at the end where they were situated. The initial distribution of excited atoms was almost certainly more complex, so that higher-order solutions with larger decay constants also have to be taken into account.

It is possible that a repetition of this type of experiment in a large vessel at a pressure sufficiently low to ensure uniformity of the discharge, but not so low as to make loss by diffusion overwhelmingly great, might allow the various processes involved to be sorted out, and hence give an experimental value for the quadrupole transition probability.

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A Linear Theory of Finite Strain

SEVERAL papers have been published by Dr. K. H. Swainger in which he claims to have originated a linear theory of elasticity involving finite strain, and he has questioned, not only the approach of other workers in the same field, but also the classical infinitesimal theory, since these appear to be in conflict with his own^{1,2}. The purpose of this communication is to show that this new theory is untenable, since a mathematical inconsistency enters at the very beginning.

Dr. Swainger bases his discussion of strain on the following ideas (for simplicity the two-dimensional case will be considered). Let the points Q , Q' , and hence the element $d\mathbf{R}$, in the strained body correspond to P , P' and $d\mathbf{r}$, respectively, in the unstrained body.

At P there exists a unique pair of directions Pa , Pb which are orthogonal and which transform into a pair of orthogonal directions QA , QB in the strained body³. Suppose that the axes Pa , Pb are rotated about P until they are parallel to QA , QB , carrying $d\mathbf{r}$ with them into a new position $\delta\mathbf{t}$. Then the infinitesimal straining displacement of Q' relative to Q is defined by the relation

$$\delta\mathbf{D} = d\mathbf{R} - \delta\mathbf{t}. \quad (1)$$

For a point S at a finite distance from Q the straining displacement of S relative to Q is then defined as

$$\mathbf{D} = \int_Q^S \delta\mathbf{D} = \int_Q^S d\mathbf{R} - \int_Q^S \delta\mathbf{t}, \quad (2)$$

the rotation described above being applied to each element $d\mathbf{r}$ of the path in the unstrained body which corresponds to QS . In the subsequent theory this quantity $\mathbf{D}$ replaces the conventional displacement

$$\mathbf{U} = \int_Q^S d\mathbf{R} - \int_Q^S d\mathbf{r}. \quad (3)$$

It is tacitly assumed throughout Dr. Swainger's theory that $\mathbf{D}$ has a meaning; that is, that the process employed in its derivation is independent of the particular path between Q and S in equation (2). This is, however, false. Let the 'local rotation' at P necessary to bring the direction of Pa into coincidence with that of QA be denoted by φ , an angle which is in general a function of position. It does not follow, of course, that any arbitrary function can be chosen to represent φ , since such a choice may not be consistent with the physics of the problem. However, the non-integrability of $\delta\mathbf{D}$ will be shown without any restrictions on φ whatsoever, beyond the assumption that it is a continuous one-valued function of position.

From equation (1), $\delta\mathbf{D}$ is a perfect differential only if $\delta\mathbf{t}$ is. Let $d\mathbf{r}$ have components dx , dy parallel to the axes of a fixed reference system Oxy . Then

$$\begin{aligned} \delta t_x &= dx \cos \varphi - dy \sin \varphi, \\ \delta t_y &= dx \sin \varphi + dy \cos \varphi, \end{aligned}$$

must be perfect differentials; that is, one-valued quantities t_x and t_y must exist such that

$$\frac{\delta t_x}{\delta x} = \frac{\delta t_y}{\delta y} = \cos \varphi, \quad \frac{\delta t_x}{\delta y} = -\frac{\delta t_y}{\delta x} = -\sin \varphi.$$

But these are the Cauchy-Riemann relations and are sufficient to ensure that $\tau = t_x + it_y$ is an analytic function of $z = x + iy$, regular in the region under consideration.

Hence

$$\frac{d\tau}{dz} = \frac{\delta t_x}{\delta x} + i \frac{\delta t_y}{\delta x} = \exp i\varphi$$

is also a function of z , so that φ must be a function of z . But φ is a real quantity, and as such can only be a constant.

Hence the quantity $\mathbf{D}$ used in Dr. Swainger's theory has a meaning only for irrotational strain (apart from a possible rigid-body rotation which may also be superimposed). In these circumstances it is effectively equivalent to the conventional displacement defined in equation (3).

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DR. Gordon describes a theory of 'straining' that is certainly not mine. Dr. Gordon merely discusses the rotation of an assembly of elemental *rigid* blocks (or the undeformed body) with initial vector diagonal $d\mathbf{r}$ and current diagonal $d\mathbf{t}$, and correctly finds that since the body is not deformable then it can only