of cells regardless of their distribution in organs and tissues. It would seem that *histologic adaptation* best expresses the specialization of a virus with regard to the kind of cell in which it grows, since histology is the science of kinds of cells.

The third type of virus adaptation is related to the species of animal which the virus invades or in which it produces a disease. This adaptation, like the others, appears to be distinctive for each virus. The rabies virus is broadly adapted in this respect, being capable of invading probably all species of mammals and birds. The distemper virus, which is more restricted, produces a disease only in members of the weasel family, the raccoons and the Canidae. The virus of the oral papillomatosis of dogs appears to be capable of invading only the dog. The adaptation to growth in a host-species or in a range of host-species might well be termed the *zoologic adaptation* of a virus.

While the cytologic adaptation of a virus seems to undergo little or no variation, the histologic and the zoologic adaptations seem to be subject to extensive natural variation. Within the ranges of the latter two adaptations, great experimental change can be effected in a virus by the selection of the species of animal injected and by the choice of tissue used as virus in serial host-to-host transfers. The distemper virus may be highly adapted to ferrets by host-to-host passage, becoming highly virulent for that animal and at the same time becoming a harmless, immunizing agent for members of the canine family. Distinctly different, artificially modified distemper viruses are produced by ferret-passage, depending upon whether the virus is passed serially through ferrets by subcutaneous injection and the use of spleen as inoculum; by intracranial injection and the use of brain tissue as transmission material; or whether it is passed by skin-to-skin inoculation. Such viruses are identical in their zoologic adaptation but differ in their histologic adaptation. A clear separation of these adaptations seems essential to qualify the nature of both natural and experimental viruses.

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URETHANE: ABSENCE OF PARALLELISM WITH THE ANTI-SULFONAMIDE ACTION OF p-AMINOBENZOIC ACID

THE demonstration by Johnson[1] that urethane (ethyl carbamate) exerts an anti-sulfanilamide effect on systems involving luminous bacteria led to the assumption that urethane should exert an anti-sulfonamide action by inhibiting the *in vivo* protective action of sulfonamides against streptococcal or other infections. That this assumption is not correct has been demonstrated in this laboratory.

p-Aminobenzoic acid (0.5 grams per kilo) completely inhibits the protective action of sulfanilamide (2.0 grams per kilogram) against a streptococcus infection (produced by the injection of 0.1 cc of a 24-hour broth culture of Strep. hemolyticus). Urethane (0.5 grams per kilogram) fails to inhibit the anti-streptococcal action of sulfanilamide (2.0 grams per kilogram). Approximately 500 mice were used to establish this point.

The failure to demonstrate an anti-sulfanilamide action by urethane in an *in vivo* system involving protection against streptococcus infections limits the applicability of data obtained from the study of luciferase systems to the broader aspects of sulfonamide action. The basic mechanisms involved in the luciferase system are not necessarily those involved in the anti-bacterial action of sulfonamides generally.

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[1] SCIENCE, 95: 104, 1942.

BLUEBERRY STORAGE

DURING 1941 the Maine Agricultural Experiment Station conducted blueberry storage studies under controlled atmosphere and controlled temperature. These studies showed a great variation in the keeping quality of the different clones of low-bush blueberries and varieties of high-bush blueberries. The low-bush showed the greatest variation, as some of the clones with poor flavor when they were put in storage had good flavor when the storage period was completed. With other clones the reverse was observed. The fully mature and overripe berries did not keep well in storage and while they appeared good when removed from storage they became soft and wet before the berries could be retailed. In these experiments, the named varieties of high-bush blueberries did not store as well as some of the high-bush selections made in Maine.

The blueberries which were stored at 5° C and in an atmosphere with an oxygen content of 5 per cent. or slightly less were in the best condition at the end of the experiment. Carbon dioxide contents of from 13 to 15 per cent. in the atmosphere were not detrimental in these studies. These conditions are similar to those used by Van Doren *et al.*[1] in the storage of cherries, and the temperature was slightly higher than that recommended by Levine *et al.*[2] for the storage of

[1] A. Van Doren, M. B. Hoffman and R. M. Smock, *Proc. Amer. Soc. Hort. Sci.*, 38: 231–238, 1941.

[2] A. S. Levine, C. R. Fellers and C. I. Gunness, *Proc. Amer. Soc. Hort. Sci.*, 38: 239–242, 1941.