The twitch of a frog's leg

Electric charges in the human body

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WE ARE ELECTRIC
The new science of our body's electrome
SALLY ADEE
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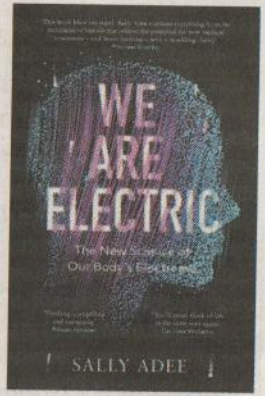
WHEN SALT IS DISSOLVED in water, its atoms leave their crystal lattice and start to move independently. If that salt is table salt, then the resulting solution will contain ions of sodium and chlorine, with each sodium ion carrying a positive charge and each chloride ion a negative one. Other salts contain other elements, but in each case their solutions contain an equal distribution of positive and negative charges.

Such solutions are the medium of blood, bile, and phlegm, of tree sap, fungal slimes, and most other fluids that living cells contain, and by which they are surrounded. Those cells distinguish themselves from these surroundings with a membrane that keeps some ions inside while others are pumped out. An uneven distribution of charges results from this, creating some millivolts of electrical potential.

There are controversies about the way in which these voltages might contribute to a cell's functioning. Nerve cells are known to use their membrane's voltage in signalling. Much less is known about the ways in which electrical properties contribute to the functioning of cells outside the nervous system, or in organisms that lack a nervous system altogether. The voltage on a cell's membrane has, in many cases, been regarded as a mere side effect of that membrane's selective permeability to the ions in its salty surroundings. In *We Are Electric*, Sally Adee argues it is more than that. She surveys research suggesting that electric properties have a role in ovulation, in coordinating the body's response to damage, and in the differentiation of cells during embryonic development. She encourages us to think that such roles might be ubiquitous.

To understand the roles that electricity might play in these processes, we would like to have a theory of the ways in which they might be influenced by manipulations of the electrical field. One can, of course, interfere with a cell in a relatively uncontrolled way, just by giving it an electric shock. What is less clear is whether electricity can be used in a controlled way, to produce effects in humans that are more beneficial than a placebo. Adee is optimistic that such effects will be forthcoming, while acknowledging that this is an area in which many breakthroughs have been claimed prematurely.

She is honest, too, about the part she herself played in creating some hype around the possible psychological benefits of passing a weak direct current through the human brain. Fifteen years ago, it was thought that such currents might "improve everything from treatment-resistant depression to poor maths skills". Adee recounts her own experiences of receiving direct current stimulation while playing a virtual-reality shooting game (where it seemed to help), and during a maths test (where it did not). Her concluding chapters admit that the evidence for beneficial effects from such stimulation is inconclusive. That modulation is characteristic of her book as a whole: although it starts with speculation about the imminent development of electrical methods for combatting cancer and slowing aging, Adee's discussion tends towards something more circumspect.



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The history of Adee's "new science" contains plenty of intrigue, even when its therapeutic promises are unfulfilled. It starts with the steampunk glamour of exploding Leyden jars, sparks rubbed from amber, and Benjamin Franklin flying his kite through a lightning storm. It then takes a gothic turn, as the eighteenth century progresses, with Luigi Galvani inducing twitches in frogs' legs and with Alessandro Volta remaining sceptical about the significance of his doing so. By 1803 it has arrived at the appalling spectacle of Giovanni Aldini terrifying the gentry with the effects that can be produced by passing a voltage through the anus of a recently hanged criminal. The details of this history retain their *Twilight Zone* fascination, even as the book comes up to date: we are told about frogs with eyes growing in their stomachs, and about a patient for whom the after-effects of having an electrode inserted into his brain include the development of a passion for the music of Johnny Cash.

Sally Adee gives a useful summary of the difficulties that scientists face in their attempts to arrive at a theory that explains the biology behind such effects, and of the advantages that might result if we do finally manage to control them. The enthusiasm that gives *We Are Electric* its readability is most supportable when critically tempered. ■