hydrochloride, nicotinic acid, calcium pantothenate, choline hydrochloride, ascorbic acid, inositol and p-aminobenzoic acid, young mice grew at a good rate but after some weeks did not present consistently clean and good looking fur. Increasing the casein and salts or doubling the daily quota of the supplements, or both, failed to improve the appearance or growth of the mice. Feeding fresh beef liver increased the growth rate and improved the pelage. A concentrate of a liver extract had similar but not as pronounced effects. Pimelic acid had no significant effect on growth and certainly no beneficial effect on the pelage, for the time range of these experiments.

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Acetylcholine Esterase Content of Brain Tumors.

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The acetylcholine esterase content of 50 brain tumors, and of 13 brain lesions not neoplastic in character, has been determined by the pharmacological method previously described.[1] All material was obtained immediately following removal in the neurosurgical operating room. The tissue to be examined for acetylcholine esterase content was exposed to the action of no drugs. The acetylcholine esterase activity (Q.CHE.) was determined as the number of milligrams of acetylcholine iodide hydrolized by 100 mg of tissue dry weight in one hour at 37°C and pH 7.61.

The histologic or pathologic structure of the tissue resected at operation and examined for Q.CHE. content was established by multiple sections, fixed in Cajal's formalin-ammonium-bromide solution, and after the appropriate time of fixation stained with, (1) Penfield's second modification of Rio-Hortega's silver sodium carbonate stain, (2) Rio-Hortega's silver lithium carbonate stain, and (3) Cajal's gold chloride sublimate method. Other material fixed in Zenker's fixative was stained with hematoxylin and eosin and with phosphotungstic hematoxylin.

As indicated in Table I, 8 tumors of the astroblastic and astrocytic

[1] Youngstrom, K. A., *J. Neurophysiol.*, 1938, **1**, 357.

TABLE I.

Type of tumor	No. of specimens	Q.CHE. Range	Q.CHE. Avg
Astrocytoma (cerebellum)	4	10.7-42	
Astroblastoma (cerebellum)	4	8.1-23	
	—8		18.8
Astrocytoma (cerebrum)	3	0.8-18.2	
Gliobastoma multiforme (cerebrum)	21	1.1-24.2	5.2
Medulloblastoma (cerebellum)	7	1.1- 6	3.6
Acoustic neurinoma	2	3.6- 3.8	
Meningioma	2	2.0- 2.6	
Oligodendroglioma	2	1.0- 5.0	
Spongioblastoma polare	1	1.0	
Neurocytoma	1	0.96	
Neuroblastoma	1	3.7	
Metastatic carcinoma	1	0.8	
Metastatic melanosarcoma	1	1.9	

types occurring in the cerebellum had an average Q.CHE. of 18.8. One tumor of this type occurring in the cerebrum had a Q.CHE. of 18.2, but 2 others listed as astrocytomas had a Q.CHE. of 0.8 and 1.9 respectively. However, these last 2 were clearly of a different histologic character from the first and may very well be examples of what Scherer[2] refers to as "malignant dedifferentiation of an astroblastoma into a glioblastoma." Histological diagnosis in such cases is notably difficult and uncertain. It is also of interest to recall that a significant clinical difference is recognized between the astrocytomas of the cerebrum and those of the cerebellum. Tumors of the astroblastic and astrocytic type occurring in the cerebellum are found chiefly in children and young adults. They are well circumscribed and when completely resected may be controlled permanently from a clinical point of view. On the contrary, tumors of similar cell structure arising in the cerebrum usually occur in adults and have a poor prognosis, facts recently emphasized by Davidoff.[3] Scherer[2] has pointed out in addition the striking morphologic differences between the diffuse growth of the cerebral astrocytomas and the localized development of the cerebellar tumors of similar cell type.

In 21 tumors of the cerebrum conforming to the structure of glioblastoma multiforme the Q.CHE. ranged between 1.1 and 24.2, Av. 5.2. Only 4 had a Q.CHE. greater than 6. The histologic variation in this type of malignant tumor of the adult cerebrum is well recognized and of special interest in view of the wide variation of Q.CHE. found in the specimens examined.

Seven medulloblastomas of the cerebellum, a tumor of uniform

[2] Scherer, H. J., *Brain*, 1940, **63**, 1.

[3] Davidoff, L. M., *Arch. Neurol. and Psychiat.*, 1940, **44**, 1246.

cell type and of recognized malignancy, showed a Q.CHE. between 1.1 and 6.0 with an average of 3.6. This contrasts markedly with the astroblastic and astrocytic tumors of the cerebellum.

Eleven varied tumors of the brain embracing the last eight types listed in the table had a Q.CHE. between 0.8 and 5.0 with an average of 2.4.

From these studies it seems apparent that the astrocyte and its progenitor the astroblast are the cell types most intimately associated with cholinesterase formation in neoplastic brain tissue. In favor of this view is the high cholinesterase content of the astrocytomas and astroblastomas and the distinctly low values obtained for practically all other types of brain tumors. Notable exceptions to this would appear to be an occasional glioblastoma multiforme with a high cholinesterase content and the 2 astrocytomas of the cerebrum which had a low Q.CHE. No satisfactory explanation of these discrepancies is available for this preliminary report on the problem.

It is also of considerable interest to note that tumors such as neurocytomas and neuroblastomas have shown a very low Q.CHE. Although some nerve cells are known to liberate acetylcholine, they do not necessarily also form cholinesterase. The unique experiments of Boell and Nachmansohn[4] lend further support to this view.

The intimate relationship between the astrocyte and cholinesterase is also suggested by their simultaneous appearance during the development of the human cerebrum.[5, 6] Data are not available for comparison of other regions in this regard. The work is being continued and will be reported more fully in another place.

[4] Boell, E. J., and Nachmansohn, D., *Science*, 1940, **92**, 513.

[5] Kershman, J., *Arch. Neurol. and Psychiat.*, 1938, **40**, 937.

[6] Youngstrom, K. A., *J. Neurophysiol.*, 1941, **4**, 473.