consists of a glass mouth-piece of 10 mm. bore of convenient length connected to some length of rubber tubing, which in turn is joined to a 'Y' tube of the same size. The 2 tubes of the Y are each connected by rubber tubing to other Y tubes of approximately 7 mm. bore. A third series of Y tubes of approximately 4 mm. bore serve to attach the delivery tubes of 2 mm. bore and which are approximately 30 cm. long. By immersing 8 small delivery tubes to the bottom of the partially filled battery jars and by blowing forcefully as in testing vital capacity in the usual way the gas from one tube is collected in the graduate cylinder. Assuming that each tube delivers approximately one-eighth of the total gas escapement in the experiment the total volume can easily be computed.

The coefficients of correlation found between results in this spirometer and results in the Tyces and Sanborn commercial spirometer are +0.85 and +0.88 respectively, computed on the basis of 154 cases.

5144

Effects of Total Absence of Function on the Optic System of Rabbits.

LOUIS GOODMAN. (Introduced by W. F. Allen.)

From the Anatomy Department of the University of Oregon Medical School.

Despite numerous experiments on the various morphogenetic factors involved in the development of the central nervous system, the effect of normal physiological stimulation of an end organ on that end organ and on the corresponding brain centers is still little understood. The rôle of function in post-embryonic growth and differentiation of an established functional nerve tract in mammals has received but slight attention. In regard to the visual apparatus, 2 procedures have been used—extirpation of eyes, and sewing of eyelids. The results of extirpation on the visual cortex vary with the animal used, its age, and the experimenter; but the effects on the optic nerve and superior colliculus are uniform. The interpretation of such results from standpoint of lack of function is physiologically unsound as there are complicating factors of traumatic and secondary degeneration, and Von Gudden's degeneration. The results of sewing of eyelids likewise vary with the animal and the experimenter. Whereas Von Gudden noticed no changes in the cerebral cortices of rabbits whose eyes had been enucleated or eyelids sewn at birth,

Berger (1900), in artificial ankyloblepharon in cats and dogs found no macroscopic or cytological changes in any part of the optic system except the visual cortex, where he noticed an arrested development both grossly and microscopically. This he attributed to reduced function, though he admitted that all light was not excluded, and suggested that atrophy of the optic nerves and lower reflex centers would probably have also occurred if all light had been excluded. Not much advance has been made since.

A technic is required which removes function completely, allows the tract under investigation to remain anatomically intact, and permits absence of function to be the only variable. Rabbits were born in a dark room of special construction. The total absence of light was proven by exposure of panchromatic films for hours. When developed, these films showed no clouding whatsoever. The diet and cleanliness of the animals were carefully tended. Rabbits were removed at monthly intervals, the last group being 6 months old, and their weight, size, eyes, and brains carefully compared with their specific controls. The animals were born and killed in the dark, and at no time have they seen light. The experiments were not only controlled by normals, but also by enucleation and lid sewing experiments. The left eye was removed or lid closed, the unoperated side acting as control in each instance (there is almost complete decussation in the rabbit). Some of these animals were reared in the light, and others in the dark room along with the rabbits comprising the main experiment. In this way, then, the results of enucleation, sewing, and total absence of function could be compared.

The present report deals with the gross results of the first 3 months of the dark room experiments. The rabbits showed excellent growth when compared with their controls. The eyes, optic nerves, superior colliculi, lateral geniculate bodies, and cerebral cortices showed by careful observation and measurements, no differences not as easily demonstrated in any unselected group of normal controls of the same age and weight. The cortex of the experimental rabbit removed at 3 months could be differentiated from that of its particular control, but that this differentiation was not based on any fundamental alterations in structure is indicated by the fact that when the experimental brain was placed in a series of 8 normal rabbit brains of the same or greater age, it could not be picked out. The striking difference between the results of extirpation of an eye and the removal of function may be illustrated: One of the dark room animals had its left eye excised on the tenth day after birth, and was killed at one month. The cerebral stump of the left

optic nerve, and the right optic tract and colliculus showed the typical Von Gudden picture of degeneration. The right unoperated optic nerve, and left tract and superior colliculus, which were anatomically intact but had never functioned, could not be differentiated from a normal control of the same age reared in the light. The occipital regions at this stage showed no alterations, nor could the 2 cortices be told from those of the control. This shows strikingly the difference between the 2 technics, and points toward the invalidity of removal of an end organ as a physiological method of inquiry into the effects of lack of function on the neurones of the second and third order.

5145

The Question of Sex Hormone Antagonism.*

CARL R. MOORE AND DOROTHY PRICE. (Introduced by B. H. Willier.)

From the Hull Zoological Laboratory, the University of Chicago.

The preparation of active hormone substances in the Department of Physiological Chemistry and Pharmacology and the development of testis hormone detection methods for the laboratory mammal in the Department of Zoology has enabled the Chicago group[1] during the last 4 years to study more directly, by injections, the effects of separate or combined sex hormone action in the rat.†

The results here given have been the basis for a new conception regarding the interaction of hypophysial and gonadal secretions in the organism, which effectively removes the troublesome notion of sex hormone antagonism as an interpretation.

Injections into the castrated male gave results upon the male ac-

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[1] For a review of our publications on this work see papers by Gallagher and Koch, *J. Biol. Chem.*, 1929, **84**, 495; Moore and collaborators, *Am. J. Anat.*, 1930, **45**, Gallagher and Koch, Moore and Gallagher, *J. Phar. and Exp. Therap.*, in press.

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