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.

aided by grants from the Graduate Research Board of the University of Illinois and the Commodore Beaumont Foundation.

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.*

It is the purpose of this progress note to announce that during February, 1936, it has been shown experimentally that laboratory-reared *Anopheles* (*Anopheles*) *punctimacula* (Dyar and Knab) when fed on the blood of suitable malaria patients, are susceptible to infection with either *Plasmodium vivax* or with *P. falciparum*.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

DEVICE FOR THE MOTOR CONDITIONING OF SMALL ANIMALS[1]

SOME time ago[2] a conditioning apparatus for use with cats was published from this laboratory. That piece gave useful service, but another apparatus is now available which far excels it in speed and reliability of training and testing.

The present model is adapted from the ordinary rotating cage, used for measuring the general activity of small animals; and is so constructed that the cat, upon turning the cage an inch or more when the sound (substitute stimulus) begins, escapes the shock by breaking the high-voltage circuit through a pendulum-switch. Details of construction, as provided in mimeographed form by the technical staff of this laboratory, will be furnished gratis upon application to either of us.

In testing the apparatus, a considerable number of animals (20 cats, 12 guinea pigs, 5 male white rats) were first used. By our earlier methods of training, a large proportion of cats always proved intractable; hence we decided to try every cat in our colony and thus find what proportion of an unselected population would work acceptably. By this preliminary test (15 to 25 trials with 1,000 cycle tone) they were divided into three groups: A, those which began reacting to the tone during these initial trials (8); B, those which by reacting well to the shock gave promise of early conditioning (9); C, those which, being unresponsive, were discarded (3). Those in A and B were then given 25 additional trials, the percentage of conditioned responses (shock avoidance) being as follows:

Group A	96%	96	88	88	64	40	40	36	
Group B	84%	64	60	48	40	24	20	8	8

Despite these encouraging results, the crucial question still remained: How will the rotator work in limen-determination? It is here that most methods fail. Cats will often do well enough with loud or complex sounds; but when a sinusoidal stimulus of low intensity is used, they may fail to react even once to tones which are known to be quite audible to them. Then, for reasons just as obscure as their former refusal, they may suddenly begin responding at a level many decibels weaker than before. With faint stimuli cats are notoriously erratic.

Two cats were accordingly chosen for threshold work, the limens being measured at three frequencies (125, 1,000 and 8,000 cycles) with the technique regularly employed at this laboratory;[3] see adjoining table.

Cat	125 cycles 1	125 cycles 2	1,000 cycles 1	1,000 cycles 2	8,000 cycles 1	8,000 cycles 2
	52	50	68	68	40	46
	54	50	70	66	36	46
	50	48	70	66	38	44
	50	46	70	68	36	44
	52	48	68	64	36	44
Mean	51.6	48.4	69.2	66.4	37.2	44.8
Standard error of mean ...	0.75	0.75	0.49	0.75	0.80	0.49

These limens, measured directly after the initial 50 trials, are as consistent (low standard errors) as are the scores of representative dogs after weeks or even months of training (*cf.* footnote 3, 226). Since these initial tests, we have used the method with many other cats in our systematic programs and have found it equal in reliability and far superior in speed to our dog-training methods.

The guinea pigs scored as follows in the second of two series of 25 trials (numbers represent percentage of conditioned responses): 88, 64, 52, 48, 20, 20, 20, 20, 20, 16, 8, 8. Though somewhat inferior to the cats, they did better than was expected. Their explosive mode of response makes them peculiarly refractory to ordinary methods of training; apparently because the conditioned stimulus must be built up to unusual potency ere it can break down the high initial resistance of the pig's sensori-motor system. In view of their thyratron-like behavior, the scores of the pigs in the rotator seem to be notably good. The five rats, finally, gave these scores in the second 25 trials: 64, 60, 40, 44, 36.

Credit for suggesting the use of a rotating cage in this type of work is due the first-named author; but we share the conviction equally, derived both from quantitative evidence like the above and also from observing the animals when they work, that a real advance has been made in the business of training laboratory animals. The rotator combines various advantages. (1) It employs the shock-incentive, which, unlike food, is stable and unfailing, even when the animal's economy, visceral or somatic, is gravely disturbed (newly op-

[1] Communication No. 20 from the Animal Hearing Research, Department of Psychology; maintained by aid of the Research Council of the American Otological Society. The present investigation was aided by a grant from the Josiah Macy, Jr., Foundation.

[2] Culler, Finch and Girden, SCIENCE, 79: 525, 1934.

[3] Culler, Finch, Girden and Brogden, *Jour. General Psych.*, 12: 223, 1935.