Y ₁	310	38(12.24)	203(64.46)	55(17.71)	14(4.51)			
		Y ₂	485	75(15.45)	311(64.09)	75(15.45)	23(4.74)	1(0.20)		
		Y ₃	86	12(13.95)	56(65.11)	16(18.60)	2(2.32)			
T	1757	221(12.57)	1112(63.28)	314(17.86)	97(5.52)	8(0.45)	5(0.28)			
C	M	Y ₁	185	20(10.81)	117(63.23)	30(16.21)	16(8.64)	1(0.54)	1(0.54)	
		Y ₂	416	46(11.05)	255(61.27)	84(20.18)	27(6.48)	3(0.72)	1(0.24)	
		Y ₃	146	17(11.64)	86(58.90)	24(16.43)	17(11.64)	2(1.36)		
	F	Y ₁	205	29(14.14)	141(68.77)	26(12.61)	9(4.39)			
		Y ₂	522	80(15.32)	328(62.81)	94(18.00)	19(3.63)	1(0.19)		
		Y ₃	133	18(13.53)	81(60.89)	29(21.80)	5(3.75)			
T	1607	210(13.06)	1008(62.51)	287(17.65)	93(5.87)	7(0.37)	2(0.12)			
		4841								

() = %

a) In 1953: MAY2 and MBY2 showed a significant increase than MCY2; and FAY1 and FBY1 showed a significant increase than FCY1 ($p < 0.01$). In T,

both A and B showed significant increase than C ($p < 0.001$).

b) In 1956: There was no significant difference at all between A, B and C.

c) Comparison between 1953: MBY1 was significantly decreased in 1956 than in 1953 ($p < 0.001$), and MCY2 and CT showed a significant increase in 1959 than in 1953 ($p < 0.001$).

Brief summary. In 1953, both A and B showed a larger tendency to monocytosis than in C. In 1956 there was nothing different between A, B and C. This gives an impression that tendency to monocytosis might have been restored to a normal condition, however, in view of the fact that there was an increase of cases of monocy-

TABLE 6.
Eosinophil Counts

G	Sex	Age	No.	0 - 1.0	1.1-5.0	5.1-10.0	10.1-15.0	15.1-20.0	20.1-30.0	30.1 →		
A	M	Y ₁	102	20(19.64)	45(44.11)	22(21.56)	12(11.76)	2(1.96)		1(0.98)		
		Y ₂	505	87(17.22)	270(53.46)	104(25.74)	29(5.74)	11(2.17)	3(0.59)	1(0.19)		
		Y ₃	86	16(18.60)	41(47.67)	23(26.74)	2(2.32)	3(3.48)		1(1.16)		
	F	Y ₁	132	21(15.90)	59(44.69)	36(27.27)	6(4.54)	7(5.30)	3(2.27)			
		Y ₂	576	77(13.36)	266(46.18)	138(23.98)	49(8.50)	27(4.68)	17(2.95)	2(0.34)		
		Y ₃	76	8(10.52)	35(46.05)	23(30.26)	4(5.26)	3(3.94)	3(3.94)			
	T		1477	229(15.50)	716(48.49)	346(23.42)	102(6.90)	53(3.58)	26(1.76)	5(0.33)		
	B	M	Y ₁	307	37(12.05)	151(49.18)	81(26.38)	27(8.79)	8(2.60)	3(0.97)		
			Y ₂	472	81(17.16)	266(56.35)	99(20.97)	22(4.66)	2(0.42)	2(0.42)		
Y ₃			97	19(19.57)	53(54.61)	18(18.54)	3(3.09)	3(3.09)	1(1.03)			
F		Y ₁	310	49(15.80)	146(47.08)	69(22.25)	28(9.03)	11(3.54)	4(1.29)	3(0.97)		
		Y ₂	485	51(10.05)	221(45.54)	131(26.99)	53(10.92)	17(3.50)	8(1.64)	4(0.82)		
		Y ₃	86	10(11.62)	43(49.96)	23(26.72)	6(6.97)	3(3.48)	1(1.16)			
T		1957	247(14.05)	880(50.08)	421(23.95)	139(7.91)	44(2.50)	19(1.08)	7(0.39)			
C	M	Y ₁	185	26(14.05)	92(49.72)	47(25.40)	16(8.64)	3(1.62)	1(0.54)			
		Y ₂	416	72(17.30)	234(56.23)	87(20.90)	13(3.12)	9(2.16)	1(0.24)			
		Y ₃	146	28(19.17)	23(15.75)	23(15.75)	4(2.72)	4(2.73)	3(2.05)			
	F	Y ₁	205	36(17.56)	96(46.82)	52(25.36)	18(8.78)	3(1.64)				
		Y ₂	522	70(13.40)	245(46.90)	146(27.95)	41(7.85)	12(2.29)	6(1.41)	1(0.38)		
		Y ₃	133	24(18.04)	70(52.62)	26(19.54)	11(8.26)	1(0.75)	1(0.75)			
	T		1607	256(15.92)	821(51.08)	381(23.70)	103(6.40)	32(1.99)	12(0.74)	2(0.12)		
T		4841										

() = %

tosis in C in 1956 than in 1953 and the fact that there had been no variation in A and B from 1953 to 1956, it is difficult to conclude that a definite tendency existed.

V. *Eosinophilia and eosinopenia*

The percentage of eosinophils in WBC differential is distributed as shown in Table 6. An investigation was performed on two cases of an abnormal increase; one was applied to those above 10% and the other to those above 5%. As to a decrease, those below 1% were considered abnormal.

1) *Eosinophilia* A) In cases when above 10% was considered as abnormal.

a) In 1953: FAY2, FBY1 and FBY2 showed a significant increase respectively than FCY1 and FCY2 ($p < 0.05$, $p < 0.05$, $p < 0.01$). AT and BT also showed a significant increase than CT ($p < 0.01$).

b) In 1956: Both FAY2 and FBY2 showed a significant increase than FCY2 ($p < 0.05$). AT also showed a significant increase than CT ($p < 0.01$). There was no significant difference observed between BT and CT.

c) Comparison between 1953 and 1956: In both M and F, A and B, excluding MAY1 and FAY1 groups, showed significant decrease in 1956 than in 1953 ($p < 0.001$). Also AT and BT showed a significant decrease ($p < 0.001$). However, in case of C, also, MCY1, MCY2 and CT showed a significant decrease in 1956 than in 1953 ($p < 0.001$).

B) In cases when above 5% was considered abnormal.

a) In 1953: FAY2, FBY1 and FBY2 showed a significant increase than FCY1 and FCY2 ($p < 0.01$). Also AT and BT showed a significant increase than CT ($p < 0.05$, $p < 0.01$).

b) In 1956: No significant difference was noted between A, B and C.

c) Comparison between 1953 and 1956: MAY1, MAY2, MBY2, MBY3, FAY2, FBY1, FBY2, FBY3, AT and BT, all of them showed a significant decrease in 1956 than in 1953 ($p < 0.01$). On the other hand, in the control group, MCY1, MCY2, MCY3 and CT were significantly decreased in 1956 than in 1953 ($p < 0.05$, $p < 0.01$, $p < 0.05$, $p < 0.01$).

2) *Eosinopenia*. There was no significant difference observed among A, B and C in each year of 1953 and 1956, and also between these two years.

3) *Result of stool examination which was conducted on patients with eosino-*

TABLE 7.

Results of Stool Examination of Survivors with Eosinophilia

G	Total-number	Number of Examined	Hookworm & Ascaris	Hookworm	Ascaris	(-)
A	202	131	34 (2.59)	43 (32.8)	10 (7.6)	44 (33.5)
B	219	142	28 (19.7)	41 (28.8)	19 (13.3)	54 (38.0)
C	158	95	19 (20.0)	27 (25.4)	12 (12.6)	37 (39.0)

() = %

TABLE 8.

A Tabulation of Chi Square of Series of Chi Square Tests Made among A, B and C Group within Each Age Group

Year		1953						1956						1956:1953					
Sex		M			F			M			F			M			F		
G		A : B	A : C	B : C	A : B	A : C	B : C	A : B	A : C	B : C	A : B	A : C	B : C	A	B	C	A	B	C
Leukocytosis	Y ₁	-7.09	-8.4	-	-	-	-	-	-	-	-	-	-	11.5	-	-	-	-	-
	Y ₂	-	-	-	-	-	-	-	-	-	-	-	-	10.9	7.8	-	26.9	-	-
	Y ₃	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.9	-
	T	-16.4	-18.7	-17.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Leukopenia	Y ₁	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Y ₂	-	-	-	-	-	-10.1	-	-	-	-	-	-	-10.8	-	-	-	-	-
	Y ₃	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	T	-	-	-	-	-	-	-	-	-	-	-	-	-8.8	-4.8	-	-	-	-
Anemia	Y ₁	-	-	-	-	13.4	8.5	-	-	-	-	-	-	-38.4	-	-	-8.3	-21.3	-
	Y ₂	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-12.8	-17.5	-
	Y ₃	-	-	-	-	-	-	-	-	-	-	-	-	-54.6	-13.6	-	-20.3	-12.3	-
	T	-	18.8	21.2	-	-	-	-	-	-	-	-	-	-18.8	-21.2	-	-	-	-
Monocytosis	Y ₁	-	-	-	-13.5	6.2	12.2	-	-	-	-	-	-	-	-7.1	-	-	-	-
	Y ₂	-	15.6	12.7	-	-	-	-	-	-	-	-	-	-	-	16.3	-	-	-
	Y ₃	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	T	-	15.9	13.9	-	-	-	-	-	-	-	-	-	-	-	14.4	-	-	-
Eosinophilia (over 10%)	Y ₁	-	-	-	-	6.4	-	-	-	-	-	-	-	-14.5	-13.9	-	-10.7	-	-
	Y ₂	-	-	-	-4.6	7.1	19.5	-	-	-	-	5.2	5.6	-9.1	-28.2	-24.1	-8.7	-22.5	-
	Y ₃	-	-	-	-	-	-	-	-	-	-	-	-	-7.1	-46.4	-	-5.3	-15.1	-
	T	-7.4	4.5	16.5	-	-	-	-	8.7	3.8	-	-	-	-37.2	-107.1	-14.4	-	-	-
Eosinophilia (over 5%)	T ₁	-	-	-	-	6.4	-	-	-	-	-	-	-	-4.2	-	-6.1	-	-18.6	-
	Y ₂	-	-	-	-4.5	7.0	19.5	-	-	-	-	-	-	-12.3	-25.3	-8.5	-12.4	-26.5	-
	Y ₃	-	-	-	-	-	-	-	-	-	-	-	-	-	-5.5	-6.3	-	-10.2	-
	T	-7.4	4.5	16.5	-	-	-	-	-	-	-	-	-	-39.4	-142.0	-10.6	-	-	-
Remarks	(-) A < C (+) A > C												(-) 1956 < 1953 (+) 1956 > 1953						

philia. In order to discuss the problem of eosinophilia it is necessary at first to investigate about infection of intestinal parasites. Therefore, on those cases that had shown eosinophilia above 10% at this survey, stool examination was performed with two methods, that is, floatation method and centrifugalization method. The results are shown in Table 7. Thus there was no significant difference among A, B and C.

Brief summary. It has been already reported that eosinophilia appeared in the convalescent period of acute radiation symptoms due to A-bomb³⁾⁴⁾⁵⁾⁶⁾. Thereafter, as the medical examination for A-bomb survivors of both Hiroshima and Nagasaki began widely conducted throughout the nation, some investigators pointed out that there was still a large tendency of eosinophilia being observed among the A-bomb survivors in spite of several years elapse since the exposure. Accordingly, to examine more closely, an analysis was performed under two conditions — one was that above 10% was regarded as abnormal and the other was that above 5% was

to be abnormal. It is obvious that in 1953, there was a significant increase of eosinophilia in the exposed. The same results were obtained with the other method "analysis of variation", which the authors have already reported. And yet, eosinophilia of the exposed were markedly decreased in 1956 than in 1953, and in the case of above 5% was considered abnormal, there was no significant difference from the control group. Also the control group, just the same as the exposed, showed a significant decrease in 1956 than in 1953. Considering this fact, the significance of eosinophilia seen in the exposed in 1953 will be more clearly shown up. However, in the case where above 10% was considered abnormal, the A-bomb exposed still showed a more significant increase in 1956 than the control. So more attention must be paid to the future process.

DISCUSSION

Although comments were made at the end of each item of investigation as "brief summary", the following is a general discussion of the examination results.

Outstanding characteristics of this investigation data, in comparison with the results of 1953 were: tendency of restoring to normal value was extremely strong within the exposed in all items of investigation. As a result, no significant difference was observed between the exposed and control.

Such a tendency was most clearly indicated in Hb. level. Namely, in 1953, the exposed group in comparison with the control definitely indicated a tendency toward anemia. However, in 1956, the incidence of anemia decreased tremendously in all age groups of the exposed in comparison with that of 1953, and showed similar distribution as the control. On the other hand the control showed no difference between 1953 and 1956. Also in the investigation which were conducted in 1946, 1947 and 1948 the exposed always showed a tendency toward anemia with a significant difference from the control. The incidence of anemia has decreased as time went on". In view of these facts it may be said that the anemia due to disturbance in the bone marrow function caused by A-bomb radiation were gradually restored and in 1956, 11 years after exposure, returned to a normal condition. The same could be said for cases of eosinophilia above 5%, too. However, if we took eosinophilia above 10% for comparison, in 1956 a significant increase was still noticed in the exposed. This would probably need further study in the future. To connect eosinophilia noted in the exposed immediately with A-bomb radiation is more dangerous than anemia or variation in WBC count. We must pay enough consideration also to various elements such as allergic disease or parasite infection. This time only stool test was performed, but no significant difference was observed between the exposed and control; that is, the results were not obtained that eosinophilia caused by any other cause than parasite infection was particularly large in the exposed. WBC count and monocyte percentage, having showed a difference between the exposed and control in 1953, found no difference between the two in 1956.

As mentioned above, the exposed which had taken a course to an abnormal picture in 1946, 1947 and 1953, were so well restored that there was no difference from the control in 1956. However, such conclusions were obtained from the statistical disposition of results of a mass medical examination, and the significance to pursue the cause of individual case of the exposed persons who showed a deviation from normal values is quite another problem. The incidence of leukemia in the exposed still shows a high rate. Such being the case, the importance of the

medical examination of an individual exposed person should not be disregarded in order to clarify the late effect of A-bomb radiation, and to discover and treat the disease in its early stage.

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