It developed in our experiments with the various gases, that in no instance, when young and old were exposed simultaneously, did the adult survive the young.

No determinations of the comparative blood CO pictures of these animals under conditions of these experiments have been made. It is, therefore, not possible to offer any physiological explanation of this survival phenomenon.

6278

Migration of Anthocyan Pigment in Plant Cells During the Flow of Electric Current, and Reversal by Acids and Alkalies.

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Visible effects of the flow of direct current through the cells of *Tradescantia* and other plants bearing anthocyan indicators have been known since the studies of Kühne.[1] They are generally accepted[2, 3, 4] as evidence of a change of acidity at the opposite ends of each cell, in accordance with the well known behavior of these pigments as indicators. A repetition of such experiments, with a variety of plants (from about a dozen families), leads the writer to a different interpretation, namely, a migration of the pigment within the cell.

The typical results with one group of plants including *Tradescantia (Zebrina)*, *Commelina*, *Rhoeo* (see also second group), *Lippia*, *Plantago*, *Sonchus*, beet and turnip, are as follows:

1. With uninjured cells, distant electrodes making contact to the tissue through agar, and low applied potential (1.5 to 6 volts in the epidermal strips as used) there is no apparent effect of current flow, the pigment remaining uniformly distributed throughout the cells and unchanged in hue.

2. With higher potentials (10 to 20 volts, probably causing some injury), or with low potentials in cells injured by chloroform or otherwise, there is a marked migration of pigment in most cells of

[1] Kühne, W. Untersuchungen über das Protoplasma und die Contractilität. Leipzig, 1864, pp. 98-100.

[2] Bethe, A. *Arch. ges. Physiol.*, 1916, **163**, 147.

[3] Mast, S. O. *Z. vergl. Physiol.*, 1931, **15**, 309.

[4] Marsh, G., Proc. Soc. Exp. Biol. and Med., 1932, **29**, 666.

the tissue toward the positive pole (anode). This results in concentrating it at the anodal end of each cell, the pink pigment there becoming deeper red in appearance, and depleting it at the cathodal end. The latter becomes almost clear, or more usually pale green, the general hue of the tissue when not pigmented with anthocyan. This green seems to have been taken to be due to increased alkalinity, but the expected intermediate hues, purple and blue, are not seen and the green is always pale.

3. Moreover the same (anodal) migration of pigment occurs in cells which have been immersed in ammonia, or other alkali. The pigment, now turned purple, blue, or dark green, depending on the degree of alkalinity, still becomes concentrated toward the anode and depleted toward the cathode in each cell, with no change of hue but only of density.

4. In almost all of these plants the direction of migration can be reversed by immersion of the tissue in acid solutions. The pigment becomes bright red or orange, and now migrates toward the cathode in each cell, becoming depleted toward the anode. The point at which this reversal occurs differs with different plants, and in one *(Lippia)*, migration remained anodal even after long immersion in 0.1 N HCl. In others the apparent "iso-electric point" of the pigment (or of some substance associated with its migration) was at pH 2, 3 or more.

5. The effects remain reversible for some time in the more favorable plants *(Commelina)*, as respects the color shifts by alternate immersion in acid or base, and the reversal of movement in the field with reversal of electrode polarity. In general the higher the current density, the faster the migration and the more densely crowded becomes the pigment at the end of each cell. The pigment migrates slowly back on breaking the current, or rapidly on its reversal.

6. Even after the pigment has been changed to a yellow or brown color by long exposure to the air, the migration may persist for a time, almost always anodally, although more sluggishly and with a marked flow of granules. The entire protoplast also contracts slightly toward the anode at this stage, although the nucleus usually remains stationary.

In contrast, a second group shows a cathodal migration of pigment without further treatment with acid. Rhubarb, with normally very bright acid cells is a logical example. In other plants, as *Ricinus, Euphorbia peplus, Bryophyllum, Melilotus, Stenotaphrum* (crab-grass), banana leaf and sometimes in *Rhoeo,* there is a cathodal migration even though the color of the pigment is pink or purple, indicating no great acidity. However, often without further treatment than exposure to the air in *Ricinus* (also in *Rhoeo* when initially cathodal), and in the others with ammonia, anodal migration is easily induced. The iso-electric point of the substance concerned in migration may thus vary considerably in different species, from about neutrality up to a very acid region. Consequently the migration could easily be reversed during an experiment either by natural changes of pH in the cells (*e. g.*, by loss of CO_2) or by the diffusion of acid and alkaline products from electrodes. These may account for certain conflicting polarities given in the literature.

Begonia, oleander, *Solidago,* nasturtium stem, *Lantana, Salicornia* and *Sesuvium* constitute a third group in which the colored cells show no very definite migration of pigment in either direction. Possibly there is a different type of pigment cells, and much of the current may flow elsewhere, particularly in the latter 2, which are salt marsh plants.

None of these findings, of course, argues against a change of acidity due to current flow in other experiments, or even in these, though masked by the more conspicuous migration. The writer hopes shortly to present indirect evidence that such a change of acidity occurs in another case. Meanwhile a classic and apparently beautifully direct demonstration must be called into some question, as must the relevance of arguments based upon it.

6279

Notes on Toxicity and Pharmacology of Indium.

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Indium was discovered spectroscopically by Reich and Richter in Freiburg zincblende. Although widely distributed in minerals, it usually occurs only in very small quantities, and only recently Westbrook[1] worked out a process to isolate this element in larger quantities from crude zinc liquors which are residues from the manufacturing of sulphuric acid.

[1] Westbrook, L. R., Am. Electrochem. Soc., 57th General Meeting, St. Louis, May 29-31, 1930.