tube D to a depth of 1 cm. Its function is to prevent any gas from the basal metabolism apparatus from escaping through the levelling device.

The constant pressure trap (4) should contain enough water to immerse tube E to a depth of 5 cm. This trap insures a constant supply of oxygen at 5 cm. pressure to the water valve (2). Excess supply of oxygen to tube E leaves the bottom of the tube.

If a record of oxygen consumption is required, as in determining oxygen deficits, a spirometer filled with oxygen, weighted to deliver gas at 5 cm. pressure and containing a volume recording device may be connected to the levelling device in place of the constant pressure trap (4). A simultaneous graphic record of respiration and oxygen consumption (Graph I) will thus be obtained.

Summary. The levelling device described makes it possible to record horizontal respiratory graphs by means of a continuous inflow of oxygen, automatically regulated to correspond to the patient's oxygen consumption. Any gas mixture desired may be kept constant during the test period since the oxygen concentration in the basal metabolism circuit remains within $\pm 0.5\%$ of the original concentration. With the use of an auxiliary recording spirometer, it is possible to record oxygen consumption and respiratory tracings simultaneously. Oxygen deficit may be accurately recorded.

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The Blood Picture in the Alarm Reaction.

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It has recently been shown that if the general condition of an animal is seriously injured by acute, non-specific damaging influences, such as exposure to cold, surgical injuries or intoxication with sublethal doses of various drugs, a characteristic symptom complex appears which has been called the "alarm reaction". It is probably the expression of the defence of the organism against damage as such. The anatomical changes seen in this syndrome have been described in previous reports.[1, 2] The principal ones are thymus, spleen and lymph gland atrophy; marked tendency towards

[1] Selye, H., *Nature*, 1936, **138**, 32.

[2] Selye, H., *Br. J. Exp. Path.*, 1936, **17**, 234.

edema formation; adrenal enlargement; and gastric and intestinal ulcers.

The severe changes in the lymphatic system made it likely that the alarm reaction would also influence the white cell count of the blood. The demonstration of constant changes in the blood picture seems desirable, because they would also be of diagnostic significance for the recognition of the alarm reaction during life.

Numerous workers have studied the effect of exercise, surgical shock, cold and drugs on the leucocyte count of the blood. Leake[3] found that subcutaneous injections of morphine caused a polymorphonuclear neutrophilic leucocytosis. Congo[4] also showed an increase in the neutrophils after treatment with pilocarpine, eserine and adrenalin. Josey and Lawrence[5] observed a moderate neutrophilic leucocytosis in the guinea pig after prolonged exposure to cold. Schultz[6] noted that after operative procedures there was an increase in the neutrophilic leucocyte count, and Weindrach[7] found a similar increase in the human after severe exercise. Borchardt[8] observed that the leucocytosis usually produced by drugs (pilocarpine, choline) in the cat is not seen after adrenalectomy, but since the adrenalin leucocytosis is also prevented by suprarenalectomy he does not agree with previous investigators who considered nonspecific leucocytosis to be the result of increased adrenalin secretion.

In order to determine whether the above mentioned changes are specific or simply the result of slight alarm reactions, we studied the blood picture changes following exposure to various damaging agents coincident with the symptoms of the alarm reaction caused by such stimuli. These experiments, which we should like to report here, allowed us to determine the repercussion of the alarm reaction on the blood count.

Both rats and mice were used for our experiments; the former were 2½ months old, the latter 2 months old. The blood of each experimental animal was examined both before and after the experiment, in order to avoid errors due to individual variations in the white cell count. Eight animals were used in each series.

In the first series, an alarm reaction was elicited by means of drugs such as adrenalin and formaldehyde. Adrenalin was given subcutaneously twice daily, the rats receiving 0.2 mg., the mice 0.15 mg.

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[3] Leake, C. D., *J. Am. Med. Assn.*, 1922, **78**, 1687.

[4] Congo, W. J. R., *J. Lab. and Clin. Med.*, 1927, **13**, 206.

[5] Josey, A. I., and Lawrence, J. S., *Fol. Haematol.*, 1932, **48**, 303.

[6] Schultz, G., *Deutsch. Arch. f. klin. Med.*, 1893, **51**, 234.

[7] Weindrach, G., *Fol. Haematol.*, 1929, **38**, 276.

[8] Borchardt, W., *Naunyn-Schmiedebergs Arch.*, 1929, **139**, 47.

per dose. Formaldehyde was given subcutaneously twice daily in doses of 0.5 cc. of a 4% solution to rats, and 0.2 cc. of the same solution to mice. Forty-eight hours after the initial injection, there was lymphopenia with marked leucocytosis due to an increase in the number of polymorphonuclear-neutrophiles. Lethal doses of formaldehyde, on the other hand, caused leucopenia which became so marked that in the terminal stages white cells had almost completely disappeared from the blood.

In the second series, the alarm reaction was produced in rats and mice by exposure to cold. The rats were placed into an icebox at a temperature of 0°C. for 5 hours a day on 2 consecutive days. Since their fur protects them very well from cold, we found it advisable to wet their skin before the exposure. In the case of the mice this was not necessary, and exposure to 0°C. twice daily for 3.5 hours on 2 consecutive days was found sufficient to elicit an alarm reaction. Forty-eight hours after initiation of treatment, they showed leucocytosis and lymphopenia. Counts made immediately after the last exposure to cold, at a time when the animals were obviously seriously damaged, showed an inverse response—that is, leucopenia.

In the third series, an alarm reaction was elicited by means of surgical shock. This was produced in the rats by gentle handling of the intestines exposed aseptically through a small abdominal incision for 4 minutes, and in the mice for 1.5 minutes. Forty-eight hours after the operation, leucocytosis again due to increase in neutrophiles was observed.

In the fourth series, the alarm reaction was elicited by means of excessive muscular exercise in a revolving cage having a diameter of 12 inches and running at 18 revolutions per minute. The rats

TABLE I.
Average white cell count in the alarm reaction.

	Normals	Formaldehyde	Adrenalin	Cold	Surgical Shock	Exercise
			Rats			
Total white cell count	13,034	25,264	22,700	22,800	25,800	24,600
Polymorphs	35	76	71	78	84	64
Small Lympho.	58	17	24	14	11	31
Large Lympho.	7	7	5	8	5	5
			Mice			
Total white cell count	8,832	18,540	20,010	13,300	17,540	16,800
Polymorphs	38	69	68	68	63	58
Small Lympho.	56	25	26	26	31	33
Large Lympho.	6	6	6	6	6	9

were exercised for 0.5 hr. twice daily the first day, and 0.75 hr. twice daily the second day; the mice 0.5 hr. twice daily on two consecutive days. Forty-eight hours after the initiation of the experiment, marked neutrophilic leucocytosis was observed. Our findings are summarized in Table I.

Summary. We conclude that the total white cell count increases mainly as a result of neutrophilic leucocytosis during the alarm reaction. At the same time, there is relative lymphopenia. Following exposure to very severe alarming stimuli, a period of leucopenia precedes this characteristic reaction. Leucopenia is observed throughout the whole experiment in those cases in which the animal was unable to resist the alarming stimulus so that death ensued.

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Effects of Ovariectomy on Body Growth and Organ Weights of the Young Albino Rat.

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Freudenberger and Billeter[1] studied the effect of spaying on body growth and the organ weights of the albino rat. In their series the ovaries were removed from the experimental animals at an average age of 26 days. All animals were completely autopsied at 6 months of age. Differences in body growth between experimental and control rats as well as many differences in organ weights were noted. Lawless[2] has recently called attention to the fact that observations published regarding the effects of castration usually concern only that characteristic which it is sought to influence, so that the published reports do not furnish a complete picture of all the changes in a castrated animal. He stated that a study of all the observable changes resulting from castration in one species would therefore seem desirable. These two statements apply equally well to the studies concerning the effects of bilateral ovariectomy. We are, therefore, carrying our studies further on this problem. We wish to present here the results of bilateral ovariectomy on young albino rats as noted when the animals were about 3 months of age. Only brief mention will be made of the literature, since the more important articles have been referred to by recent writers.[1, 3]

[1] Freudenberger, C. B., and Billeter, O. A., *Endocrinology*, 1935, **19**, 347.
[2] Lawless, J. J., *Anat. Rec.*, 1936, **66**, 455.
[3] Holt, H., Keeton, R. W., and Vennesland, B., *Am. J. Physiol.*, 1936, **114**, 515.