

## TOXICITY AND CHEMICAL POTENTIAL

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In 1895 Scheurlen<sup>1</sup> discovered that the addition of sodium chloride to solutions of phenol increased their toxicity towards anthrax spores and towards staphylococcus; he explained his discovery by a hydrate theory. The discovery was confirmed and the theory rejected by Beckman;<sup>2</sup> and in 1897 Scheurlen<sup>3</sup> discarded his theory in favor of another one, viz., that the degree of dissociation of phenol in solution is affected by the addition of salt. In the meantime, Paul and Krönig<sup>4</sup> had published the results of an extensive series of experiments in which they showed that a number of other salts shared the power of sodium chloride to affect the toxicity of phenol; their conclusions were summed up in the words "In general, organic salts seem to have less influence than inorganic salts, and sodium salts are more effective than those of potassium, but we are not able to offer a satisfactory explanation."

While writing a paper "On the Second Differential Coefficients of Gibbs' Function,"<sup>5</sup> at about the time this toxicological work was coming out, it occurred to me that the increase in the chemical potential of the phenol due to addition of salt to its aqueous solution might well account for its increased action on bacteria; if this were so, a solution of phenol to which salt had been added would have the same toxic effect as the (more concentrated) solution of phenol in pure water which has the same phenol potential; that is, two phenol solutions, with or without salt, which were in equilibrium with the same solution of phenol in some immiscible solvent, would prove to be isotonic.

This conclusion was supported by the observations of

<sup>1</sup> Arch. f. exp. Path. u. Pharm., 37, 74 (1895).

<sup>2</sup> Centrbl. f. Bakteriologie, 20, Abt. I, 577 (1896).

<sup>3</sup> Münch. Med. Wochenschr., 44, 81 (1897).

<sup>4</sup> Zeit. phys. Chem., 21, 414 (1896).

<sup>5</sup> Jour. Phys. Chem., 1, 633 (1897).