warranted that the lipotropic activity of casein and in particular the combined oral administration of cystine plus choline afford a definite but not regular protection against pathological changes in the liver (necrosis, cirrhosis, atypical nodular proliferation of bile ducts, adenocarcinoma, malignant hepatoma) produced by a diet containing dimethylaminoazobenzene.

Further, it is noteworthy that no malignant changes were seen in rats fed rations containing dimethylaminoazobenzene but no rice (diets B and C). This may be due, apart from the effect of casein (present in diets B and C), either to a special carcinogenic property of rice or to other differences, such as content of butter fat, lard, sugar or corn starch in the rations used.

The experimental period lasted up to 175 days.

The experiments were performed on several hundred rats and are being continued.

## 13032 P

## Centripetal Discharges in Dorsal and Ventral Roots Following Stimulation of Muscle by Ventral Root Volleys.

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When a ventral spinal root (L 7 or S 1) of the cat under light dial narcosis (0.5 ml/kilo Ciba) is stimulated, discharges arising in the periphery are conducted centripetally to both dorsal and ventral roots. Afferent activity consequent upon muscle contraction would be expected, but the discharges under consideration are such as to suggest that the mediation of muscle receptors is not involved. Centripetal discharges in ventral roots have been observed following the administration of eserine,[1] or prostigmine.[2] Apparently such discharges have not been observed previously in the non-eserinized preparation.

*Dorsal Root Discharges.* Record A of the accompanying figure shows the early centripetal activity (spike potentials 1 and 2) recorded from L 7, D. R. following a single shock to L 7, V. R. Similar discharges from the periphery may be recorded if S 1 roots

1 Dun, F. T., and Feng, T. P., *Chin. J. Physiol.*, 1940, **15**, 433.

2 Masland, R. L., and Wigton, R. S., *J. Neurophysiol.*, 1940, **3**, 269.

are substituted. Activity of comparable latency, though less intense, may be recorded from S 1 D. R. after an L 7 V. R. shock and vice versa. Spike potentials 1 and 2 follow the stimulus rate at frequencies yielding fused contraction. The later activity of record A suffers immediate conditioning, and is thus, presumably, of different origin.

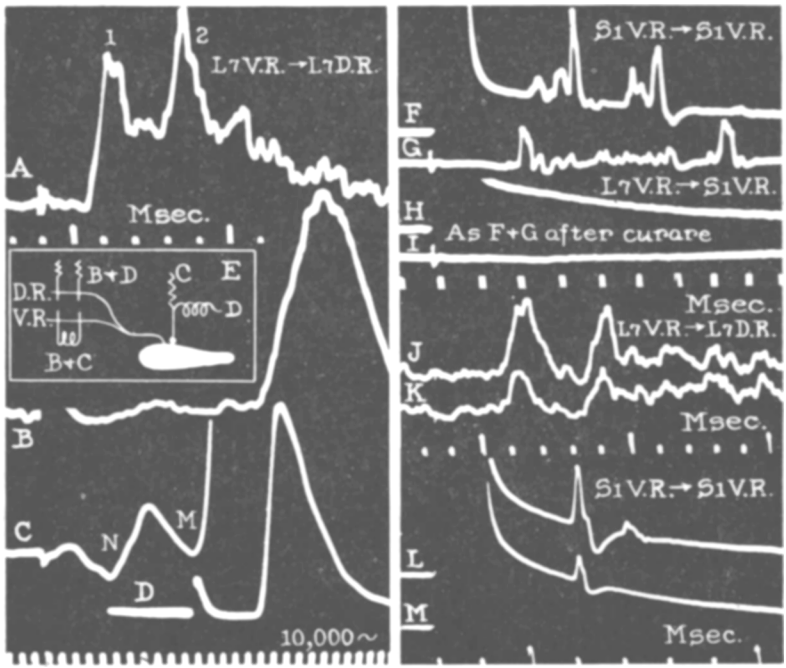


FIG. 1.

Denervation of the distal or proximal muscle groups of the hind leg respectively shows that spike potential 1 arises in the proximal part of the leg, while spike 2 arises in the distal part. Therefore, the succession of spike potentials represents varying conduction times rather than repetitive discharge. Great care must be taken in denervation experiments to identify and avoid discharges due to stimulation at cut nerve ends by nerve action potentials,[3] or by muscle action potentials.[4] The latter is the more serious and enduring artefact.

[3] Hering, E., *Sitzungsber. d. k. Akad. Wissenschaft. Math.-Naturwissensch. Cl.*, Wien, 1882, **85**, Abt. III, 237; Renshaw, B., and Therman, P. O., *Am. J. Physiol.*, 1941, in press.

[4] Matteucci, C., *C. R. Acad. Sci.*, Paris, 1842, **15**, 797.

Records B, C, and D are recorded from a leg preparation cut down so that only *M. gemellus* superior responds to an S 1 V. R. volley. The details of the root-nerve-muscle preparation and the disposition of electrodes are shown in inset E. The latency of response B in the S 1 D. R. was unchanged from that of the spike potential 1 obtained in the intact leg preparation at the beginning of the experiment. Record C shows the nerve (N) and muscle (M) action potentials recorded at the junctional region. The neuromuscular delay is approximately 0.55 msec., in agreement with the findings of others.[5] Record D shows the conduction time from the muscle to the D. R. leads and is placed so that the stimulus artefact coincides in time with the onset of the muscle action potential (M) of record C. The sum of efferent conduction time, neuromuscular delay, and afferent conduction time approaches the total latency of the return discharge B. This evidence supports the view that the afferent fiber endings are stimulated directly by the activated muscle. The most rapidly conducting fibers are involved.

*Ventral Root Discharges.* Following a single shock to a ventral root of the intact leg preparation, impulses return from the periphery in the same (F), and adjacent ventral roots (G). Similar discharges occur in stimulated and unstimulated fractions of a split L 7 V. R. Stimulation of L 7 and S 1 roots simultaneously, with leads on one of the roots, results in more than summation of the antidromic discharges; hence some motor fiber endings are stimulated subliminally at the periphery following either of the shocks alone.

*Action of Curare.* Full curarization abolishes the centripetal discharges in ventral roots, (compare H and I with F and G) and dorsal roots. During partial curarization, reduced centripetal responses occur. Such responses are further reduced if long rest intervals are not allowed between stimulations. This effect parallels the "Wedenski type" inhibition of muscular contraction seen in partial curarization.[6] J and K, obtained at an interval of 1 sec., illustrate the reduced response in the L 7 D. R. and its inhibition. L and M show, in a comparable experiment, the inhibition of ventral root response.

*Conclusion.* The latency of the discharges under consideration, their parallelism with muscle action in the normal and curarized

[5] Lorente de Nó, R., *Am. J. Physiol.*, 1935, **111**, 272; Eccles, J. C., and O'Connor, W. J., *J. Physiol.*, 1939, **97**, 44.

[6] Hofmann, F. B., *Pflüger's Arch.*, 1903, **93**, 186; Bremer, F., and Titeca, J., *Arch. Internat. Physiol.*, 1935, **42**, 223; Rosenblueth, A., and Morison, R. S., *Am. J. Physiol.*, 1937, **119**, 236.

preparations, and the fact that they occur in fibers other than those carrying the centrifugal motor volley, point to the synchronously active muscle as the causal agent. The suggestion may be advanced that the action potential of the excited muscle is capable of stimulating intramuscular motor and sensory nerve endings.

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## Bactericidal Effect of Ultraviolet Rays on Non-Spore Forming Bacteria and Mold Spores.

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Fellers[1] and Garret and Arnold[2] reported effective sterilization of drinking glasses by ultraviolet light produced by the "Sterilamp". Owing to the ease with which such objects can be exposed, this means of sterilization has many advantages. The "Sterilamp" was employed in this investigation as the source of ultraviolet light. In one series of experiments exposures of drinking glasses were made in the Steril-Ray Cabinet, in which 4 Sterilamps were used. For the remainder of the experiments, results of which are reported in this investigation, a laboratory cabinet, fitted with 2 Sterilamps, was used. The inside measurements of this cabinet were 14 x 14 x 10.5 inches and it was lined with polished aluminum foil. The shelf was made of one-half inch mesh screen and placed about 8 inches from the lower surface of the Sterilamps.

The first experiments were carried out with suspensions of bacteria and mold-spores in Petri dishes. Films of nutrient broth cultures were made on the bottoms of sterile Petri dishes as suggested by Ross.[3] Agar medium in Petri dishes was also sprayed with an atomizer. Another method of inoculation was to rinse the containers with a suitable suspension of the bacteria. In order to study the lethal effect of ultraviolet light on non-sporulating bacteria and on mold-spores, one ml portions of the suspensions were placed in sterile Petri dishes, exposed definite times to the light, and finally melted agar was added to the exposed suspensions. The most satisfactory method for inoculation consisted of rinsing the drinking

[1] Fellers, R. V., *The American City*, August, 1938.

[2] Garret, O. F., and Arnold, R. B., *Milk Plant Monthly*, August, 1938.

[3] Ross, Virginia L., M.S. Thesis, University of Michigan, 1938.