A flock showing no carrier birds was free from cholera for the entire period of observation, although other pens on the same farm were infected. Autopsies on cholera and roup-"cold" cases from these flocks yielded organisms bacteriologically similar to those recovered from the nasal clefts of the "healthy" carrier birds.

The various strains from carriers, roup cases, and cholera cases are being studied further. For the most part they are similar, react the same culturally and serologically, and appear identical to the Strain Pa. When administered artificially to chickens, they lead to the same types of reaction as those described above.

We conclude, therefore, that *Pasteurella aviseptica* infection, like that of *B. levisepticum,* is primarily a respiratory disease, with the local manifestations commonly known as roup, "colds," etc., and the general pneumonia-septicaemia phase recognized as fowl cholera. The endemic focus of infection is believed to be the "healthy" nasal carrier or roup—"cold"—case, and the organisms from these various types of clinical disease are considered to be essentially similar.

[1] Hertel (*Arb. a. d. Kais. Gesundheitsamt,* 1904, xx, H. 3) and Müller (*Monatschr. f. prakt. Tierheilk.,* Stuttgart, Enkes Verl., 1910, xxi, H. 9, No. 10) reported similar results.

[2] Webster, Leslie T., *J. Exp. Med.,* 1924-1927.

3729

Bone Marrow as an Organ.

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Before the mechanism of bone marrow as an organ could be analyzed, certain factors had to be clarified, among which are the structure of its vascular system and the maturation of blood cells. Chart 1 shows maturation as a constantly changing process with more than one variable. There are two critical points, (1) where the specific granules begin, and (2) where the last division of the myelocyte has taken place, giving a reduction to a common size and state of maturity, the leucocyte. The myelocytes are classified according to the number of granules, type A, having the first small clump of granules; type B, showing increasing numbers, and type C, the cell with the maximum number.

Supravital differential counts of blood and bone marrow of 5 normal and 2 abnormal rabbits are given in Tables I-III. Each survey included the epiphysis and shaft of each of the long bones and one rib. Table I shows that the normal rabbit's marrow contains about 70% granulocytes to 25% nucleated red cells. In early embryonic stages, only red cells are formed; during fetal stages, white cells are minimal; in the new-born rabbit the erythroid-myeloid ratio of the bone marrow is nearly the reverse of that of the adult.

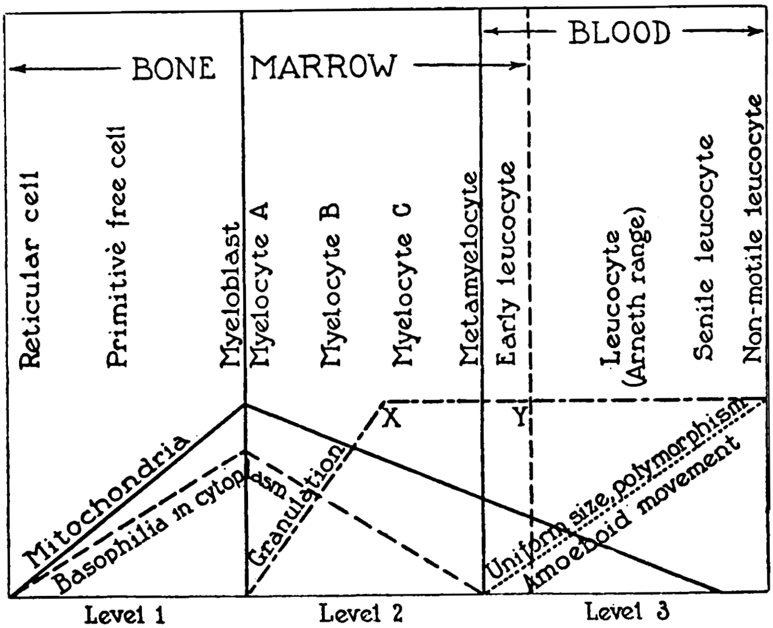

CHART 1. Diagram of the maturation of granulocytes.

The proportions of the stages of granulocytes are shown in Table II. The first 5 rabbits had normal blood and bone marrow, and in them the major supply of cells was of myelocytes C—(85%) with minimal numbers of types A and B and myeloblasts. The delivery of granulocytes from normal bone marrow is rhythmic, based on rhythmic and orderly division and maturation; the mechanism of delivery depends on a reciprocal relationship between myelocytes C and early leucocytes. The last 2 rabbits had a leucocytosis, pseudo-eosinophiles 71% and 68%, with the normal at 44%. Corresponding to this change in the blood, the marrow had a characteristic pattern; in Rabbit 19 B myelocytes type B were 19.29%; in Rabbit 13 B, the type B were 48.59% and type A 2.87%. This is a shift toward the immature stages detected by cytoplasmic criteria, comparable to the Arneth "shift to the left" for the leucocytes.

The classification of myelocytes by the number of granules is a more sensitive index than their changing chemistry, for the term "promyelocyte", the cell with unripe granules, combines types A and B and probably part of type C into one group.

The pattern of the marrow for red cells (Table III) shows that the major supply is at the stage of the normoblast (69%) with smaller numbers of late erythroblasts and minimal numbers of early erythroblasts and megaloblasts. The delivery of red cells is through a reciprocal relationship between normoblasts and the reticulated red cells.

TABLE I.
Showing the erythroid-myeloid ratio in blood and bone marrow in rabbits. Supravital technique.

Rabbit No.	Peripheral blood.			Bone marrow.			Number of cells counted
	W.B.C.	Myeloid cells	R. B. C.	Total myeloid	Total erythroid	All other cells	
		(Total No.					
1B	15,900	42% (6678)	6,360,000	72%	26%	2%	4800
2B	12,600	40% (5040)	6,130,000	71%	27%	2%	4200
3B	14,900	45% (6705)	5,800,000	71%	19%	10%	7500
6B	11,900	48% (5712)	6,230,000	71%	21%	8%	7300
7B	8,900	46% (4094)	5,230,000	68%	28%	4%	6500
13B	12,200	83% (10,120)	5,610,000	63%	27%	10%	4800
19B	14,800	71% (10,508)	6,050,000	59%	37%	4%	5900

TABLE II.
Showing the percentage of types of cells within the myeloid group in bone marrow in rabbits. Supravital technique.

Rabbit No.	P. M. N.	Neutrophilic myelocytes			Myelocytes		Myeloblasts	Myeloid cells counted
		C	B	A	Eosinophilic	Basophilic		
1B	3.15	92.10	1.84	0.11	2.06	0.74	0.	3,484
2B	7.34	79.38	8.35	0.43	2.37	1.57	0.56	2,988
3B	3.96	87.33	3.46	0.58	2.10	0.40	2.17	5,277
6B	1.93	90.87	3.16	0.36	1.22	0.84	1.62	5,215
7B	7.13	78.33	5.09	0.56	4.58	2.98	1.33	4,358
Average for five normal rabbits	4.66	85.72	4.36	0.41	2.45	1.29	1.11	21,322
19B	19.99	54.43	19.29	0.76	2.36	2.95	0.22	3,514
13B	8.78	32.27	48.59	2.87	3.60	2.97	0 92	3.027

TABLE III.

Showing the percentages and total numbers of all the cells of the bone marrow in rabbits. Supravital technique.

Rabbit No.	P. M. N.	Neutrophilic myelocytes			Myelocytes "C"		Myeloblasts	Primitive	Clasmatocytes	Megakaryocytes	Monocytes	Lymphocytes	Red blood cells			Total cells counted
		C	B	A	Eosino-philic	Baso-philic							Normo-blasts	Erythro-blasts	Megalo-blasts	
1B	2.28%	66.47	1.34	0.06	1.44	0.53	0	0	0.44	0.49	0.36	0.06	22.83	3.70	0	
	110	3209	65	4	70	26	0	0	22	24	18	3	1097	179	0	4827
2B	5.18%	55.93	5.87	0.30	1.67	1.08	0.40	1.25	0.28	0.47	0.18	0.07	20.78	6.44	0.04	
	220	2371	249	13	71	46	17	53	12	20	8	3	881	273	2	4239
3B	2.71%	61.30	2.43	0.40	1.47	0.29	1.51	9.91	0.23	0.26	0.05	0.09	15.15	4.05	0	
	209	4607	183	31	111	22	114	745	18	20	4	7	1139	305	0	7515
6B	1.39%	64.80	2.17	0.25	1.06	0.53	1.09	6.49	0.87	0.51	0.05	0	13.40	7.34	0	
	101	4739	159	19	78	39	80	475	64	38	4	0	980	537	0	7313
7B	4.85%	53.31	3.46	0.37	3.12	2.02	0.81	1.87	0.96	0.79	0.10	0.01	14.31	13.85	0.01	
	311	3414	222	24	200	130	57	120	62	51	7	1	917	887	1	6404
13B	5.47%	20.44	30.53	1.80	2.26	1.83	0.58	7.86	1.08	0.62	0.08	0.02	17.39	9.96	0	
	263	983	1468	87	109	89	28	378	52	30	4	1	836	479	0	4807
19B	11.77%	32.14	11.39	0.45	1.39	1.74	0.13	2.23	0.94	0.63	0.05	0	22.40	14.74	0	
	701	1913	678	27	83	104	8	133	56	38	3	0	1335	878	0	5957

The structure of bone marrow is adapted to the maintenance of an erythroid-myeloid ratio, the regulation of the proportion of the stages of maturation of both red and white strains, and the delivery of cells to the blood. The regulation of these factors is in part vascular and in part chemical. With red cells developing in collapsed capillaries, and white cells developing extravascularly near dilated sinuses, the mechanism that controls the proportion of collapsed to dilated sinuses regulates in part the erythroid-myeloid ratio. The chemical forces that act on the marrow cells, as distinct from those that act on the endothelium, are divided into two activities: chemotactic factors (C) that attract the cells into the blood, and growth-stimulating, or maturation (M) factors for both red and white strains. Certain chemotactic factors for the white cells are known—bacterial proteids and the physiological product, nucleic acid. A maturation factor for red cells has been discovered by Minot and Murphy[1, 2] in liver.

1 Minot, G. R., and Murphy, W. P., *J. Am. Med. Assn.*, 1926, lxxxvii, 470.

2 Murphy, W. P., and Minot, G. R., *Boston Med. and Surg. J.*, 1926, clxxxxv, 410.

3730

Vitamin B Testing Revised.

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The demonstration by Smith and Hendrick,[1] Goldberger and coworkers,[2] and others[3] in this country that what we have called vitamin B is composed of at least two factors, each with specific functions and properties, necessitates the revision of existing vitamin B tests. In England, Chick and Roscoe[4] have been able to confirm the contentions of Goldberger. They showed that wheat embryo is distinctly richer in antineuritic factor than in antipellagric factor, by utilizing autoclaved yeast as the source of antipellagric and a preparation of Peters to supply the antineuritic. The Peters' fraction was separated by Kinnersley and Peters[5] of Oxford University by controlling the selective adsorption of norite. During the past year Williams and Waterman of our laboratory have also succeeded in separating a yeast fraction which is antineuritic, but is apparently