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Absorption Through the Nasal Mucosa of Mice.

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Following the technique of Clark¹ and Olitsky and Cox² in their investigation of absorption through the mucosa of the nose, mice were inoculated intranasally with 0.02 cc. of a mixture of equal parts of 10% potassium ferrocyanide and 10% iron and ammonium citrate. 0.01 cc. of the solution was allowed to drop in small droplets on the outside of each nostril, from which position the mouse gradually breathed it into the nose. At 2, 5, 15, and 30 minutes and 1, 2, 3, 4, 6, and 8 hours the mice were sacrificed by decapitation; the whole head was dropped into 10% formalin containing 5% HCl. After 5 or 6 days in this fixative, to allow for complete decalcification, each head was divided down the middle line and, after clearing and embedding, microscopical preparations were made from each side. They were lightly stained with Mayer's carmine and mounted.

As a result of the examination of preparations from 40 mice, 12 each at 2 and 15 minutes and 2 each at the other times, it is possible to state that in mice at least, the whole process has reached its maximum in animals killed at 2 minutes and from then on the picture is one of decreasing amounts of Prussian blue in any tissue of the area examined. The granules are dispersed through the lymphatics, the blood vessels, and the subarachnoid space. Previous investigators^{1, 2} had not examined preparations earlier than one hour.

At 2 minutes the solution is passing through both olfactory and respiratory mucosa. In the former a few granules are seen between the cells but the great majority appear in streams along the receptor fibrils of the olfactory neuron cells and scattered within the cytoplasm of these cells. Absorption is thus chiefly through these sensory cells. In the respiratory mucosa the granules are thickly clustered over the cilia. They may be seen between the tall columnar cells, or again, within the cytoplasm of these cells, but to a lesser degree than in the olfactory mucosa. This appearance of absorp-

¹ Clark, W. E. le G., *Great Britain Rep. Pub. Health and Med. Subj.*, Ministry of Health, No. 54, 1929.

² Olitsky, P. K., and Cox, H. R., *Science*, 1934, **80**, 566.

tion through the cells is very different from that seen in connection with dead mucosal cells which are stained diffusely blue and contain granules in nucleus as well as cytoplasm.

Granules appear in the cytoplasm of some of the cells of the serous glands. In the submucosa, granules of Prussian blue lie scattered in the tissue spaces but are gathered for the most part in small, thin-walled, ramifying lymphatics. Capillaries and venules contain a few granules and the sinusoids in the turbinates contain many. Granules can be seen in capillaries or venules accompanying branches of the olfactory nerve, or running in separate foramina through the cribriform plate.

Under the low power of the microscope, branches of the olfactory nerve supplying areas of olfactory mucosa where absorption is most active, namely, the upper and anterior portion of the septum and the turbinates, appear as blue bands. Under oil immersion it is seen that the perineural spaces are filled with granules and that the granules also lie deep in the bundles between the fibres. This appearance is confined to the smaller branches. The main bundles running up to and through the cribriform plate show granules within the perineural sheath or, as the nerve enters the subarachnoid space, adherent to the outside of the nerve. Granules are also to be seen in the perineural sheath, and occasionally between fibres, of the trigeminal nerve but are fewer than in the olfactory branches.

Granules lie within and line the arachnoid network in the subarachnoid space, especially at the anterior angle of the skull. The pia-arachnoid membrane over the olfactory bulbs is heavily sprinkled with distinct little blue granules.

None is to be seen within the brain itself, save very occasionally in small blood vessels. Granules occur in the subdural sinuses, especially the cavernous.

At 5 minutes absorption is less. In the submucosa there are fewer granules between the nerve fibres and within the perineural sheaths of the smaller branches but the lymphatics and small vessels contain even more than at 2 minutes. Within the cranial cavity granules are less frequent in the pia-arachnoid membrane but elsewhere are as plentiful as before. At 15 minutes there are considerably less than at 5. Absorption has almost ceased through the respiratory mucosa but some still occurs through the olfactory cells. Nerves, lymphatics, and blood vessels in the submucosa show greatly reduced numbers of granules. Granules are fewer in the pia-arachnoid membrane, the subarachnoid space, and the sinuses.

From now on there is a steady decrease in the distribution of

Prussian blue granules anywhere in the tissues. At 8 hours masses of blue granules are still to be seen tangled in mucus over the mucosa. Some absorption is still occurring through the olfactory cells and, very occasionally, between the cells. In the submucosa a very few granules can be seen in the tissue spaces or within lymphatics subjacent to areas of mucosa where absorption is still occurring. Along one or two branches of the olfactory nerve, small clumps of granules appear within the perineural sheath and similar clumps appear within the subarachnoid space. A few scattered granules occur in the pia-arachnoid over the olfactory bulb.

Absorption, therefore, occurs chiefly by way of the olfactory sensory cells and appears at its maximum in mice killed at 2 minutes. Passing chiefly along the nerve fibres, it has reached the subarachnoid space and the pia-arachnoid membrane within this time.

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Comparison of Resistance of Bacteria and Embryonic Tissue to Germicidal Substances. VIII. Mercuric Chloride.

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The use of mercuric chloride as a disinfectant dates from the time of Robert Koch.¹ It has long been recognized as one of the most powerful disinfectants known. The germicidal power is exceedingly high in aqueous solution but enormously reduced in the presence of organic matter and some inorganic ions. It is precipitated by proteins and other organic compounds, hard water, alkalis, numerous salts, metals and sulfides.

It appears to be definitely established that mercuric chloride owes its germicidal properties to the positive or mercuric ion. This means that the compound is effective only in the dissociated state. Krönig and Paul² found that a 1-500 solution of the mercurial salt in water is much less than twice as active as a 1-1,000 dilution. The

¹ Koch, R., Ueber Desinfection, Mittheil, Kaiserl. Gesendheitsamt, Vol. 1, quoted from "A Handbook on Antiseptics," by H. D. Dakin, New York, The Macmillan Co., 1917.

² Krönig, B., and Paul, Th., *Z. f. Hygiene*, 1897, **25**, 1.