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A MECHANICAL ANALOGY IN THE THEORY OF EQUATIONS[1]

To the mathematician the solution of a problem is the more interesting if it utilizes methods and principles from fields that at first glance seem foreign to the one in which the problem lies. The question of whether a linear differential equation has algebraic solutions is sufficiently important to attract attention of itself, but its answer by reference to the properties of regular polyhedrons has become a mathematical classic. Such analogies are not, however, to be regarded as mere *tours de force* whose purpose is only to astonish, or to appeal to a certain esthetic sense; the instance just mentioned shows that the new point of view may disclose wide vistas hitherto undiscerned. If there is a choice of terms in which the analogy may be stated, the formulation which is most concrete and most striking may also be the most illuminating.

Such considerations as these, doubtless, have led to the description of what are essentially vector methods with complex variables in terms of mechanical systems. I propose here to discuss the progress that has been made by the aid of such an interpretation in studying the distribution in the complex plane of the roots of algebraic equations in one variable.

On the algebraic side the chief purpose of the investigations to be considered has been to obtain what may be called *theorems of separation, i. e.,* theorems which state whether roots of an equation do or do not lie in specified regions of the complex plane. Such theorems may also state how many roots lie in the specified regions, or may give limits, inferior or superior, for the number of roots thus situated. These regions may be defined in terms

[1] Address of the vice-president and chairman of Section A—Mathematics, American Association for the Advancement of Science, Toronto, 1921.