

the breaking-weight upon bridges of this description, as, according to the last experiment, the beam broke with 313,000 changes; or a period of eight years, at the same rate as before, would be sufficient to break it. It is more than probable that the beam had been injured by the previous 3,000,000 changes to which it had been subjected; and assuming this to be true, it would follow that the beam was undergoing a gradual deterioration which must some time, however remote, have terminated in fracture.

*February 11, 1864.*

Major-General SABINE, President, in the Chair.

The following communications were read:—

- I. "On the Calculus of Symbols.—Fourth Memoir. With Applications to the Theory of Non-linear Differential Equations." By W. H. L. RUSSELL, A.B. Communicated by Professor CAYLEY. Received July 31, 1863.

(Abstract.)

In the preceding memoirs on the Calculus of Symbols, systems have been constructed for the multiplication and division of non-commutative symbols subject to certain laws of combination; and these systems suffice for linear differential equations. But when we enter upon the consideration of non-linear equations, we see at once that these methods do not apply. It becomes necessary to invent some fresh mode of calculation, and a new notation, in order to bring non-linear functions into a condition which admits of treatment by symbolical algebra. This is the object of the following memoir. Professor Boole has given, in his 'Treatise on Differential Equations,' a method due to M. Sarrus, by which we ascertain whether a given non-linear function is a complete differential. This method, as will be seen by anyone who will refer to Professor Boole's treatise, is equivalent to finding the conditions that a non-linear function may be externally divisible by the symbol of differentiation. In the following paper I have given a notation by which I obtain the actual expressions for those conditions, and for the symbolical remainders arising in the course of the division, and have extended my investigations to ascertaining the results of the symbolical division of non-linear functions by linear functions of the symbol of differentiation.

- II. "On Molecular Mechanics." By the Rev. JOSEPH BAYMA, of Stonyhurst College, Lancashire. Communicated by Dr. SHARPEY, Sec. R.S. Received January 5, 1864.

The following pages contain a short account of some speculations on molecular mechanics. They will show how far my plan of molecular