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Personal Landmarks from the Legacy of Arthur Phelps JOHN

LOWKE, CSIRO Materials Science and Engineering — I have been influenced for my whole life by Art Phelps, more than by anyone else – other than my wife! I first heard of Art Phelps in 1960 when, in the middle of doing my PhD in Adelaide, South Australia, Frost and Phelps published their land-mark paper, not only on drift velocities, the subject of my PhD, but on Boltzmann analyses, which were to deliver detailed cross sections for all common gases. Later I dared to suggest to my university that one of my two external PhD examiners be Phelps, a move that led to me being accepted for a position at Westinghouse Research Laboratories in Pittsburgh for 6 years, with Phelps as my direct supervisor. Throughout this period, Phelps refused to be a co-author of any of my papers, leaving me with severe doubts as to what he thought of their quality! I list areas where insights from Phelps inspired the growth of new fruit. (1) That transverse and longitudinal electron diffusion coefficients differ, typically by a factor of two. (2) That averaging radiation absorption coefficients in electric arcs, using common weightings involving Black Body radiation, can and usually do lead to errors of orders of magnitude. (3) That CO₂ laser discharges are largely controlled by electron attachment rather than by diffusion or recombination. (4) That boundary conditions for electrons at metal electrodes in arc welding, are not zero, but from an astrophysical analogy, are zero when extrapolated to one mean free path beyond the surface. (5) That the metastable vibrational states of nitrogen become an energy gain rather than a loss process for low energy electrons as occur in electrical breakdown in air, resulting in increases of the ionisation coefficient by orders of magnitude. Coupled with the detachment of electrons from negative ions by singlet delta states of metastable oxygen molecules, sustaining discharge electric fields are reduced a factor of five. Phelps worked on this problem with me until a few months before he died.

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