changes in resting or action potential magnitudes with developed tension[12–14].

The precise mechanism of drug actions cannot be determined through the use of an electrical approach; but specific inferences may be drawn. These would be the relationships between flux studies and configurations of the action potentials. In the present study the observed facts suggest that nicotine may alter contractility by changes in the duration of the action potential, which implies alterations in potassium fluxes.

Zusammenfassung. Die Wirkungen von Nikotin auf die Kontraktilität und die Membranpotentiale des Rattenatriums wurden untersucht. Nikotin ($5 \times 10^{-4} M$) erhöhte gleichzeitig die entwickelte Spannung sowie die Dauer und Fläche des Aktionspotentials. Ein möglicher Zusammenhang dieser Änderungen mit der erhöhten Kontraktilität wird diskutiert.

S. SHIBATA[15], P. H. HOLLANDER[16] and J. L. WEBB[17]

Department of Pharmacology, School of Medicine, University of Southern California, Los Angeles (California, USA), 3 November 1967.

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[15] Present address: Department of Pharmacology, School of Medicine, University of Hawaii, Leahi Hospital, 3675 Kilauea Avenue, Honolulu, Hawaii 96816.
[16] Present address: Department of Pharmacology, School of Medicine, Ohio State University, Columbus, Ohio.
[17] Deceased 22 July 1966.

Influence of Prenatal X-Radiation on Brain Lipid and Cerebroside Content in Developing Rats

Prenatal X-radiation markedly alters the functional development of the central nervous system[1]. Histological[2] and biochemical[3] studies in rats have shown that exposure to X-radiation at 14 days of gestation increases the proliferation of glial cells in the developing brain of the offspring. Since glial cells are implicated in the myelination of the CNS[4], alterations in glial cell number may affect the process of myelination, which, in turn, would influence CNS development.

The present study, therefore, was designed to investigate in the rat the effects of prenatal X-radiation on brain lipids and cerebrosides, which are the components of the myelin sheath.

Eight pregnant Long-Evans rats were exposed to a single dose of 100 R whole-body X-radiation at 14 days of gestation. The pregnant animals were placed in individual open-ended cylindrical lucite containers and were rotated on a movable platform 80 cm from the X-ray source, a Picker 180 kV, 15 mA X-ray therapy unit using 0.5 mm Cu and 1.0 mm Al filters. The dose rate, 19 R/min, was measured in air by means of a Victoreen condenser R-meter which was placed inside the lucite container at the level of the animal's body. In order to eliminate any changes due to maternal stress other than X-radiation, 8 pregnant animals were sham-irradiated for the same length of time and served as controls. At delivery, the litters of X-irradiated rats were similar in number and size to those of controls.

The animals were sacrificed by decapitation at time periods of 9, 12 and 16 days after birth. The whole brain was immediately removed, dissected free of grossly visible blood vessels, blotted free of moisture and weighed. The cerebral cortex and diencephalon midbrain were then dissected and weighed. Water content in samples of these structures was determined by drying at 104 °C under vacuum for 4 days.

Lipids were extracted from samples of cerebral cortex and diencephalon midbrain with 2:1 chloroform/methanol, according to the method of FOLCH et al.[5]. Lipids excluding gangliosides were determined gravimetrically. Values for lipids were expressed as mg/100 mg of wet tissue. The method described in ROUSER et al.[6] for the fractionation of brain lipids on Florisil columns was adapted for small amounts of lipids. Two components of the cerebroside molecule, galactose and sphingosine, were analysed. For the isolation of galactose and sphingosine the column eluants which contained the cerebroside were subjected to acid hydrolysis[7,8]. Sphingosine was determined by the method of LAUTER[9] and galactose was determined by the orcinol-sulphuric acid reaction[10]. The galactose content of the sample was read directly from a standard curve and was multiplied by 4.66 to give the actual value of the cerebrosides. A mean molecular weight of 846 was used for the calculation of cerebrosides. Values for cerebrosides were expressed as mg/100 mg of lipid.

To determine whether the parameters measured in control and irradiated rats differ significantly in their means, the *t*-test for non-paired data was applied[11].

Body weights of prenatally X-irradiated rats did not differ from those of control rats at any of the age periods studied (Table I), whereas brain weights of irradiated rats were markedly lower compared to controls at all age periods (Table I). No differences were observed in the

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Table I. Effects of prenatal X-radiation[a] on body and brain weights and % water of developing rats

Age: days after birth	Groups	Body weight (g)	Brain weight (g)	% water	
				Cerebral cortex	Diencephalon midbrain
9	Control	18 ± 0.5[b]	0.847 ± 0.006	88.71 ± 0.43	88.50 ± 0.25
	Irradiated	20 ± 0.7	0.621 ± 0.020 (< 0.001)[c]	87.99 ± 0.24	87.84 ± 0.27
12	Control	27 ± 1	1.023 ± 0.014	86.37 ± 0.13	87.04 ± 0.15
	Irradiated	30 ± 2	0.795 ± 0.25 (< 0.001)	86.40 ± 0.10	87.11 ± 0.15
16	Control	43 ± 3	1.229 ± 0.016	83.90 ± 0.07	83.29 ± 0.40
	Irradiated	43 ± 2	0.922 ± 0.047 (< 0.001)	84.11 ± 0.13	82.66 ± 0.20

[a] 100 R whole-body X-radiation was delivered to pregnant rats at 14 days of gestation. [b] Mean ± S.E. [c] Numbers in parentheses are *P*-values for comparison to control.

Table II. Effects of prenatal X-radiation[a] on lipids and cerebrosides of developing rats

Age: days after birth	Groups	Lipids[b] (mg/100 mg wet tissue)		Cerebrosides (mg/100 mg lipid)	
		Cerebral cortex	Diencephalon midbrain	Cerebral cortex	Diencephalon midbrain
9	Control	2.93 ± 0.06[c]	3.39 ± 0.05	1.01 ± 0.10	1.65 ± 0.10
	Irradiated	2.93 ± 0.05	3.26 ± 0.08	1.28 ± 0.21	2.56 ± 0.01 (< 0.001)[d]
12	Control	3.56 ± 0.04	4.05 ± 0.03	0.85 ± 0.06	3.11 ± 0.08
	Irradiated	3.65 ± 0.03	3.99 ± 0.02	0.87 ± 0.10	4.00 ± 0.20 (< 0.01)
16	Control	4.17 ± 0.07	5.22 ± 0.11	1.77 ± 0.25	6.69 ± 0.17
	Irradiated	4.18 ± 0.07	4.99 ± 0.08	2.09 ± 0.18	7.67 ± 0.34 (< 0.05)

[a] 100 R whole-body X-radiation was delivered to pregnant rats at 14 days of gestation. [b] Lipids include total lipids minus gangliosides. [c] Mean ± S.E. [d] Numbers in parentheses are *P*-values for comparison to control.

percentage of brain water between experimental and control animals (Table I).

The concentration of lipids increased with age in both the cerebral cortex and the diencephalon midbrain in all animals (Table II) with no significant differences between control and irradiated animals at any of the ages studied (Table II). The concentration of cerebrosides in the diencephalon midbrain was significantly higher in irradiated rats than in controls at all ages. In the cerebral cortex, the increase in cerebroside concentration among irradiated animals was not statistically significant compared to controls, yet the % of increase in these animals at 16 days was approximately the same as that observed in the diencephalon midbrain of irradiated rats. Since the subcortical structures undergo rapid myelination between 10 and 15 days after birth[12], the cerebroside-elevating effects of X-radiation would be more prominent in these CNS areas. The differential effect of X-radiation on the 2 brain structures, then, is attributed to their respective stage of development at the time of measurement.

The increased sensitivity of the developing CNS to electrical stimulation after prenatal X-radiation has been attributed predominantly to the lowering of the threshold of subcortical structures[1], those brain structures in which a marked increase in cerebroside concentration was found. Since cerebrosides are membranous components, changes in their concentration may be regarded as one of the factors underlying alterations in CNS activity[13].

Résumé. Lorsque des rats sont irradiés par des rayons X au 14e jour de la gestation, le contenu en cérébrosides du cortex cérébral et du diencéphale est plus élevé que chez les témoins. Or il est bien connu que ce traitement entraîne d'une part une prolifération gliale et d'autre part une augmentation de la sensibilité du système nerveux central à une stimulation électrique. La possibilité d'une relation entre ces phénomènes est discutée.

ANTONIA VERNADAKIS[14], REGINA CASPER[15] and PAOLA S. TIMIRAS

Department of Physiology, University of California, Berkeley (California 94720, USA),
11 September 1967.

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[14] Present address: Department of Psychiatry and Department of Pharmacology, University of Colorado Medical Center, Denver (Colorado).

[15] USPHS HD-101 fellow.