# STUDIES IN THE BLOOD CYTOLOGY OF THE RABBIT

## V. Consecutive Lymphocyte and Monocyte Observations on Groups of Normal Rabbits

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(Received for publication, April 14, 1930)

Previous papers of this series have contained the results of repeated blood examinations on 5 groups of normal male rabbits with respect to the erythrocyte and hemoglobin determinations (1), the total white cell contents (2), and the neutrophile (pseudo-eosinophile), the basophile, and the eosinophile cell counts (3). The purpose of these experiments was to obtain information on the general character or trend of the spontaneous variations described by the cellular constituents of the peripheral blood over prolonged periods of time, and the data obtained have, in each instance, been presented on the basis of the consecutive weekly mean values of each group. In the present paper, the results on the non-granular cells—the lymphocytes and the monocytes—are reported.

### *Materials and Methods*

A description of the materials and methods employed in these experiments and of the method of analyzing the results obtained has been given in the paper dealing with the observations on the erythrocytes and hemoglobin (1). Suffice it to say here that the period of time covered by the experiments extended from October, 1927 to July, 1929, and in the majority of cases, the blood was examined at weekly intervals. The numbers of examinations were: Group I, 35; Group II, 13; Group III, 8; Group IV, 29; Group V, 26. Each of the first 4 groups comprised 10 and the last, 5 normal male rabbits. The supravital neutral red technic was used in making the differential white cell counts and 100 cells were counted in each specimen.

### RESULTS

The consecutive lymphocyte and monocyte determinations on 5 groups of normal rabbits are given in Tables I to V in the form of mean

TABLE I

*Group I—10 Rabbits. Consecutive Values for Lymphocytes and Monocytes*

| Date | Lymphocytes | | | Monocytes | | |
|---|---|---|---|---|---|---|
| | Mean values | Standard deviation | Coefficient of variation | Mean values | Standard deviation | Coefficient of variation |
| *1927–28* | *per cmm.* | *per cmm.* | *per cent* | *per cmm.* | *per cmm.* | *per cent* |
| Oct. 24* | 2253 ± 185 | 867 | 25.97 | 987 ± 83 | 388 | 39.31 |
| Nov. 1 | 1861 ± 92 | 431 | 23.16 | 1092 ± 139 | 650 | 59.52 |
| Nov. 8** | 1929 ± 165 | 772 | 40.02 | 1153 ± 104 | 487 | 42.24 |
| Nov. 15 | 2560 ± 105 | 491 | 19.18 | 1085 ± 83 | 389 | 35.85 |
| Nov. 22 | 2005 ± 169 | 794 | 39.60 | 1409 ± 185 | 869 | 61.67 |
| Nov. 29 | 2984 ± 210 | 983 | 32.94 | 1209 ± 174 | 817 | 67.63 |
| Dec. 6 | 2781 ± 238 | 1117 | 40.17 | 1073 ± 114 | 533 | 49.67 |
| Dec. 13 | 3171 ± 399 | 1871 | 59.00 | 1178 ± 127 | 596 | 50.59 |
| Dec. 20 | 2209 ± 166 | 778 | 35.22 | 1231 ± 127 | 595 | 48.33 |
| Dec. 27 | 2554 ± 197 | 922 | 36.10 | 864 ± 77 | 362 | 41.90 |
| Jan. 3 | 2945 ± 333 | 1559 | 52.94 | 1045 ± 52 | 245 | 23.44 |
| Jan. 10 | 3425 ± 256 | 1202 | 35.09 | 967 ± 73 | 341 | 35.26 |
| Jan. 17 | 3429 ± 352 | 1648 | 49.11 | 1025 ± 102 | 480 | 46.83 |
| Jan. 24 | 3511 ± 285 | 1336 | 38.05 | 967 ± 58 | 270 | 27.92 |
| Jan. 31 | 3444 ± 284 | 1332 | 38.68 | 1023 ± 81 | 380 | 37.15 |
| Feb. 7 | 3501 ± 263 | 1235 | 35.28 | 1100 ± 106 | 497 | 45.18 |
| Feb. 14 | 3070 ± 225 | 1056 | 34.40 | 1201 ± 134 | 627 | 52.21 |
| Feb. 21 | 4671 ± 496 | 2324 | 49.75 | 1218 ± 148 | 693 | 56.90 |
| Feb. 28 | 2507 ± 151 | 708 | 28.24 | 1145 ± 101 | 474 | 41.40 |
| Mar. 6 | 2934 ± 183 | 859 | 29.28 | 1117 ± 76 | 354 | 31.69 |
| Mar. 13 | 2532 ± 221 | 1037 | 40.96 | 1183 ± 138 | 648 | 54.78 |
| Mar. 20 | 2563 ± 166 | 779 | 30.39 | 1084 ± 83 | 389 | 35.89 |
| Mar. 27 | 3044 ± 217 | 1015 | 33.34 | 1112 ± 104 | 488 | 43.88 |
| Apr. 3 | 3322 ± 335 | 1571 | 47.29 | 1181 ± 127 | 595 | 50.38 |
| Apr. 10 | 3966 ± 337 | 1578 | 39.79 | 1027 ± 123 | 576 | 56.09 |
| Apr. 17 | 3734 ± 245 | 1149 | 30.77 | 1107 ± 121 | 569 | 51.40 |
| Apr. 24 | 3073 ± 288 | 1352 | 44.00 | 933 ± 134 | 627 | 67.20 |
| May 1 | 4165 ± 316 | 1483 | 35.61 | 933 ± 93 | 438 | 46.95 |
| May 8 | 3358 ± 251 | 1178 | 35.08 | 1092 ± 87 | 407 | 37.27 |
| May 15 | 3775 ± 190 | 891 | 23.60 | 1071 ± 100 | 468 | 43.70 |
| May 22 | 3624 ± 169 | 792 | 21.85 | 1245 ± 110 | 516 | 41.45 |
| May 29 | 4182 ± 324 | 1521 | 36.37 | 1410 ± 294 | 1377 | 97.66 |
| June 5 | 4602 ± 205 | 959 | 20.84 | 1543 ± 169 | 790 | 51.20 |
| June 12 | 4455 ± 473 | 2219 | 49.81 | 1270 ± 117 | 546 | 42.99 |
| June 19 | 3376 ± 292 | 1371 | 40.61 | 1106 ± 114 | 536 | 48.46 |
| Mean | 3186 ± 83 | 731 | 22.94 | 1125 ± 16 | 139 | 12.36 |
| Minimum | 1861 | | | 864 | | |
| Maximum | 4671 | | | 1543 | | |

* October 24 and 26.

** November 4 and 9.

TABLE II

*Group II—10 Rabbits. Consecutive Values for Lymphocytes and Monocytes*

| Date | Lymphocytes | | | Monocytes | | |
|---|---|---|---|---|---|---|
| | Mean values | Standard deviation | Coefficient of variation | Mean values | Standard deviation | Coefficient of variation |
| *1928* | *per cmm.* | *per cmm.* | *per cent* | *per cmm.* | *per cmm.* | *per cent* |
| Mar. 29 | 2210 ± 173 | 809 | 36.61 | 573 ± 35 | 165 | 28.80 |
| Apr. 3 | 3313 ± 262 | 1227 | 37.04 | 677 ± 101 | 474 | 70.01 |
| Apr. 10 | 3073 ± 287 | 1347 | 43.83 | 844 ± 89 | 416 | 49.29 |
| Apr. 17 | 3429 ± 286 | 1342 | 39.13 | 1076 ± 154 | 724 | 67.29 |
| Apr. 24 | 3067 ± 203 | 950 | 30.97 | 853 ± 102 | 476 | 55.80 |
| May 1 | 3257 ± 231 | 1081 | 33.19 | 680 ± 64 | 299 | 43.97 |
| May 8 | 3215 ± 216 | 1012 | 31.48 | 777 ± 83 | 388 | 49.94 |
| May 15 | 2605 ± 247 | 1158 | 44.45 | 721 ± 126 | 590 | 81.83 |
| May 22 | 3960 ± 284 | 1331 | 33.61 | 1028 ± 101 | 475 | 46.21 |
| May 29 | 3758 ± 365 | 1713 | 45.58 | 843 ± 97 | 455 | 53.97 |
| June 5 | 3864 ± 252 | 1180 | 30.54 | 796 ± 70 | 329 | 41.33 |
| June 12 | 3236 ± 244 | 1144 | 35.35 | 1063 ± 110 | 517 | 48.64 |
| June 19 | 3526 ± 222 | 1040 | 29.50 | 1166 ± 66 | 310 | 26.59 |
| Mean | 3270 ± 87 | 465 | 14.22 | 854 ± 32 | 173 | 20.26 |
| Minimum | 2210 | | | 573 | | |
| Maximum | 3960 | | | 1166 | | |

TABLE III

*Group III—10 Rabbits. Consecutive Values for Lymphocytes and Monocytes*

| Date | Lymphocytes | | | Monocytes | | |
|---|---|---|---|---|---|---|
| | Mean values | Standard deviation | Coefficient of variation | Mean values | Standard deviation | Coefficient of variation |
| *1928* | *per cmm.* | *per cmm.* | *per cent* | *per cmm.* | *per cmm.* | *per cent* |
| Sept. 20 | 1971 ± 268 | 1254 | 63.62 | 712 ± 113 | 529 | 74.30 |
| Sept. 28 | 2454 ± 287 | 1345 | 54.81 | 780 ± 88 | 414 | 53.08 |
| Oct. 10 | 2178 ± 82 | 385 | 17.68 | 739 ± 80 | 373 | 50.47 |
| Oct. 19 | 2497 ± 142 | 667 | 26.71 | 813 ± 103 | 482 | 59.29 |
| Nov. 2 | 2009 ± 167 | 784 | 39.02 | 797 ± 101 | 472 | 59.22 |
| Nov. 9 | 2352 ± 151 | 708 | 30.10 | 820 ± 64 | 300 | 36.59 |
| Nov. 16 | 1883 ± 110 | 516 | 27.40 | 733 ± 89 | 415 | 53.69 |
| Nov. 22 | 2348 ± 181 | 850 | 36.20 | 895 ± 112 | 525 | 58.66 |
| Mean | 2212 ± 53 | 220 | 9.95 | 786 ± 13 | 55 | 7.00 |
| Minimum | 1883 | | | 712 | | |
| Maximum | 2497 | | | 895 | | |

values, together with the probable errors of the means, the standard deviations, and the coefficients of variation. The curves in Text-figs.

TABLE IV

*Group IV—10 Rabbits. Consecutive Values for Lymphocytes and Monocytes*

| Date | Lymphocytes | | | Monocytes | | |
|---|---|---|---|---|---|---|
| | Mean values | Standard deviation | Coefficient of variation | Mean values | Standard deviation | Coefficient of variation |
| *1928–29* | *per cmm.* | *per cmm.* | *per cent* | *per cmm.* | *per cmm.* | *per cent* |
| Nov. 27 | 2616 ± 173 | 812 | 31.02 | 546 ± 39 | 183 | 33.56 |
| Dec. 4 | 2713 ± 153 | 717 | 26.44 | 499 ± 45 | 212 | 42.47 |
| Dec. 11 | 2319 ± 182 | 854 | 36.84 | 452 ± 55 | 256 | 56.63 |
| Dec. 18 | 2168 ± 211 | 991 | 45.72 | 790 ± 171 | 801 | 101.35 |
| Dec. 26 | 2160 ± 186 | 871 | 40.31 | 362 ± 49 | 229 | 63.24 |
| Jan. 2 | 1563 ± 82 | 383 | 24.48 | 456 ± 60 | 280 | 61.40 |
| Jan. 8 | 2040 ± 172 | 807 | 39.55 | 490 ± 90 | 422 | 86.08 |
| Jan. 15 | 1955 ± 84 | 394 | 20.13 | 563 ± 48 | 224 | 39.80 |
| Jan. 22 | 1839 ± 160 | 751 | 40.81 | 704 ± 87 | 406 | 57.72 |
| Jan. 29 | 2470 ± 154 | 720 | 29.15 | 591 ± 73 | 342 | 57.84 |
| Feb. 5 | 1873 ± 144 | 676 | 36.09 | 546 ± 70 | 330 | 60.34 |
| Feb. 13 | 2036 ± 108 | 505 | 24.80 | 826 ± 148 | 693 | 83.89 |
| Feb. 19 | 1907 ± 146 | 686 | 35.97 | 893 ± 101 | 474 | 53.08 |
| Feb. 26 | 2038 ± 139 | 651 | 31.96 | 1066 ± 100 | 468 | 43.87 |
| Mar. 12 | 2007 ± 142 | 668 | 33.29 | 1006 ± 92 | 431 | 42.81 |
| Mar. 19 | 2189 ± 129 | 604 | 27.58 | 857 ± 74 | 346 | 40.40 |
| Mar. 26 | 2290 ± 199 | 934 | 40.76 | 635 ± 66 | 310 | 48.85 |
| Apr. 2 | 1561 ± 185 | 869 | 55.70 | 856 ± 94 | 443 | 51.74 |
| Apr. 9 | 2530 ± 168 | 787 | 31.09 | 1066 ± 98 | 460 | 43.15 |
| Apr. 16 | 2765 ± 233 | 1092 | 39.50 | 709 ± 57 | 269 | 37.95 |
| Apr. 23 | 2971 ± 200 | 939 | 31.62 | 916 ± 99 | 462 | 50.44 |
| Apr. 30 | 2301 ± 183 | 857 | 37.23 | 619 ± 88 | 413 | 66.63 |
| May 7 | 2574 ± 146 | 686 | 26.64 | 699 ± 46 | 216 | 30.95 |
| May 14 | 2514 ± 150 | 668 | 26.55 | 622 ± 62 | 276 | 44.34 |
| May 21 | 1672 ± 93 | 413 | 24.71 | 565 ± 36 | 159 | 28.19 |
| May 28 | 2523 ± 169 | 752 | 29.78 | 479 ± 58 | 259 | 54.11 |
| June 4 | 1960 ± 172 | 763 | 38.94 | 678 ± 62 | 276 | 40.77 |
| June 11 | 1920 ± 153 | 682 | 35.53 | 509 ± 44 | 196 | 38.50 |
| June 18 | 2609 ± 205 | 860 | 32.94 | 530 ± 42 | 176 | 33.18 |
| Mean | 2210 ± 45 | 363 | 16.40 | 673 ± 24 | 190 | 28.20 |
| Minimum | 1561 | | | 362 | | |
| Maximum | 2971 | | | 1066 | | |

1 and 2, illustrating the mean values, have been drawn in the form of the percentage deviations of the smoothed means from standard

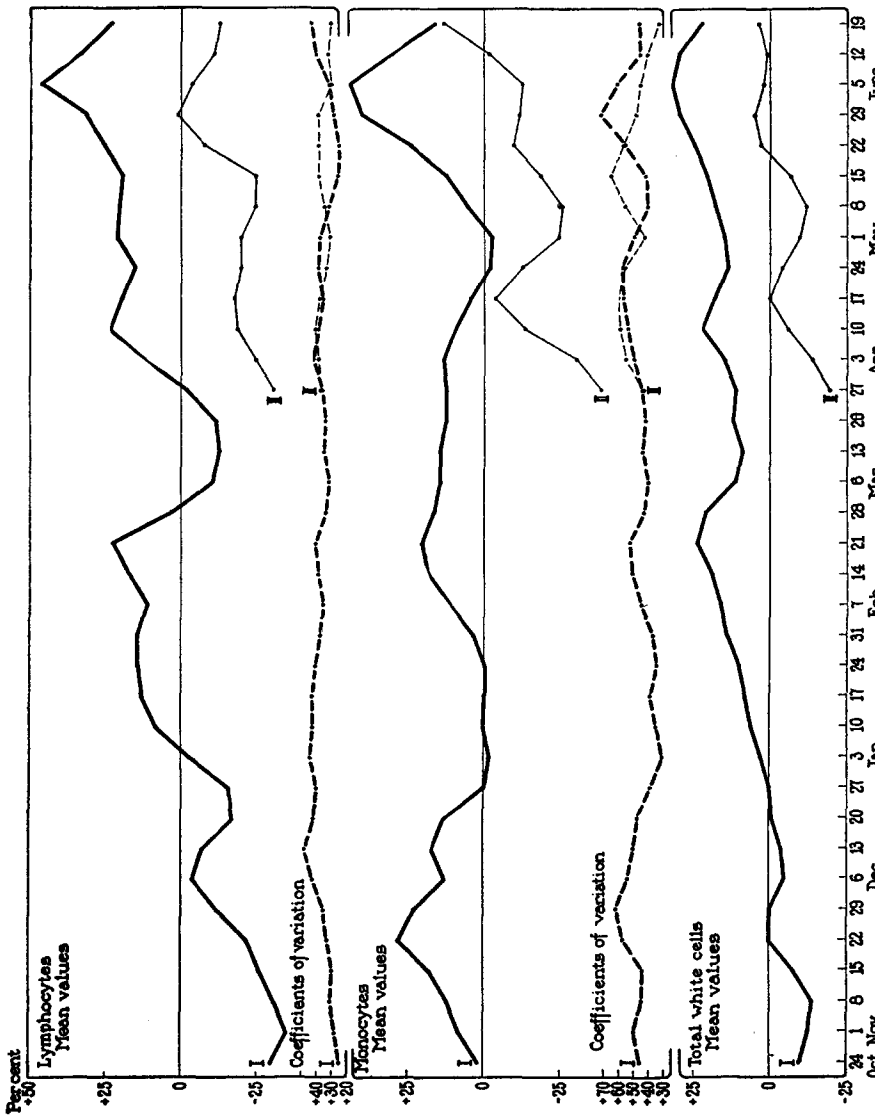
values (1,4); similar curves for the total white cells (2) have been included to facilitate convenient comparisons with their fluctuations. The other curves in the text-figures represent the smoothed coefficients

TABLE V

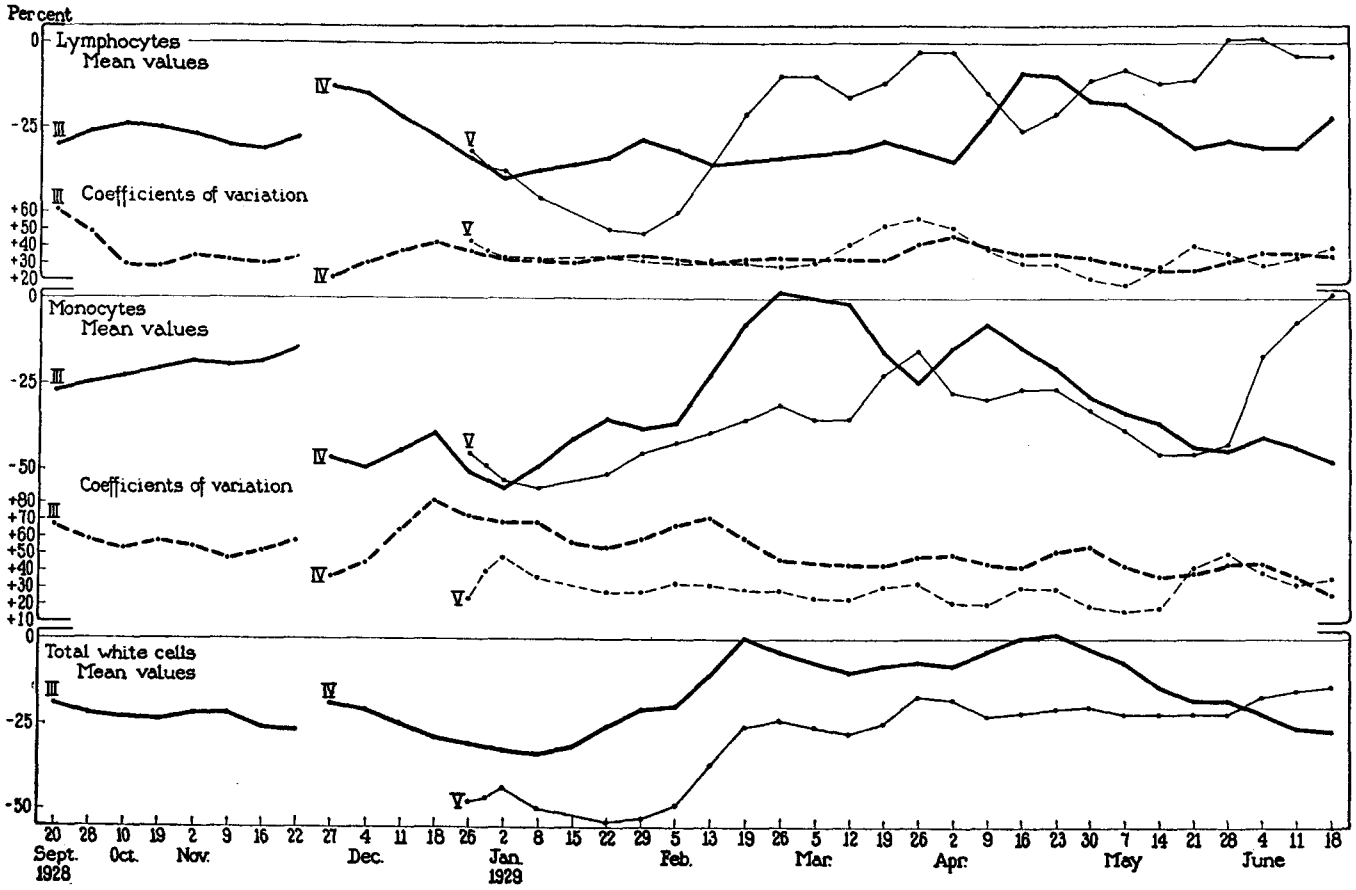
*Group V—5 Rabbits. Consecutive Values for Lymphocytes and Monocytes*

| Date | Lymphocytes | | | Monocytes | | |
|---|---|---|---|---|---|---|
| | Mean values | Standard deviation | Coefficient of variation | Mean values | Standard deviation | Coefficient of variation |
| *1928–29* | *per cmm.* | *per cmm.* | *per cent* | *per cmm.* | *per cmm.* | *per cent* |
| Dec. 29 | 2310 ± 95 | 314 | 13.59 | 631 ± 92 | 305 | 48.34 |
| Dec. 31 | 1650 ± 206 | 683 | 41.39 | 350 ± 34 | 113 | 32.29 |
| Jan. 3 | 2127 ± 386 | 1279 | 60.13 | 588 ± 65 | 215 | 36.56 |
| Jan. 10 | 1676 ± 130 | 431 | 25.72 | 309 ± 26 | 86 | 27.83 |
| Jan. 24 | 1135 ± 107 | 353 | 31.10 | 544 ± 60 | 200 | 36.76 |
| Jan. 31 | 1503 ± 90 | 299 | 19.89 | 505 ± 46 | 153 | 30.30 |
| Feb. 7 | 1198 ± 139 | 460 | 38.40 | 591 ± 44 | 146 | 24.70 |
| Feb. 15 | 2147 ± 211 | 698 | 32.51 | 605 ± 69 | 227 | 37.52 |
| Feb. 21 | 2304 ± 146 | 485 | 21.05 | 618 ± 47 | 156 | 25.24 |
| Mar. 1 | 2941 ± 328 | 1087 | 36.96 | 723 ± 71 | 234 | 32.37 |
| Mar. 8 | 2820 ± 156 | 517 | 18.33 | 639 ± 47 | 146 | 22.85 |
| Mar. 15 | 2387 ± 167 | 552 | 23.13 | 561 ± 67 | 223 | 39.75 |
| Mar. 22 | 2610 ± 214 | 710 | 27.20 | 816 ± 148 | 492 | 60.29 |
| Mar. 29 | 3092 ± 396 | 1314 | 42.50 | 905 ± 133 | 441 | 48.75 |
| Apr. 5 | 3038 ± 133 | 440 | 14.48 | 671 ± 132 | 436 | 64.98 |
| Apr. 12 | 2668 ± 114 | 377 | 14.13 | 635 ± 54 | 179 | 28.19 |
| Apr. 19 | 1990 ± 226 | 749 | 37.64 | 875 ± 73 | 242 | 27.66 |
| Apr. 26 | 2357 ± 208 | 688 | 29.19 | 523 ± 60 | 199 | 38.05 |
| May 3 | 2927 ± 160 | 529 | 18.07 | 788 ± 31 | 101 | 12.82 |
| May 10 | 2700 ± 117 | 388 | 14.37 | 563 ± 31 | 101 | 17.94 |
| May 17 | 2886 ± 139 | 459 | 15.90 | 524 ± 32 | 106 | 20.23 |
| May 24 | 2219 ± 184 | 610 | 27.49 | 547 ± 85 | 283 | 51.74 |
| May 31 | 3580 ± 605 | 2006 | 56.03 | 531 ± 56 | 184 | 34.65 |
| June 7 | 2913 ± 176 | 584 | 20.05 | 880 ± 60 | 198 | 22.50 |
| June 14 | 2913 ± 173 | 572 | 19.64 | 1023 ± 107 | 353 | 34.51 |
| June 21 | 2944 ± 260 | 861 | 29.25 | 1007 ± 125 | 414 | 41.11 |
| **Mean** | 2424 ± 80 | 607 | 25.04 | 652 ± 23 | 176 | 26.99 |
| **Minimum** | 1135 | | | 350 | | |
| **Maximum** | 3580 | | | 1023 | | |

of variation of the means. The standard values used in this comparison of mean values are: lymphocytes, 3050 per cubic millimeter; monocytes, 1000 per cubic millimeter; total white blood cells, 9560 per cubic millimeter.




TEXT-FIG. 1. Mean values for consecutive lymphocyte and monocyte determinations as percentage deviations from standard values. 1927–28.




TEXT-FIG. 2. Mean values for consecutive lymphocyte and monocyte determinations as percentage deviations from standard values. 1928–29.

## DISCUSSION AND SUMMARY

The results of these experiments will be discussed in chronological order. It will be noted that the observations on Group II were made during the spring of 1928 at which time Group I was still being examined, and that Groups IV and V were followed during the winter and spring months of 1928 and 1929.

Group I was examined at weekly intervals from October 24, 1927 to June 24, 1928 (Table I). From the curves in Text-fig. 1, which illustrate the lymphocyte and monocyte mean values in the form of percentage deviations from standard values as given above, it will be seen that the mean numbers of lymphocytes were considerably increased above their low initial level by the end of the experiment. This change was accomplished gradually and in a fairly consistent fashion with the exception of a minor drop of the values in December and June and an abrupt and pronounced fall at the end of February and the first half of March. In the case of the monocytes, the general level of which was continuously above the standard value, no such sustained increase of mean values was observed. The curve representing these cells contains 3 major upward swings which occurred in November, in February and March, and in May. During certain periods, as in October and November, and again in May and June, the lymphocyte and monocyte curves follow the same general trend. At other times, however, this parallel relationship did not hold. In January, the lymphocyte curve describes a sharp rise while the monocyte curve is stationary and in February, March, and April, when an abrupt fall of the lymphocyte curve is followed by a pronounced rise, the monocyte curve describes a slight but protracted decline. It will be seen by the curve in Text-fig. 1, that the total white cell count was considerably increased during the experiment, and a comparison with the lymphocyte curve shows that its fluctuations are frequently reflected in those of the total white cells. Although the coefficients of variation of the lymphocyte means (Table I) are of a high order of magnitude, the curve of the smoothed values (Text-fig. 1) is quite regular. The monocyte coefficients (Table I) are slightly higher than those of the lymphocytes and their smoothed curve (Text-fig. 1) is more irregular.

Group II was examined from March 29 to June 19, 1928 (Table II). The curves representing its lymphocyte and monocyte means (Text-fig. 1) bring out clearly the lower numerical levels of both classes of cells as compared with those of Group I. In the case of the lymphocytes the general forms of the curves of Groups I and II are very similar but with the monocytes, the resemblance is less striking.

The lymphocyte and total white cell curves are, on the whole, much alike. There are certain portions of the latter curve, however, which resemble the monocyte more than the lymphocyte curve, as for example, that covered by the last two observations. The coefficients of variations of the lymphocyte and monocyte means of Group II (Table II) are of the same order of magnitude as those of Group I and their smoothed curves (Text-fig. 1) present the same general appearance.

Group III was examined from September 20 to November 22, 1928 (Table III). From the curves in Text-fig. 2, it will be seen that the levels of both the lymphocyte and the monocyte mean values were of the same order as those of Group II rather than those of Group I. Only minor changes in the values of Group III were observed. The monocyte curve describes a gradual comparatively slight rise while the lymphocyte curve shows no clearly defined trend. The total white cell curve describes a slight downward trend and it is almost a mirror image of the monocyte curve. With the exception of the first two points of the lymphocyte curve, the curves of the smoothed coefficients of variation of the lymphocyte and monocyte means (Text-fig. 2) are comparable to those of Groups I and II.

Group IV was examined from November 27, 1928 to June 19, 1929 (Table IV). The general level of the lymphocyte mean values was comparable to the results in Groups II and III and to the first quarter of the findings of Group I. During December, the trend of mean values was decreasing as shown by the falling curve (Text-fig. 2); during January, February, and March, a low level was fairly constantly maintained; in April, an abrupt increase occurred and this was succeeded by a second decrease. The curve representing the monocytes (Text-fig. 2) shows first that the general level of mean values was usually lower than that of Group I and was more comparable to those of Groups II and III. From very low levels in December and early January, the pronounced upward swing of the curve in February, March, and April indicates the increase of monocytes during this time, and its subsequent descent illustrates the eventual drop in the numbers of these cells. The general trend of the lymphocyte and the monocyte means is similar in the beginning and during the last third

of the experiment, but during much of the time, the increase of monocytes was accompanied by practically no change in the level of lymphocyte mean values. In general form, the total white cell curve (Text-fig. 2) has many points of resemblance with the monocyte as well as with the lymphocyte curve.

The coefficients of variation of the lymphocyte means (Table IV, Text-fig. 2) which are on the whole quite uniform, are of a similar order of magnitude to those of the other groups. The coefficients of the monocytes (Table IV, Text-fig. 2) are somewhat more variable and tend to be slightly higher than those of the other groups.

Group V was examined from December 29, 1928 to June 21, 1929 (Table V). The mean lymphocyte values as shown by the curve in Text-fig. 2 were on the whole higher than those of Group IV examined during the same months, but they did not equal the high levels of Group I examined the previous year. In its first portion, the curve representing these findings resembles that of Group IV, but its rise was initiated in February and from then onward to the end of the experiment, a comparatively high level prevailed. The rise of the Group IV curve, which was of short duration, occurred in March and April. In respect to the maintenance of higher values in the spring months, Group V resembled Groups I and II. The monocyte curves of Groups IV and V are, on the whole, similar in general form until the end of the experiment (Text-fig. 2); during June, the curve for Group V describes an abrupt and marked rise while that of Group IV continues its downward trend. The general level of the Group V mean values was slightly lower than those of Group IV. It will be noted by comparing their respective curves, that the movements of the lymphocyte and monocyte mean values are generally similar in direction during the first two-thirds of the experiment. In April and May, however, the lymphocyte curve is rising while the monocyte curve is falling; in June the lymphocyte curve is stationary at a high level while the monocyte curve shows an abrupt rise. On the whole, the general contour of the total white cell curve of Group V (Text-fig. 2) resembles the lymphocyte more than the monocyte curve. During April and May, however, when its level continues to be quite regularly maintained, the lymphocytes are rising and the monocytes

are falling; in June, when it is undergoing a gradual and comparatively slight rise, the lymphocytes are high and the monocytes are very high.

The coefficients of variation of the lymphocyte means of Group V (Table V, Text-fig. 2) are entirely comparable to those of Group IV; those of the monocyte means (Table V, Text-fig. 2) on the other hand, are considerably smaller and are generally more uniform. As far as general level is concerned, the monocyte coefficients of Group V are the lowest of any of the 5 groups.

There are certain features of these results which merit special attention. In the first place, the general levels of both lymphocyte and monocyte mean values during 1927–28 were on the whole higher than in 1928–29, as was found with the red cells and hemoglobin (1), the total white cells (2), and the neutrophiles, the basophiles, and the eosinophiles (3). Secondly, the parallelism shown by two groups examined during the same months with respect to the direction of a change in the level of mean cell values and the time of its occurrence, which was characteristic of the other cells and of the hemoglobin content, was less pronounced in the case of the lymphocytes and monocytes. With Groups I and II, the lymphocyte curves are very similar but those of the monocytes are less alike; with Groups IV and V, the monocyte curves up to their last periods have a general resemblance to each other while the lymphocyte curves are frequently dissimilar. Thirdly, the general trend of cell level shown by the lymphocytes was one of increasing values in the late winter and spring months while lower values prevailed in the fall and winter. In the case of the monocytes, a similar but less consistent trend toward higher numerical values was observed and in addition to a late winter and spring rise, there was some indication that higher counts were characteristic of the early winter months (Group I, November; Group III, rise of curve from a lower September to a higher November level; Group IV, fall of curve from a higher November to a lower December level). Fourthly, the period of greatest irregularity in the lymphocyte mean values occurred in the late winter and spring months of both years; with the monocytes, on the other hand, this feature was observed in the fall and early summer months of the first year and during the late winter, the spring and the early summer months of the second year.

The significance to be attached to the major changes in the levels of lymphocyte and monocyte mean values is indicated by the following examples of the ratios of the differences of various means to their probable errors.

| Group number | Lymphocytes | | | Monocytes | | |
|---|---|---|---|---|---|---|
| | Dates of mean values | | Ratio | Dates of mean values | | Ratio |
| I | Oct. 24 | June 19 | 3.26 | Oct. 24 | June 5 | 2.94 |
| | Feb. 21 | May 20 | 4.03 | May 1 | June 5 | 3.16 |
| | Mar. 20 | June 5 | 7.72 | | | |
| II | Mar. 29 | May 22 | 5.26 | Mar. 29 | June 19 | 7.91 |
| III | Sept. 20 | Oct. 19 | 1.74 | Sept. 20 | Nov. 22 | 0.92 |
| IV | Nov. 27 | Jan. 2 | 6.61 | Dec. 26 | Feb. 26 | 6.34 |
| | Jan. 2 | Apr. 23 | 3.45 | Feb. 26 | June 18 | 4.96 |
| | Apr. 23 | June 11 | 2.46 | Feb. 26 | Mar. 26 | 3.59 |
| V | Dec. 29 | June 14 | 3.06 | Dec. 26 | June 21 | 2.43 |
| | Jan. 24 | Mar. 8 | 8.92 | May 17 | June 14 | 4.46 |
| | Apr. 19 | June 7 | 3.23 | | | |

The question of the numerical relationship of lymphocytes and monocytes in the peripheral blood has received much attention. In so far as the results on these groups of normal rabbits are concerned, the present findings indicate that a constant and consistent relationship between these cells does not obtain over long periods of time. This feature of the observations may be best appreciated by comparing the respective curves representing the consecutive weekly mean values of these cells (Text-figs. 1 and 2). In certain portions, both curves show similar changes in level during the same weeks, indicating that both classes of cells have undergone analogous numerical changes (Group I, November, May, June; Group IV, January, April, May; Group V, February, April). In other portions, however, the curves move in opposite directions (Group I, December, January, April; Group II, June; Group III, October; Group IV, December, February; Group V, May, June). It is evident, however, that before final conclusions on the lymphocyte-monocyte numerical relationship can

be drawn, the results of experiments of this type must be analyzed from the standpoint of the individual animal.

## CONCLUSIONS

Consecutive weekly observations on the lymphocyte and monocyte counts of the peripheral blood were made on 5 groups of normal rabbits, a total of 45 animals, during a period of 20 months from October, 1927 to July, 1929. Individual groups were examined 8 to 35 weeks. The results are analyzed on the basis of the mean group values of each week.

In the case of the 4 groups followed 13 to 35 weeks, there was a general tendency for the lymphocyte mean values to become increased; with the group observed 8 weeks, the level of mean values showed little change. The general trend of the monocyte mean values was also in the direction of higher levels but it was less pronounced than that of the lymphocytes.

The period of greatest irregularity in the mean values of the lymphocytes was in the late winter and spring months of both years. With the monocytes, periods of fluctuating values occurred in the fall of 1927, the spring and early summer of 1928, and in the late winter, spring, and early summer of 1929.

There was a certain degree of parallelism in the case of two groups examined during the same months with respect to the direction and time of occurrence of a change in the level of lymphocyte and monocyte mean values.

The general levels of lymphocyte and monocyte mean values in the groups examined during 1927–28 were higher than in the groups of 1928–29.

The results based upon the trends of mean group values obtained from consecutive weekly observations showed no evidence of a consistent numerical relationship between lymphocytes and monocytes.

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