Since we were more interested in any shift which might occur in the usualness and type of association than in the association time, the latter was not determined and the experimental subjects wrote the association words as answers to the stimulus words which were dictated to them. Twenty-nine control and O_2-lack experiments, in which the distribution of the associations according to their frequency was determined by the Kent-Rosanoff tables, were calculated as the control experiments described above. The result represented in the thin line of Fig. 1 is that O_2-lack brings about a marked shift in the type of response toward the more individual reactions. Moreover, it is found that the number of perseverations (repetition of the same response) increases under O_2-lack to an extent inversely proportional to the O_2-concentration inhaled. Finally, it must be mentioned that under such O_2-lack not infrequently entirely irrelevant reactions (dissociations) occur.

Experiments in which the effect of various O_2-concentrations on associations was studied on the same subject proved strikingly that the changes in associations mentioned above are due to O_2-lack, since they gradually increased with decreasing O_2-concentration. One illustration may be given in the following table, which is self-explanatory:

THE INFLUENCE OF O_2-LACK ON ASSOCIATONS. SUBJECT W

	Number of perseverations	Number of dissociations
Control	3	0
9.8 per cent. O_2	7	0
8.65 per cent. O_2	10	3
7.93 per cent. O_2	15	9

CO_2 experiments (6 to 9 per cent.) were carried out under similar conditions with similar results. In general, the CO_2 effect is less than that of O_2-lack.

This holds true, also, for the effects of hyperpnea. But in all three groups of experiments the resulting changes in the association response were the same and consisted in: (1) an increased number of individual and less frequent reactions; (2) an increased number of perseverations; (3) the occurrence of dissociations. It is obvious from these results that the alteration in cortical excitability due to O_2-lack, CO_2-excess and hyperpnea leads to similar changes in vision and hearing, as well as in associations, whereas CO_2-excess and diminution in CO_2 due to hyperpnea have opposite effects on tendon[3] and vestibular[4] reflexes. As to the type of change in associations observed in our experiments, it may be said that it is similar to those observed in some mental diseases.[5] There was no general parallelism between the discomfort felt by the subjects (dyspnea, etc.) and the changes recorded.

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THE INFLUENCE OF THE ADRENAL GLANDS ON CALCIUM METABOLISM[1]

IN a previous communication,[2] one of us summarized evidence indicating a functional interrelationship between the adrenal and parathyroid glands. Mention was made of observations on disturbances in calcification of dentin in rats' incisors induced by excess of parathyroid extract. These changes were found to be similar or identical with those which follow bilateral adrenalectomy in rats.

Characteristic disturbances in calcification of dentin occur in the incisors when both adrenal glands are excised, in rats. They are manifested by the presence of globules disseminated throughout the predentin of the middle third of the incisor.

The "globular predentin" stains, with eosin and haematoxylin, like intermediate dentin. It was not present in nearly a thousand rats that were observed in other studies, in which adrenalectomy was not performed, except in three animals that received single large doses of parathyroid extract and were examined 19 hours later.

Other evidences of disturbed calcification in the dentin are deep staining of the labial dentin by haematoxylin and prominent stratification in the lingual dentin. In adrenalectomized animals that survived up to about 10 days the post-operative dentin could be distinguished from the pre-operative by the presence of a deeply stained band corresponding to the portion of dentin that was laid down and calcified about the time of the operation. The presence of this band permits measurement of the post-operative dentin. The organic matrix of the dentin is laid down at the rate of 16 μ daily, therefore, the width of the post-operative dentin, expressed in μ, when divided by 16 will yield the survival period of the animal. The calculated survival period corresponded remarkably with the actual period noted in our experimental records.

In adrenalectomized rats whose survival was prolonged by the presence of accessory adrenal bodies, the characteristic globular predentin was absent. They showed changes similar to those found in rickets, *viz.*, wide predentin (40–84 μ) and prominent inter-

[3] C. E. King, W. E. Garrey and W. R. Bryan, *Am. Jour. Physiol.*, 102: 305, 1932; Strughold and Jörg, *Zeitschr. f. Biol.*, 94: 150, 1933.

[4] Gellhorn and Spiesman, *loc. cit.*

[5] Kent and Rosanoff, *loc. cit.*

[1] From the Department of Histology, College of Dentistry, University of Illinois, and the Physiological Laboratory, University of Chicago. This investigation was

globular dentin. This observation suggests the probability of a relation of disturbed adrenal function to the calcium disturbances associated with the development of rickets.

The results obtained in our experiments afford interesting information on calcification processes of enamel and dentin. In a small number of animals the enamel-forming cells (ganoblasts) showed intracellular globules which stained deeply with haematoxylin.

Occurrence of globular predentin in adrenalectomized rats, as in animals that were subjected to the action of parathyroid extract, confirms the observation that adrenal insufficiency is associated with disturbances in calcium metabolism.[3] It also lends support to the suggestion of a functional interrelationship between the adrenal and parathyroid glands. Indeed, it seems possible that the disturbances in calcium metabolism, which lead to the changes in the dentin, in adrenalectomized animals, may be the result of functional disturbances in the parathyroid glands. Although evidence favors the probability that the adrenal cortex is primarily involved, the possible relation of the medulla has not been excluded in these experiments.

The foregoing summarizes our observations on a series of 45 bilaterally adrenalectomized rats. Details of the experiments will be included in another paper, to be published elsewhere in the near future.

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LIGHT AND REPRODUCTION IN GAME BIRDS[1]

GROUSE, quail and pheasants were irradiated in open air cages for six hours after sunset from December 14, 1935, to January 16, 1936, at the Experimental Game Farm of the New York State Conservation Department. A 50-watt Mazda lamp suspended over each experimental cage gave an illumination of 10 foot-candles in the center of the floor.

Due to the cost of the birds, few could be sacrificed, but the following results showed undoubted effects.

Pheasants: Hatched on August 8, 1935. In five control females weights of ovary varied from 72 to 160 milligrams. In the single experimental animal, ovary weighed 176 milligrams, an increase of 31 per cent. over control average. In five male controls, weights of testes were from 70 to 164 milligrams. In one experimental bird, the weight of the testes was 702 milligrams, an increase of 463 per cent.

Quail: Hatched in spring, 1935. In three female controls, ovary weighed 48 to 57 milligrams, with an average of 52 milligrams. One experimental female yielded an ovary weighing 210 milligrams, an increase of 307 per cent. In three male controls, weights of testes were from 13 to 23 milligrams with an average of 18 milligrams. One experimental bird gave testes weighing 313 milligrams, an increase of 1,740 per cent.

Grouse: Hatched in spring, 1935. Single female control gave an ovary weighing 157 milligrams, and an experimental female gave an ovary of 263 milligrams, an increase of 68 per cent. A single male control gave testes weighing 27 milligrams, while an experimental bird yielded testes weighing 600 milligrams, an increase of 2,080 per cent.

Although the number of experimental birds is small, the great differences between the size of the gonads in control and irradiated pheasants, quail and grouse show that light has a profound stimulating effect upon the reproductive organs. Sections of the testes of the irradiated males revealed fully formed sperm associated with enlarged tubules, but not a single sperm or spermatid was seen in the control testes. The females in all cases did not respond to the same degree as the males. However, hormonic stimulation of the ovaries of the irradiated females was observed by the enormous increase in the size of the oviducts.

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ANOPHELES EXPERIMENTALLY INFECTED WITH MALARIA PLASMODIA

DURING a recent study of anopheline mosquitoes caught in dwellings on the military reservation at Fort Sherman, Canal Zone, the author found a specimen of *A. punctimacula* which was naturally infected with malaria plasmodia, the stomach showing five oocysts, all of which contained sporozoites. Since this observation, which was reported at the 1935 meeting of the American Society of Tropical Medicine,[1] experiments have been conducted with a view to determining the relative importance of *A. punctimacula* as a malaria vector.

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2 J. M. Rogoff, SCIENCE, 80: 319, 1934.

3 J. M. Rogoff and G. N. Stewart, *Am. Jour. Physiol.*, 86: 25, 1928.

1 Research supported in part by assistance of grant-in-aid of the Society of Sigma Xi and the Rockefeller Foundation.

1 J. S. Simmons, "*Anopheles* (*Anopheles*) *punctimacula* Naturally Infected with Malaria Plasmodia." Read by W. H. W. Komp at the meeting of American Society of Tropical Medicine, St. Louis, Mo., November 20–22, 1935. To be published in the March issue of the *American Journal of Tropical Medicine.*