

a good indication of overall level of fat metabolism.¹ One might expect just such a condition as an adaptation on the part of the stickleback to Arctic living: the high caloric values of the fats make them ideal sources of energy in an environment such as the Arctic.

Other adaptations of a metabolic nature are known to exist in Arctic fish: polar cod tissue shows Q_{O_2} -temperature curves peculiarly adapted to functioning at low temperatures.¹¹

Summary. 1. Whole Arctic sticklebacks and ordinary guppies were analyzed for fatty acids, cholesterol and lipid phosphorus.

2. It was found that diet does not have an appreciable effect on the lipids in the guppies.

3. Cholesterol and fatty acid are higher in the guppies than in the Arctic fish. On the other hand phospholipid is essentially the same in all the fish examined.

4. There is more phospholipid in relation to cholesterol in the Arctic sticklebacks than in the guppies, a fact which may be interpreted as indicating a higher level of fat turnover in the former than in the latter.

5. The ratio of cholesterol/lipid phosphorus is lower in the stickleback than in the guppy, indicating a lower water content in the tissues of the former. This may be correlated with the reported ability of the stickleback to resist freezing injuries.

¹¹ Field, J., and Peiss, C. N., *Fed. Proc.*, 1949, **8**, 44.

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Electroencephalographic Changes Associated with Painful and Non-Painful Peripheral Stimulation. (17454)

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This work was undertaken to ascertain whether the perception of pain is associated with a specific change in the electroencephalogram (E.E.G.), which might be used as an objective criterion of pain.

Methods. A Grass Electroencephalograph was used with 6 or 8 electrodes in 17 experiments on as many subjects. In addition to the usual 8 electrodes (2 frontals, 2 parietals, 2 temporals and 2 occipitals) the Grinker needle electrode¹ in the sphenoid bone was employed in 2 experiments, and a saline saturated cotton electrode pressed against the posterior pharyngeal wall in one. For the purpose of exploring any changes from the region of the base of the skull or hypothalamus near the foramen ovale in still another experiment an insulated needle electrode was inserted (under infiltration anesthesia) between the mandible and zygoma to a depth of 5.5 cm. Monopolar registration was employed with the lobe of the ear as indifferent electrode. Pain was produced in several ways in each experiment. (a) A Von Frey hair stimulator

was applied to a previously determined pain point on the right forearm with a pressure of 8 g. (b) The web of the skin between the thumb and index finger of the right hand was pressed between a forceps. (c) As a control in two experiments heat, cold and touch were applied to the right forearm without causing pain.

Results. In all experiments a definite change in the E.E.G. occurred. It consisted of a decrease in amplitude, which was in the nature of a loss of electrical entropy and must be separated from the attention wave, which frequently appeared as an additional factor. The change was not specific for a pain stimulus or sensation since a similar response was obtained with heat, cold and touch. The decrease was bilateral and was not confined to any large cortical area, though it was more pronounced in the parietal, occipital and temporal region in a decreasing order of mag-

¹ Grinker, R. R., and Scrota, H. M., *J. Neurophysiol.*, 1938, **1**, 573.

nitude of change.

Bipolar registration, shifting of electrodes, use of needle electrodes or coupling of 2 to 8 electrodes did not yield any essential improvement. The changes in the records from the base of the skull were similar to those observed from the cortical area.

In 4 experiments with morphine an additional decrease occurred to some extent on the application of the pain stimulus. Further tests were not made because pain and morphine² tend to produce both flattening of the middle range of waves which makes reliable

² Gibbs, F. A., and Maltby, G. L., *J. Pharm. and Exp. Therap.*, 1943, **78**, 1.

interpretation of experimental data practically impossible.

Summary. The possibility of E.E.G. registration of pain was examined in 17 human subjects. A decrease in amplitude of the waves was observed, which was more evident in the parietal, occipital, temporal and frontal in a descending order. This change, however, is not dependent on the nature and degree of pain and it is not specific as it occurred with cold, heat and touch as well.

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Experimental Pulmonary Edema. II. Pathogenesis of Pulmonary Edema Caused by Ammonium Ion.* (17455)

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Koenig and Koenig¹ have described an acute pulmonary edema following the administration of ammonium salts to different species. It appears to be specifically a result of the ammonium ion. The occurrence and gross appearance of this edema resembles epinephrine induced pulmonary edema and in an effort to obtain information about the mechanism of the ammonium pathology a study has been made of its relation to edema due to epinephrine and adrenergic stimuli.

Experimental. Epinephrine induced pulmonary edema may be prevented by adrenergic blocking agents.^{2,3} Their influence was observed upon ammonium pulmonary edema. Unfasted guinea pigs were divided into groups with the same sex distribution. All groups

were lightly etherized to pass a stomach tube. Group 1, the controls, were given a sham dose of 10 cc water per kg body weight. All other groups received 1200 mg/kg of a 12% solution of NH_4Cl by oral gavage. Ten minutes before receiving the ammonium salt groups 3, 4 and 5 respectively received by intravenous injection in 1 cc saline/kg; 2 mg/kg of a B-haloethylamine, N-(9-fluorenyl)-N-ethyl-B-chloroethylamine-HCl ("SKF-501"); 2.5 mg/kg N-(2-chloroethyl)-N-ethylbenzhydramine-HCl ("SY-2"), which like "SKF-501" is an effective adrenergic blocking agent; and 1.5 mg/kg of the potent antihistaminic N-B-dimethylaminopropylthiodiphenylamine - HCl ("Phenergan", 3277 R.P.). The presence of pulmonary edema was determined at an autopsy by gross inspection and lung weight was used as a measure of its extent.

The summarized data comprise Table I. Group 1 was killed with ether while all of the animals in the other groups succumbed with convulsions 5-30 minutes after receiving the ammonium salt. The two adrenergic blocking agents and the antihistaminic all were

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¹ Koenig, H., and Koenig, R., *PROC. SOC. EXP. BIOL. AND MED.*, 1949, **70**, 375.

² Stone, C. A., and Loew, E. R., *PROC. SOC. EXP. BIOL. AND MED.*, 1949, **71**, 122.

³ MacKay, E. M., and Pecka, E. F., Jr., *PROC. SOC. EXP. BIOL. AND MED.*, 1949, **71**, 669.