virgin does between 3 and 4 months old and were obtained from the same source. One hundred and nineteen determinations were made on 31 pregnancies. Of 39 fractional tests, 2 were positive with .05 cc. of urine; 10 with .1 cc., and the remaining 27 required .5 cc. or more.

Sixty-two similar determinations were made on 10 cases of excessive vomiting, 4 of which were of the pernicious type. Of 16 tests on these patients, one, associated with a hydatidiform mole, was positive with .01 cc. and .0075 cc.; 4 were positive with .0125 cc.; 6 with .05 cc. and 4 with .1 cc.

Due consideration was given to the concentration of urine as evidenced by the specific gravity, since I[2] have previously shown that this is a factor in the amount of urine required to produce a positive reaction.

In 5 of the vomiting cases, followed to date, it was found that the amount of urine required to produce a positive reaction increased as the symptoms improved.

Although the amount of urine required to produce a positive reaction varies considerably in the normal cases, it would seem that the discrepancy between that group and the vomiting cases is too great to be explained by simple concentration of urine or normal variation.

7679 C

Sweat Secretion Produced by Pilocarpine in the Cat.*

J. C. HINSEY AND C. C. CUTTING.

From the Department of Anatomy, Stanford University.

Completely denervated sweat glands may be made to secrete by pilocarpine (Langley and Anderson,[1] Langley[2]), in spite of the fact that section of a peripheral nerve may lead to a much diminished secretion, which Burn[3] attributed to the section of the somatic motor fibers rather than to the sensory or sympathetic fibers in the

[2] Schoeneck, F. J., *Am. J. Obst. and Gynec.*, 1932, **23**, 712.

* This study was conducted with the aid of the Rockefeller Foundation Grant for Fluid Research in the Medical Sciences at Stanford University.

[1] Langley, J. N., and Anderson, H. K., *J. Physiol.*, 1904, **31**, 423.

[2] Langley, J. N., *J. Physiol.*, 1922, **56**, 110.

[3] Burn, J. H., *J. Physiol.*, 1925, **60**, 365.

nerve. Burn believed that this was due to circulatory effects produced by muscular inactivity and found that it paralleled the decreased vasodilator response to histamine. Furthermore he found that pilocarpine following deafferentation of the hind limb in the cat produced a diminished response, accompanying the decreased movement and impaired circulation that was present for a time following the operation. This diminution disappeared later on. Burn,[3, 4] further showed that the exaggerated sweat response following sympathectomy was due mainly to the removal of the sympathetic control of the blood vessels and also in some animals to a hypersensitiveness of the denervated glands and vessels to pilocarpine.

Guttmann[5] has reviewed the literature on this problem of sweat secretion in man and has described it as seen in a number of Foerster's patients. He has suggested that the sweat glands have a secretory innervation through the sympathetic chain as well as directly by way of the ventral roots to the spinal nerves, and an inhibitory innervation by way of the dorsal roots (Dieden[6]). Langley[7] denied vigorously that there could be any direct secretory innervation to sweat glands aside from that passing through the sympathetic chain in the cat. He also found a facilitory instead of an inhibitory effect in the cat on stimulation of the 6th and 7th lumbar dorsal roots in case the secretion was already in progress, due, he thought, to the presence of the accompanying dorsal root vasodilatation.

In the case of the human, sweating plays a much more important rôle in the control of body temperature, and the distribution of the sweat glands is much more extensive. However, it would seem strange that there should be wide differences in the distribution of visceral innervation in man and in the experimental animals, in which the only secretory innervation known is by way of the thoracolumbar sympathetic, and no inhibitory innervation by dorsal root fibers has been demonstrated.

In our laboratory we have 4 cats in which the right hind limb has been deafferented for 3 years and sympathectomized for 2 years, 2 animals which have been sympathectomized for 3 years and deafferented for 2 years, and 2 which have been sympathectomized 20 and 22 months respectively. Kennard and Fulton[8] have observed a

[4] Burn, J. H., *J. Physiol.*, 1922, **56**, 232.

[5] Guttmann, L., *Ztschr. f. d. ges. Neurol. u. Psychiat.*, 1931, **135**, 1.

[6] Dieden, H., *Ztschr. f. Biol.*, 1916, **66**, 387.

[7] Langley, J. N., *J. Physiol.*, 1891, **12**, 347.

[8] Kennard, M. A., and Fulton, J. F., personal communication, 1934.

difference in the sweating produced by pilocarpine injected into monkeys in which the premotor area (area 6 of Brodmann) had been unilaterally removed. There was no difference in the sweating produced by pilocarpine following unilateral deafferentation in the monkey. At Fulton's suggestion, we have made some observations on sweating in our series of cats. The sympathectomies consisted of removing the right abdominal sympathetic chain from L2 through L7 and in a number of cases through S1. The deafferentation consisted of cutting the right dorsal roots L4-S2 proximal to the dorsal root ganglia. The somatic motor innervation was still intact in these animals; in fact they walked quite well on the dorsum of the foot in the deafferented limb.

Pilocarpine HCl (5 mg. per kg.) was injected subcutaneously and the pads of the feet were observed for sweating. Care was taken to remove any superficial horny layers of epidermis which had accumulated on the pads of the operated side. The observations were all qualitative and not quantitative. Sweating appeared at about the same time (3 to 5 minutes) on the operated side as on the normal side and seemed to be about the same in amount (observed with hand lens). This was true not only for the 6 deafferented-sympathectomized cats but also for the 2 in which the sympathetic chain alone was removed. Thus it would seem that sweating can take place 2 years after all the known pathways to the skin were interrupted. Furthermore, 20 and 22 months after sympathectomy no increased secretion was seen on the operated side.

These observations demonstrate that 2 years after denervation of the skin, the sweat glands had not atrophied appreciably in spite of their separation from the central nervous system. Furthermore they support Burn's contention that the decreased response to pilocarpine following section of peripheral nerves is due to section of somatic motor fibers which were still intact in our experiments. Inasmuch as in the cat there is no known direct secretory innervation by way of the ventral roots and spinal nerves, the effect of somatic motor impulses must be indirect through their action on skeletal muscles. The preganglionic sympathetic supply to the right hind limb had been completely removed by the abdominal sympathectomy. However, in all of these experiments the 2S ganglion was left in so that a few postganglionic fibers were still present in the foot-pads (Langley[1]). This supply, however, is very slight and it does not seem probable that the sweat which was seen in the foot-pads of the operated side could be attributed to an action of the pilocarpine upon the nerve endings of these fibers. It is more likely that the action was directly upon the gland cells as Langley[2] believed.