

and can be more or less influenced by nerve impulses from higher levels, especially by those which are concerned in emotional states.

Other centres, or pathways, are formed by education, and this is particularly the case in those reflexes which take place through the cerebral cortex. Such reflexes are "conditioned," and are therefore liable to various alterations and especially to inhibition.

Functional centres or pathways may be formed in abnormal states. Fixed ideas probably result from the establishment of certain pathways in the cortex of the cerebrum. In asthma afferent nerve impulses resulting from certain stimuli produce a reflex contraction of the bronchial muscle and a narrowing of the bronchioles. The reflex may become a "conditioned" one, and be induced by any afferent impulse resulting from a stimulus which has been associated with its occurrence. The pathways in time are so "grooved" that the reflex takes place very readily, and is excited by any afferent nerve impulse which has previously been associated with the asthma.

The phenomenon of pain, and especially of visceral pain, may be influenced in the same way. The frequent carriage of nerve impulses from the heart along the pain paths results in a lessened resistance of the synapses along the pathways taken. The occurrence of pain is facilitated, and a condition of status anginosus may be set up in which afferent impulses from other sources may spread into the same paths and produce pain. An attack of angina may be induced in this condition by a carious tooth or other source of pain.

In the production of visceral pain the afferent impulses from the organ affected spread into the pain paths in the lower level of the central nervous system, but the sensation of pain is located in some part of the body wall which is supplied with afferent nerves the impulses in which are capable of exciting a more or less localized sensation. In the areas supplied by these nerves various phenomena occur. Hyperaesthesia is sometimes met with, and the margins of the hyperaesthetic area are constantly varying in position. The hyperaesthesia is probably due to a decreased resistance of the synapses leading to the pain pathways, so that nerve impulses which would not ordinarily cause pain now do so because they pass more readily into the pain pathways.

The fluctuation in the extent of the area affected may be due to variations in resistance of the synapses in the pathways of the afferent neurones coming from the borders of the area, and be ascribable to the phenomenon of fluctuation or variation in the actual units employed in carrying the nerve impulses.

But other changes than sensory are usually found. Increased tone, or the actual contraction of muscle, often occurs in the body wall. The rigidity of muscle, especially well seen in the abdominal wall as the result of irritation of an abdominal viscus, is a reflex phenomenon, and is subject to the same variations as that affecting the sensory changes. A temporary centre is created in the central nervous system, and afferent impulses from the irritated viscus make use of certain pathways with the production of a number of end-results. If the afferent impulses are sufficiently numerous, or if there is any condition present which decreases the resistance of the synapses, the impulses may spread and occasion not only pain, hyperaesthesia, and contraction of muscle in a definite area, but vomiting, cardiac, vasomotor, and other reflexes.

Sensation and reflex action are closely bound up together. Even visceral reflexes may be productive of sensation. Alterations in the heart beat, palpitation, respiratory disturbances, vaso-constriction, and vaso-dilatation give rise to subjective phenomena. Irritability, exhaustion, and depression are of common occurrence in ill health. The fatigue of a synapse renders that synapse more resistant to the passage of a nerve impulse, and fatigue of the afferent pathways should be a negation. But fatigue and the sensations met with in ill health are positive sensations and not mere negations. They are, as a rule, general and not localized to any particular part. Their cause is unknown, but must be sought for in some alteration in the afferent nerve impulses affecting the conscious state.

REPORT OF THREE AUTOPSIES FOLLOWING CARBON TETRACHLORIDE TREATMENT.

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WITH the object of confirming the report that carbon tetrachloride may produce pathological lesions of the liver,* a number of condemned prisoners were treated with small doses of the drug. *Post-mortem* examinations were made on three of the prisoners. In two cases the intestines were removed in three sections after double ligatures had been applied; the sections were opened and washed separately to determine the number of free and attached parasites in each.

Each prisoner received 4 c.cm. of carbon tetrachloride, followed in two hours by 2 oz. of saturated Epsom salt solution. No food was allowed previous to treatment except in the case of No. 8925, who by mistake received his ordinary breakfast at 6 a.m., and was treated at 10 instead of 8 in order to permit the passage of the food into the intestines. One and a half hours after the administration of the salts they were allowed tiffin.

Prisoner 8925 received 4 c.cm. carbon tetrachloride at 10 a.m. on February 21st, the salts at noon, and had tiffin at 1.30 p.m. The number of worms counted in the first twenty-four hours was: hookworms 101 (male 38, female 63), ascaris 1, oxyuris over 1,000. In the second and third periods of twenty-four hours no worms were found. The man was executed on February 24th. In the contents of the large intestine two oxyuris and two trichuris were found, and attached to its walls nine trichuris and twelve oxyuris. In the lower two-thirds of the small intestine three ascaris were found in the contents and one ascaris and one trichuris attached. Two ascaris were attached to the duodenum and upper third of the small intestine. Prisoner 8937 received 4 c.cm. carbon tetrachloride at 8 a.m., the salts at 10 a.m., and had tiffin at 11.30. During the first twenty-four hours one hookworm (female) was found and one oxyuris. In the second and third periods of twenty-four hours no worms were found; he was executed on February 24th at 8 a.m. In the contents of the large intestine eight hookworms (six male and two female) were found and two trichuris. Three other trichuris were attached to the walls. In the contents of the lower two-thirds of the small intestine one ascaris was found, and two trichuris attached to the wall; no worms were found in the duodenum and upper third of the small intestine. Another prisoner 8992, received 4 c.cm. of carbon tetrachloride, but in his case the worms were not counted, nor were the intestines examined. None of the patients made any complaint.

Sections of the organs were stained with osmic acid according to the method of Marchi. Sections also were stained by haemotoxin and eosin.

No. 8925.—The liver showed fatty degeneration, many of the cells containing fat globules; the largest of the globules measured about 10 microns. The kidney cells contained a few globules of fat. The spleen was greatly enlarged and showed pigment and fibrotic changes due to numerous attacks of malaria.

No. 8937.—The liver showed slight fatty degeneration, the kidney no recognizable changes.

No. 8992 showed no changes in liver or kidney.

Conclusions.

1. A dose of 4 c.cm. of carbon tetrachloride given as in the above cases may produce fatty degeneration of the liver.

2. Although numerous fat globules may appear in the liver cells apparently as a result of the administration of carbon tetrachloride, the changes in the liver are of a temporary nature and do not appear to contraindicate the use of the drug, because many patients have been treated with much larger doses and have not complained of any discomfort other than very slight giddiness, nor have symptoms or signs of ill health arisen in them. Further, many hundreds of school children have received doses of carbon tetrachloride, and in no case has any sign of ill health occurred subsequent to treatment.

3. In case No. 8925 the changes in the liver were so marked that we would have expected signs of marked ill health during life, but these were absent; consequently it appears that much fat (presumably derived from fatty degeneration) may appear in the liver and yet be a matter of small importance as concerns the health of the patient.

* Docherty, J. F., and Burgess, E.: Action of Carbon Tetrachloride on the Liver, BRITISH MEDICAL JOURNAL, November 11th, 1922, p. 907.