

A STUDY OF THE EFFECTS OF RADIUM AND X-RAY TREATMENT OF MYELOGENOUS LEUKEMIA *

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Abstract—

Myelogenous Leukemia is a rare, and to the extent of present knowledge, incurable blood disease. The case here observed presents a number of distinctive features, among which is the relatively small number of white blood corpuscles when considered in comparison with most cases of the disease. Three ray treatments, two of Radium and one of X-Ray, gave results from which it is difficult, as well as inadvisable, to draw definite conclusions. The progress of the disease during the period of observation, November, 1919, to April, 1920, the various effects of the ray treatments upon the elements of the blood stream, and other features of interest and significance are shown by means of graphs and charts.

The work with which this paper deals was the study of a case of *myelogenous leukemia* by means of differential blood counts. A brief clinical history of the case is taken from the Sanatorium records.

The patient was a man 59 years of age, engaged in farming. He sought medical attention on November 27, 1919, at which time he reported the previous duration of the disease to be 18 months. He complained of general weakness, loss of weight, aches in the limbs, headache, flashes before the eyes, feeling of distress, and fullness in the epigastrium. Examination disclosed sub-normal nutrition, flaccidity of the muscles, and marked increase in the size of the spleen. The hemoglobin test gave a result of 75%. The case was diagnosed as *myelogenous leukemia*.

The period observed is from November, 1919, until April, 1920. During that time three Ray treatments were given. The first, about December 6, consisted of 5,000 milligram hours of Radium treatment. On December 5,

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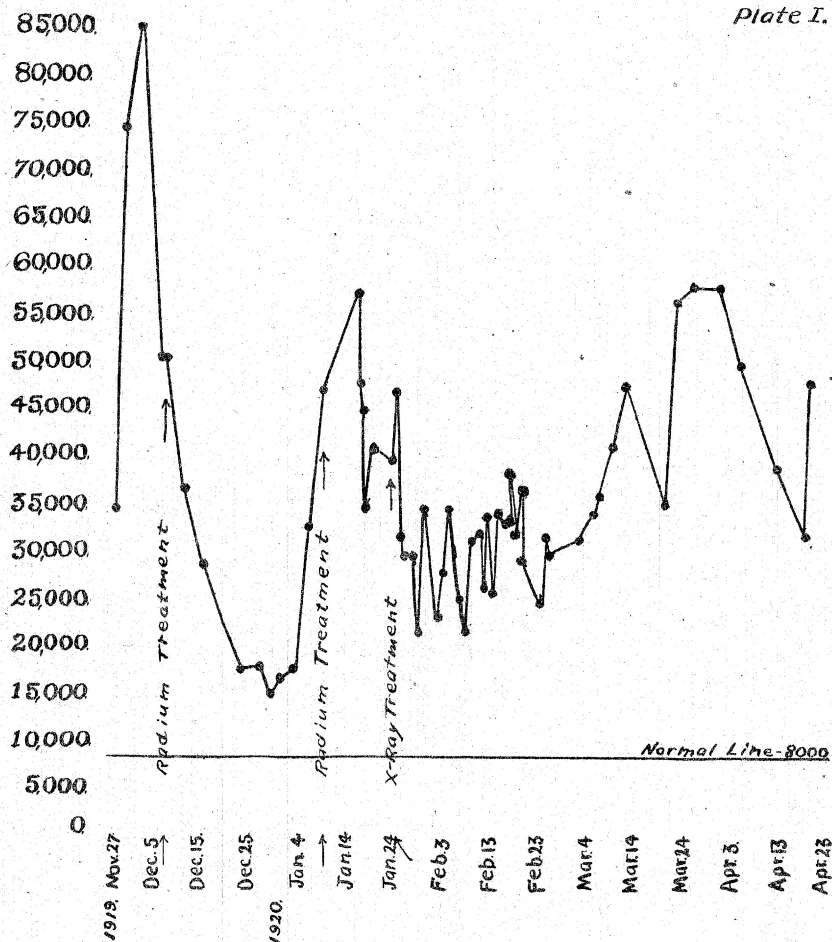
before treatment, the white count was reported as 85,000; on December 15, after treatment, it was 28,000. Also, both spleen and liver had decreased in size. The lower border of the spleen maintained about the same position, but the upper border showed a marked retraction. The patient grew cheerful and hopeful of improvement. On January 10, 1920, a second Radium treatment was given. On January 6 the white count was reported as 33,000; on January 15, after this treatment, it was 47,000. On January 24 an X-Ray treatment was administered. Later X-Ray treatments beyond the extension of this study were made. The patient died in October, 1920, making the total duration of the disease 2 years, 5 months.

In the blood picture the most striking feature was, of course, the large number of white corpuscles, and especially the presence of a large percentage of myelocytes of the neutrophile variety. *Anemia*—decrease in the number of red corpuscles, was also present. A large number of nucleated red cells was found. Many of the red cells, as well as the white, showed karyokinetic figures. Extruded nuclei, blood platelets, and fragmented cells were prominent. *Anisocytosis*, *Poikilocytosis*, and crenation were present in variable extent throughout the period of observation. The hemoglobin was diminished in approximate proportion to the red blood corpuscles, and stood usually at 75%. A number of rare pathological forms were noticed. One *megakaryocyte* was discovered.

The progress of the disease can best be observed by means of the accompanying charts and graphs. Chart I shows the complete observation (with exception of certain white counts in the earlier part of the treatment for which slides were not available. These counts are taken from clinical reports and included in the graphs). For each day for which blood slides were available a differential count was made of 200 white cells. The tabulation shows the percentage of Polymorphonuclear neutrophiles, Polymorphonuclear eosinophiles, Polymorphonuclear basophiles, Lymphocytes, Mononuclear leucocytes, neutrophilic Myelocytes, eosinophilic Myelocytes, and basophilic Myelocytes, respectively. During the

TOTAL W. B. C. COUNT.

Plate I.

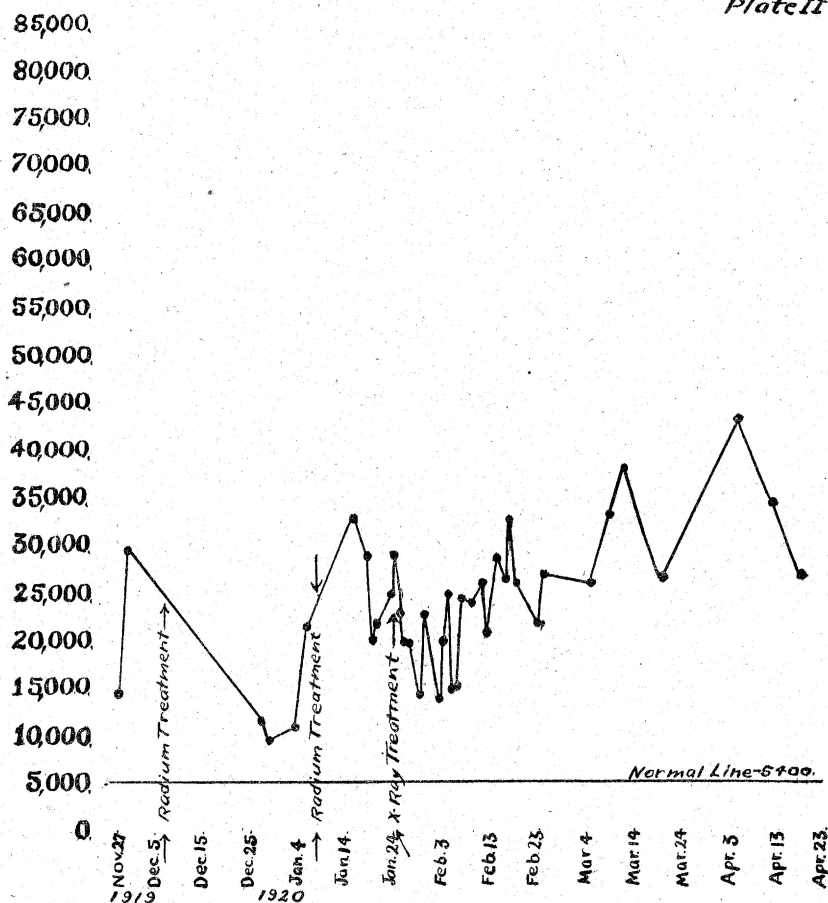


counting of 200 white cells, the actual number of nucleated red cells appearing in the field was recorded. These are grouped as normoblasts, megaloblasts, and microcytes, respectively. The chart shows in the first three columns the hemoglobin tests, the number of white blood corpuscles in 1 cubic millimeter of blood, and the number of red blood cells per cubic millimeter.

The data of the second chart is computed from that of the first. Here the actual number per cubic millimeter of

TOTAL P. M. N. COUNT.

Plate II

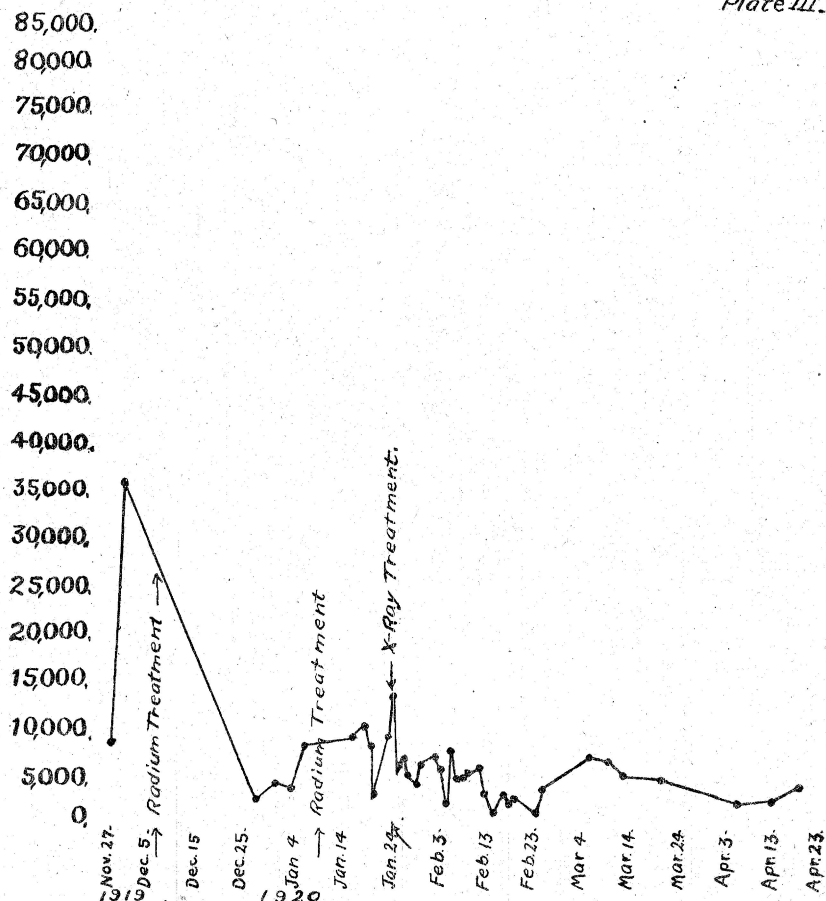


polymorphonuclear neutrophils, neutrophilic myelocytes, and remaining white cells is shown. This chart is the basis for the first four graphs that follow.

The first graph (Plate I) shows the Total White Blood Count. The variability of the number of white blood cells, a characteristic of this disease, is easily seen, especially in the period of most intensive observation, January 25 to February 18. The ray treatments are indicated by the arrows. It will be noticed that after each

TOTAL N-MY. COUNT.

Plate III.



treatment the total white count fell perceptibly only to rise again.

The second graph (Plate II) shows the total per cubic millimeter of polymorphonuclear neutrophils. Here also the count is seen to fall after ray treatment.

The third graph shows the total per cubic millimeter of neutrophilic myelocytes. The influence of the ray treatment is more uncertain, though the general trend is downward.

TOTAL N. COUNT.
(P.M.N. + n-My.)

Plate IV.

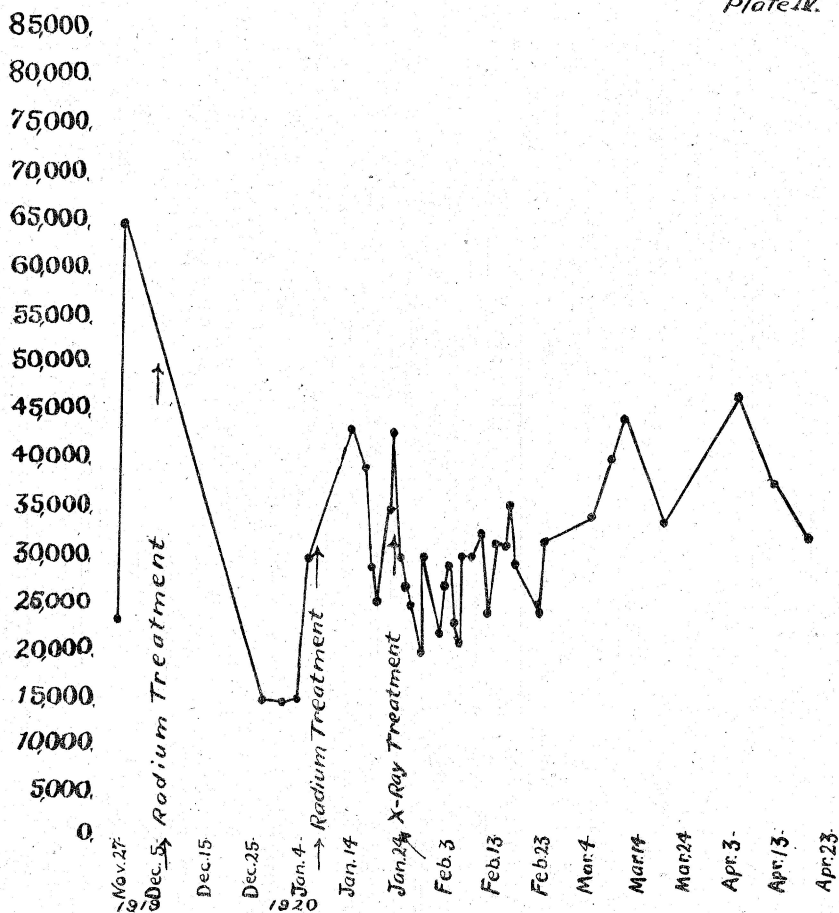
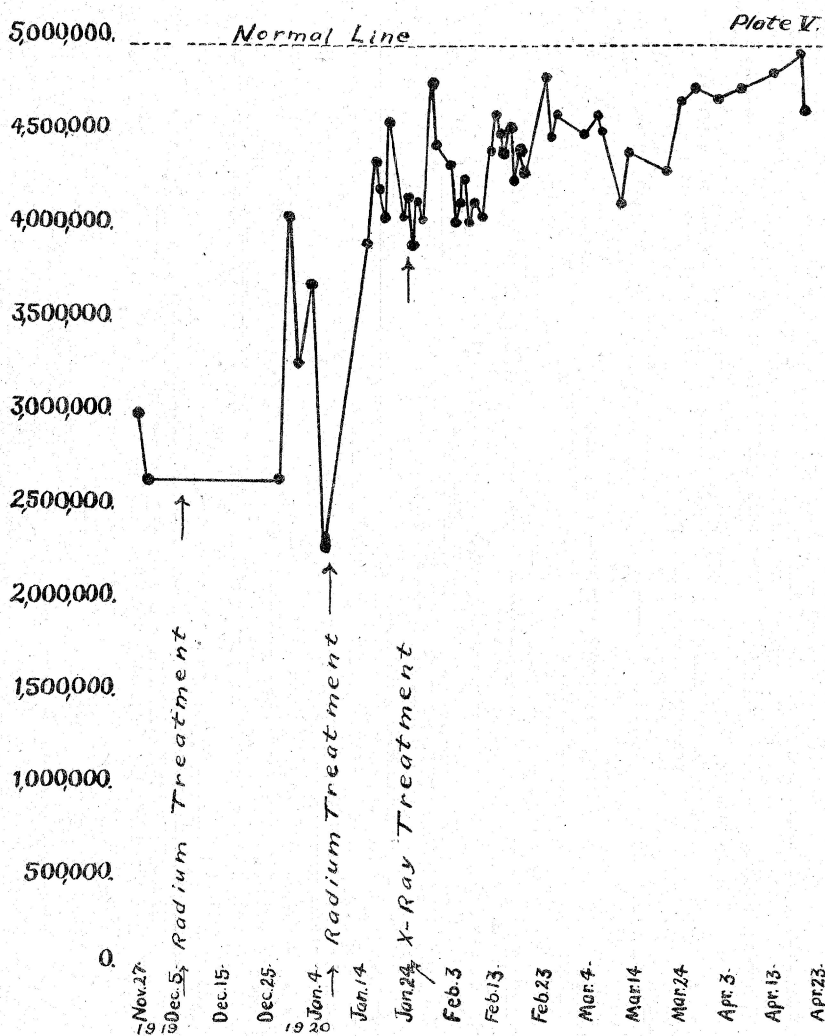


Plate IV portrays all neutrophilic cells—the polymorphonuclear neutrophils and neutrophilic myelocytes added. The general effect is the same as that noted in Plate II.

The fifth graph (Plate V) shows the count per cubic millimeter of red blood corpuscles. It will be remembered that besides leukemia, anemia was present in this case. The red blood count varied from 2,500,000 (half the normal number) to practically normal. The general

TOTAL R. B. C. COUNT.



effect of the ray treatment seems to be a raising of the count. The general trend of the curve is seen to be upward.

As has been suggested, the observations here tabulated include only a fractional part of the entire course of the disease. From observation covering so brief a period of a single case it is obviously impossible to draw any definite conclusions as to the whole effects of Radium or

X-Ray treatment of Myelogenous Leukemia. Many more cases must be subjected to exacting study before reliable conclusions can be made. Effective treatment for Myelogenous Leukemia is a problem for the future to solve.

EXPLANATION OF SYMBOLS FOR PLATES AND CHARTS.

Hb	Hemoglobin test.
W. B. C.	White Blood Corpuscles.
R. B. C.	Red Blood Corpuscles.
P. M. N.	Polymorphonuclear neutrophiles.
P. M. E.	Polymorphonuclear eosinophiles.
P. M. B.	Polymorphonuclear basophiles.
L	Lymphocytes.
M	Mononuclear leucocytes and Transitionals.
n-My	neutrophilic Myelocytes.
e-My	eosinophilic Myelocytes.
b-My	basophilic Myelocytes.
No	Normoblasts.
Mg	Megaloblasts.
Mi	Microcytes.
Total N.	Total number of neutrophilic cells—P. M. N. + n-My.

See Charts I and II on the following pages.

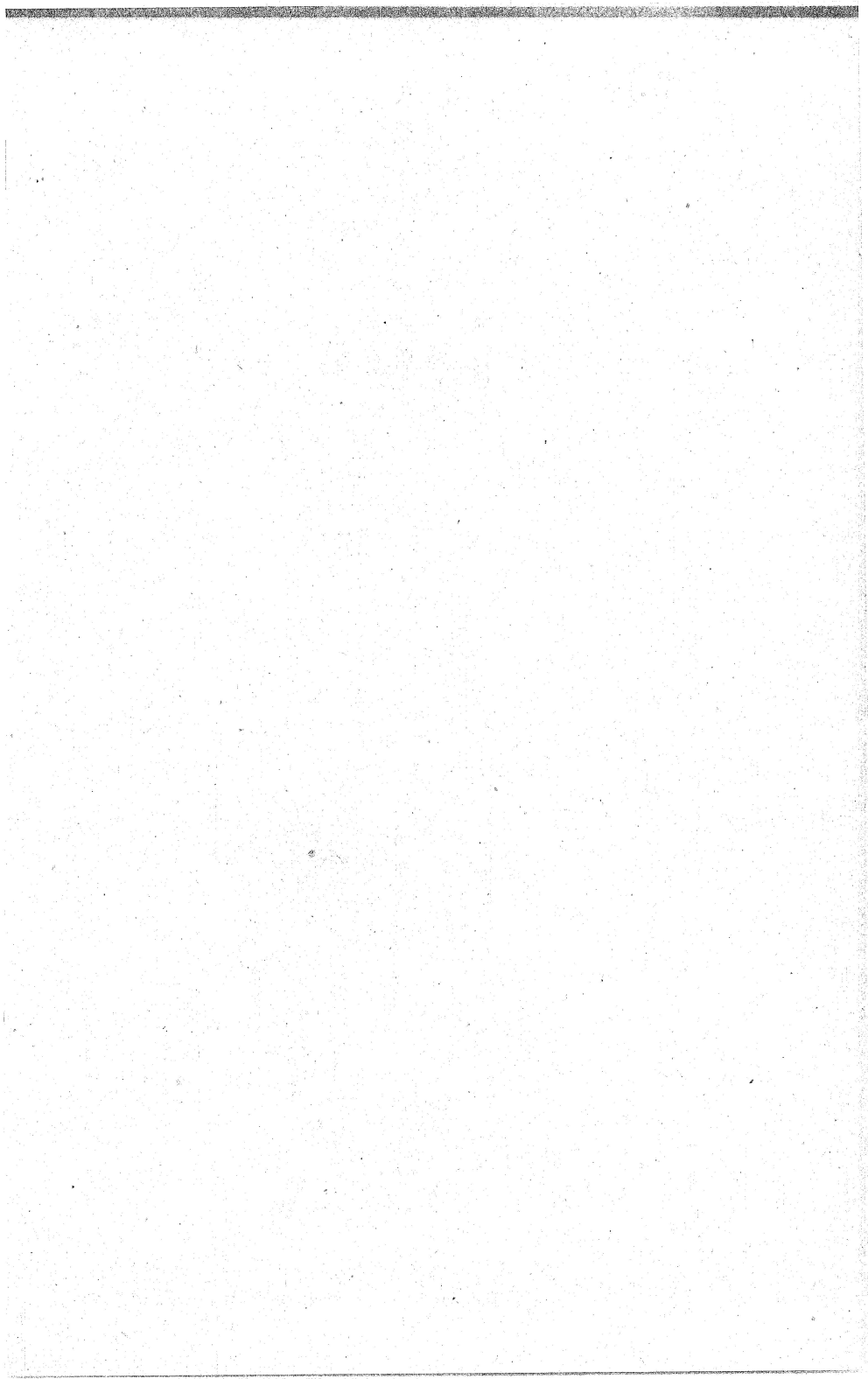


CHART I.

A case of Myelogenous Leukemia.				— W. B. C. — Differential Count.							
Date.	Hb.	W. B. C.	R. B. C.	PMN	PME	PMB	L	M	n-My	e-My	b-My
1919											
11-27.....	75	33,900	2,960,000	42	2	.....	25	5	26	.....	.....
11-28.....				43.2	0.2	1.5	8.5	9.8	34.3	.....	2.5
11-29.....		74,400	2,600,000	39	2	2	5	3	48	.....	.....
12-27.....		17,000	2,600,000	69	.....	.....	6	6	17	.....	.....
12-29.....		14,600	4,080,000	.....	.....	.....	.....	.....	.....	.....	.....
12-31.....		16,200	3,232,000	60	.....	.....	8	2	29	.....	1
1920											
1-3.....		17,400	3,664,000	60	.....	.....	12	5	23	.....	0.5
1-6.....	58	33,000	2,240,000	64	.....	.....	6	2	25	0.5	2
1-15.....		47,000	3,892,000	69	.....	0.5	5	2	21	1.5	1
1-17.....		56,800	4,304,000	.....	.....	.....	.....	.....	.....	.....	.....
1-18.....	75	44,400	4,160,000	64	0.5	0.5	10	1	23.5	.....	0.5
1-19.....		34,000	4,048,000	58	.....	0.5	9	4	24.5	2.5	1.5
1-20.....		40,400	4,528,000	52.5	2	1.5	5.5	3	33.5	1	1
1-23.....		59,200	4,068,000	62.5	1	.....	7	4	25.5	.....	.....
1-24.....		46,600	4,120,000	62	.....	.....	6.5	3	28.5	.....	.....
1-25.....		51,000	3,860,000	72	.....	.....	3	3.5	21.5	.....	.....
1-26.....		29,200	4,128,000	67	3	.....	2	4	23	1	.....
1-27.....		29,200	4,040,000	66	2.5	0.5	5	7.5	18.5	.....	0.5
1-29.....		21,000	4,784,000	68	0.5	0.5	4	3	22.5	1	0.5
1-30.....		34,200	4,416,000	66	.....	0.5	3.5	9.5	19.5	.....	.....
2-2.....		22,800	4,320,000	60.5	1.5	.....	.....	5	32	1	1
2-3.....		27,600	4,028,000	71	4	.....	.....	3.5	21.5	.....	.....
2-4.....		34,000	4,112,000	73	2	0.5	4	10	10.5	.....	.....
2-5.....		25,400	4,232,000	61	0.5	0.5	5	.....	32	0.5	0.5
2-6.....		21,400	4,007,000	71	0.5	.....	1	1.5	25.5	.....	0.5
2-7.....		50,400	4,136,000	79	1	1	1	1	16.5	.....	0.5
2-9.....		31,200	4,056,000	76.5	1	1	1	2.5	16.5	.....	1.5
2-10.....		25,600	.....	.....	.....	.....	.....	.....	.....	.....	.....
2-11.....		33,000	4,384,000	78.5	0.5	0.5	.....	2.5	18	.....	.....
2-12.....		25,000	4,570,000	81	1.5	0.5	1	1.5	14	.....	1
2-13.....		33,800	4,456,000	.....	.....	.....	.....	.....	.....	.....	.....
2-14.....		32,800	4,360,000	86	2.5	.....	1.5	4	6	0.5	.....
2-15.....		57,800	4,520,000	.....	.....	.....	.....	.....	.....	.....	.....
2-16.....		31,200	4,232,000	84	0.5	0.5	.....	2	12.5	0.5	.....
2-17.....		36,000	4,432,000	90	.....	.....	0.5	3	6.5	.....	.....
2-18.....		28,800	4,264,000	89	.....	.....	0.5	1.5	8.5	0.5	.....
2-23.....		24,400	4,776,000	89.5	.....	.....	1	1	7.5	0.5	.....
2-24.....		31,000	4,464,000	85.5	.....	.....	0.5	.....	14	.....	.....
2-25.....		29,200	4,632,000	.....	.....	.....	.....	.....	.....	.....	.....
3-2.....		30,800	4,496,000	14	.....	1	.....	.....	.....	.....	.....
3-5.....		33,600	4,576,000	76	.....	.....	0.5	1	22.5	.....	.....
3-6.....		55,400	4,496,000	.....	.....	.....	.....	.....	.....	.....	.....
3-8.....		.....	.....	86	1.5	0.5	.....	.....	11	.....	1
3-9.....		40,800	4,104,000	80.5	.....	.....	0.5	0.5	17.5	.....	.....
3-10.....		.....	.....	79.5	0.5	0.5	.....	.....	19	.....	0.5
3-12.....		47,000	4,376,000	80	2	.....	3	3	12	0.5	.....
3-20.....		34,600	4,288,000	78	1.5	0.5	2	0.5	15.5	0.5	1.5
3-23.....		56,000	4,656,000	.....	.....	.....	.....	.....	.....	.....	.....
3-26.....		57,600	4,736,000	.....	.....	.....	.....	.....	.....	.....	.....
3-31.....		57,600	4,656,000	.....	.....	.....	.....	.....	.....	.....	.....
4-2.....		49,200	4,736,000	89.5	1	.....	1	1.5	7	.....	.....
4-5.....		38,400	4,800,000	87.5	2	0.5	0.5	4	5.5	.....	.....
4-12.....		31,000	4,832,000	89	2.5	0.5	.....	0.5	7	.....	0.5
4-18.....		47,600	4,632,000	84.5	.....	1	0.5	0.5	13.5	.....	.....
5-8.....		.....	.....	83.5	0.5	1	5.5	3	6	.....	0.5

I.

— R. B. C — Actual number in 200 cells.			REMARKS.
No	Mg	Mi	
.....	.....	.....	Some Poikilocytosis.....
20	23	.....	Anisocytosis.....
.....	.....	.....	Radium treatment December 6, } Taken from laboratory report, not counted by me.
6	.....	.....	Some Poikilocytosis; one megakaryocyte.
.....	.....	.....	Poikilocytosis.
19	.....	.....	Poikilocytosis.
16	3	.....	Poikilocytosis.
5	.....	.....	Little Poikilocytosis; Aniso.; Mitotic Reds.
22	.....	.....	Radium treat., 1-6 to 1-15; pronounced poik. Taken from lab. report.
.....	.....	.....	Poikilocytosis. Crenation.
19	.....	.....	Poikilocytosis. Anisocytosis. Polychromasis.
29	4	.....	Crenated red cells prominent.
37	11	.....	Anisocytosis. Poikilocytosis not prominent.
19	3	.....	Anisocytosis. Poik. not prominent. X-Ray treatment.
20	1	.....	Anisocytosis. Poik. not prominent.
17	5	.....	Anisocytosis. Poik. not prominent.
33	6	.....	Anisocytosis. Poik. not prominent.
30	2	.....	Anisocytosis. Poik. not prominent.
20	.....	.....	Many extruded nuclei.
6	7	.....	Anisocytosis. Poikilocytosis not prominent.
11	17	.....	Anisocytosis. Poik. not prominent.
11	11	.....	Anisocytosis. Poik. not prominent.
19	6	.....	Anisocytosis. Poik. not prominent.
30	2	.....	Several extruded nuclei.
8	9	.....	Several extruded nuclei.
8	5	10	Poikilocytosis and Anisocytosis prominent.
16	6	.....	Poik. and Aniso. prominent.
.....	.....	.....	Poik. and Aniso. prominent.
12	20	.....	Poik. and Aniso. prominent.
8	7	.....	Poik. and Aniso. prominent.
.....	.....	.....	Little Aniso. and Poik. Several extruded nuclei.
21	2	.....	Little Aniso. and Poik. Several extruded nuclei.
7	7	1	Little Aniso. and Poik. Several extruded nuclei.
7	1	1	Little Aniso. and Poik. Few extruded nuclei.
1	.....	.....	Little Aniso. and Poik. Few extruded nuclei.
9	2	1	Little Aniso. and Poik. Few extruded nuclei.
12	3	1	Little Aniso. and Poik. Few extruded nuclei.
.....	.....	.....	Little Anis. and Poik. Few extruded nuclei.
6	1	.....	Little Anis. and Poik. Few extruded nuclei.
.....	.....	.....	Little Aniso. and Poik. Very few extruded nuclei.
4	3	.....	Little Aniso. and Poik. Very few extruded nuclei.
9	3	.....	Little Aniso. and Poik. Very few extruded nuclei.
1	5	1	Little Aniso. and Poik. More extruded nuclei.
12	6	4	Little Aniso. and Poik. More extruded nuclei.
12	1	25	Little Aniso. and Poik. More extruded nuclei.
.....	.....	.....	Anisocytosis. Several extruded nuclei.
5	.....	8	Anisocytosis. Several extruded nuclei.
21	1	9	Anisocytosis. Several extruded nuclei.
5	.....	6	Anisocytosis. Several extruded nuclei.
9	1	6	Anisocytosis. Several extruded nuclei. Poik.
.....	.....	.....	Half of the lymphocytes are of the large variety. 2 extruded
16	1	.....	nuclei. 1 Karyokinetic figure. Poik. and Aniso. very slight.

CHART II.

ACTUAL NUMBER OF CELLS PER. CU. MM.

Date	P. M N.	n-My.	Total N.	All Other	Total WBC
1919					
11-27	14,238	8,814	23,052	10,848	33,900
11-29	29,016	35,712	64,728	9,672	74,400
12-27	11,730	2,890	14,620	2,380	17,000
12-31	9,720	4,698	14,418	1,782	16,200
1920					
1- 3	10,440	4,002	14,442	2,958	17,400
1- 6	21,120	8,250	29,370	3,630	33,000
1-15	32,430	9,870	42,300	4,700	47,000
1-18	28,416	10,434	38,850	5,550	44,400
1-19	19,720	8,330	28,050	5,950	34,000
1-20	21,210	3,534	24,744	15,656	40,400
1-23	24,500	9,996	34,496	4,704	39,200
1-24	28,892	13,281	42,173	4,427	46,600
1-25	22,320	6,665	28,985	2,015	31,000
1-26	19,564	6,716	26,280	2,920	29,200
1-27	19,272	5,402	24,674	4,526	29,200
1-29	14,280	4,725	19,005	1,995	21,000
1-30	22,572	6,669	29,241	4,959	34,200
2- 2	13,794	7,296	21,090	1,710	22,800
2- 3	19,596	5,934	26,530	1,070	27,600
2- 4	24,820	3,570	28,390	5,610	34,000
2- 5	14,884	8,008	22,892	1,508	24,400
2- 6	15,194	5,457	20,651	749	21,400
2- 7	24,016	5,016	29,032	1,369	30,400
2- 9	23,868	5,148	29,016	2,184	31,200
2-11	25,905	5,940	31,845	1,155	33,000
2-12	20,250	3,600	23,750	1,250	25,000
2-14	28,208	1,968	30,176	2,624	32,800
2-16	26,208	3,900	30,108	1,092	31,200
2-17	32,400	2,340	34,740	1,260	36,000
2-18	25,632	2,448	28,080	720	28,800
2-23	21,838	1,830	23,268	1,132	24,400
2-24	26,505	4,840	30,845	1,155	31,000
3- 5	25,536	7,560	33,096	504	33,600
3- 9	32,844	7,140	39,984	816	40,800
3-12	37,600	5,640	43,240	3,760	47,000
3-20	26,988	5,363	32,351	2,249	34,600
4- 5	43,050	2,706	45,756	3,444	49,200
4-12	34,176	2,688	36,864	1,536	38,400
4-18	26,195	4,185	30,380	620	31,000