

# SCIENCE

VOL. 86

FRIDAY, JULY 9, 1937

No. 2219

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SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. MCKEEN CATTELL and published every Friday by

## THE SCIENCE PRESS

New York City: Grand Central Terminal

Lancaster, Pa.

Garrison, N. Y.

Annual Subscription, \$6.00

Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

## THE INTERIONIC ATTRACTION THEORY OF ELECTROLYTES

By Dr. D. A. MacINNES

THE LABORATORIES OF THE ROCKEFELLER INSTITUTE FOR MEDICAL RESEARCH

IN 1883 Arrhenius advanced the theory that in solutions of salts, acids and bases the molecules are, partly at least, split up into positively and negatively charged ions. Thus, for example, an aqueous solution of sodium chloride was conceived to consist in large part of positively charged sodium ions and negatively charged chloride ions, which may be represented by  $\text{Na}^+$  and  $\text{Cl}^-$ . The theory encountered vigorous opposition, based mostly on the apparently quite reasonable objections that sodium, for instance, which is well known to be a soft inflammable metal, could hardly be present in water, and also, that if positive and negative ions are as close together as they must be in a solution they would certainly be expected to attract each other and recombine. In spite of these objections and others, the theory gained adherents rapidly since it accounted more or less adequately for the main facts about solutions of what we now term electrolytes. The most im-

portant facts about such solutions are that, in the first place, they are conductors of electricity and, in addition, that they exhibit abnormal thermodynamic properties, by which we mean that, for example, they produce exceptionally large depressions of the freezing points and vapor pressures of the solvents in which they are dissolved.

The mental picture with which Arrhenius worked was somewhat as shown in Fig. 1. The symbols + and - represent the positive and negative ions, respectively. A part of the ions are considered to be free, and another portion of the ions are in contact with each other, forming neutral molecules. The former were considered to conduct electricity and the latter to have no influence on the conductance of a solution. The positions of the ions and neutral molecules would, of course, be rapidly shifting, due to thermal vibrations. Neutral molecules were thought to be constantly break-

# Science

**86 (2219)**

*Science* **86** (2219), 8-42.

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