animal protein in the diet did not prevent or delay the onset of lathyrism, since characteristic symptoms were observed in 3½ to 5 weeks.

In a second series the effect of cold water extracts of the peas was studied. *Lathyrus* peas were extracted overnight at 0° with distilled water, the fluid decanted and extraction repeated 3 times. The combined extracts were evaporated to a thick syrup *in vacuo*. Edible split peas were similarly extracted. To the split pea residue was added the extract of the *Lathyrus* peas and to the *Lathyrus* residue, the split pea extract. The combined extract and residue in each case were dried in thin layers at 80°, ground finely and incorporated into the diets, as described above. All of the rats receiving the *Lathyrus* extract-split pea residue developed acute lathyrism in from 2½ to 4½ weeks, while none of the rats receiving the split pea extract-*Lathyrus* pea residue diet showed any symptoms in 7 to 8 weeks. It thus appears that the toxic substance is readily extracted from *Lathyrus* meal by cold water and that the extracted residue is relatively non-toxic. This is in accord with the findings of Geiger,[5] who extracted peas with boiling water.

Pathological studies of the bones made with the cooperation of Professor Carl V. Weller revealed changes in the long bones of the leg similar to those observed in acute scurvy. The rat is believed to be able to synthesize ascorbic acid and does not require the preformed dietary vitamin. It was believed that the toxic principle of *Lathyrus odoratus* might either affect the synthesis of ascorbic acid or in some way increase the requirement beyond the capacity of synthesis of the organism. In a third series, rats fed the sweet pea diet were paired, one animal of each pair receiving in addition 12 mg of ascorbic acid. All of the animals showed symptoms of acute lathyrism within the usual period of time. No preventive effect of the ascorbic acid could be demonstrated.

Further experiments designed to determine the nature of the toxic principle are in progress.

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Role of the Premotor Cortex in Human Motor Activity.

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The collateral systems (thalamus, basal ganglia, cerebellum, and premotor cortex) which play such a prominent role in human motor activity are particularly refractory to experimental manipulation, due to the fact that complex motor dysfunction is peculiarly human and has no certain counterpart in lower mammals. It is desirable, therefore, to employ human material for information relative to the motor complex. This report serves to clarify certain points concerning the anatomy and function of the human premotor region.

A patient (aged 38 years) was subjected to bilateral (2-stage) premotor cortical excision (Klemme)[1] for the relief of generalized tremor in both upper extremities, moderate tremor and rigidity of the left lower extremity, and tremor of the tongue. The right side was operated first with relief of the contralateral tremor. The left side was operated 9 months later, the patient expiring on the seventh post-operative day. At no time was there loss of volitional movement, the residua being generalized weakness, more marked on the left, and inability to do finely coördinated movements with the left hand. Degeneration studies with the Swank-Daven-

[1] Klemme, R. M., *Res. Publ. Assn. Nerv. Ment. Dis.*, 1940, **21**, 596.

port and Weigert technics, which showed the effects of the right (old) lesion only, revealed the following relationships. The efferent bundles from the excised region follow two distinct pathways: (1) commissural fibers which pass to the opposite premotor cortex via the corpus callosum; and (2) projection fibers which aggregate on the lateral aspect of the superior part of the lateral ventricle, pass through the posterior limb of the internal capsule and continue through the lateral aspect of the medial one-third of the basis pedunculi, the medial aspect of the corticospinal field in the pons, diffusely through the pyramid, and enter the spinal cord in the medial aspect of the homolateral anterior white column. Insofar as the myelin stain permits, terminal relationships are indicated to thalamus, substantia nigra, brain stem nuclei, and the anterior horn of opposite side in the spinal cord.

The influence of the premotor bundle on involuntary movements incident to diseases of the basal ganglia has been amply demonstrated by alleviation of the movements through surgical interruption of the pathway. Success has attended operations or pathology in which: (1) the premotor area is excised (Klemme,[1] Bucy[2]), (2) parts of the basal ganglia and considerable subcortical tissue is destroyed (Meyers),[3] (3) the internal capsule is damaged by hemorrhage (Wilson),[4] (4) the pyramid is sectioned (Putnam),[5] and (5) the anterior white column in the spinal cord is cut (Putnam).[5] In all these procedures the bundle just described would be interrupted.

This schema of premotor relationships differs from Bucy's[6] parapyramidal system in being a continuous pathway from cortex to spinal cord and is in agreement with Kennard's[7] findings in the monkey. While the differences in the pathway do not make the mechanisms involved incompatible with those outlined by Bucy, we wish to call attention to the relationships of the premotor bundle at the final-common-path cell as an additional factor in the mechanism. Of approximately 4000 terminals ending in relationship to the largest anterior horn cells (Minckler)[8] only 10% are derived from cortical levels. In the light of recent information on synaptic transfer it would seem doubtful that these few terminals could, alone, initiate a discharge at the final-common-path. It is more probable that additional terminals come into play in governing the final discharge. While an irregularity in discharge manifested by involuntary movements may have its ultimate inception in distorted cerebral function (Bucy),[6] the immediate muscle activity is derived through the final-common-path. It would seem, then, that the interrelationships at this point must be included in any explanation of the mechanics of movement.

Summary. The premotor cortex of man gives rise to bundles passing (1) to the premotor cortex of the opposite side and (2) through the internal capsule to thalamus, brain stem nuclei, and spinal cord. Interruption of this pathway alleviates the involuntary movements incident to disease of the basal ganglia. The interrelationships of terminals at the final-common-path are considered important in explaining the mechanism of these movements.

[2] Bucy, P. C., *Res. Publ. Assn. Nerv. Ment. Dis.*, 1940, **21**, 551.

[3] Meyers, R., *Res. Publ. Assn. Nerv. Ment. Dis.*, 1940, **21**, 602.

[4] Wilson, S. A. K., *Modern Problems in Neurology*, William Wood & Co., N. Y., 1929.

[5] Putnam, T. J., *Res. Publ. Assn. Nerv. Ment. Dis.*, 1940, **21**, 666.

[6] Bucy, P. C., *J. Neuropath. and Exp. Neurol.*, 1942, **1**, 224.

[7] Kennard, M. A., *Arch. Neurol. and Psychiat.*, 1935, **33**, 698.

[8] Minckler, J., *Science*, 1942, **96**, 117.