Seiler Strasse 29.
Hamburg. Jan 23. 1894.

Dear Sir 11/71

Having been reading your letters again, I am induced to enter briefly on another question, to which I may successfully add a few points of interest for your optional consideration in a leisure hour.

The theory of matter due to Thomson and Herml Helmholtz is attracting much notice. There is fundamental consideration I would here venture viz that we, as most (when conceptions are analysed) have apparently a better conception of a perfect liquid than of an ordinary one. This (if a fact), should recommend the idea to notice, rather than not. For a mind without special scientific training realises an ordinary liquid (erroneously no doubt) as perfect: for this mind does not think of a liquid as consisting of more or less rigid molecules sliding over each other, when disturbed. The liquid is thought of as liquid throughout — water for instance: it is conceived as a perfect liquid popularly. May not the <u>perfect</u> liquid (of Thomson) then be a fundamental conception we have, or really the primitive and easier conception? This may be deserving of notice as a question. So far the theory seems to present no difficulty. But there is another point I would call attention to.

Prof. J. J. Thomson (in a former friendly letter to me dated Dec. 4, 1888) suggested that the "perfect liquid in which the vortex rings are swimming" might be much less dense; and G. Johnstone Stoney I think theorises that it has no density at all. Prof. J. J. T. supposes viz — "The substance of the ring may be a liquid of very much greater density than the surrounding fluid." The ground for modifying this seems to be that the surrounding fluid is regarded as the ether, and it is viewed as lighter than gross matter. But I have never clearly understood why many look at the "surrounding fluid" as the ether. I confess I am only able to regard clearly some structure (vortex-structure) in the fluid as the ether (luminiferous), not the surrounding fluid.

But even if this objection be waived (and viewing these ideas with every respect, of course); it seems to me <u>strange</u> how the same (continuous) fluid can have <u>two inertiae</u>, or a <u>sudden</u> break of density outside the (vortex) ring. Some might say so that this looks like <u>two</u> principles, involving complexity. In the respect that the fluid is frictionless or offers no resistance to bodies moving through it, why should it signify how great its density or <u>inertia</u> is? I should be glad to be enlightened in defence of above view of sudden change of value of density of fluid: as no doubt you have heard these views, and your expositions are specially clear to me.

Assuming for argument, no such break in value of density to occur, and accepting the convincing evidence of the <u>open</u> structure of matter afforded by the passage of electromagnetic waves through stone walls as if they were no obstacles (also in view of possible truth of something like Le Sage's gravitation theory?); then it seems a curious fact and of interest to note that the mass of a cubic centimetre of fluid (continuous) must be greater and may be millions of times greater than the mass of a cubic centimetre of fluid mercury. For the latter metal consists of open structure small closed circuits or rings (called its "molecules") as it appears: so that the total volume of what we call a cubic centimetre of mercury must be relatively small, say less than one millionth of a cubic centimetre. Hence enormous density of Thomsonian fluid, if it have one uniform inertia; but this may give it great power in natural effects, it may be fitting?

But assuming for a moment for the sake of argument that Prof. J. J. Thomson's hypotheses (suggested) is true: then it seems to me it would be needful to define the boundary of the vortex core as sharply as the transition between the two densities in the continuous fluid is assumed by him to be sudden. Suddenly outside the ring the density is to diminish. Taking for simplicity a straight vortex core: could it be said that the vortex core is — "that portion of the fluid which we might imagine suddenly solidified without making any difference in the relative motion of the particles of the fluid." I have attempted to define the core in my mind thus, with what success or truth I am not able to say with certainty. But it must be defined with precision, especially if the inertia of fluid is suddenly to change there (definition seems needful). If my attempted definition be incorrect, I should be glad if the true definition of boundary of core were pointed out, even independently of whether the inertia suddenly* alters or not. I should be obliged for this, if it be possible to put it into simple language. After all, every result affecting motion must be deducible from Newton's 3 axioms. Your elucidation (I may remark) of how stress on a vortex filament was independent of its length, was perfectly clear to me.

Rotation of core without slip (actual) has been facilitated as a conception (may I say) in my case by illustration of a shaft (oiled) revolving in its bearing. Then reducing (in imagination) gradually diameter of molecules of oil will — I suppose — reduce slip between each layer of oil which makes up the thickness of the film intercepted between the shaft and the bearing. The greater the number of (molecular) layers of oil, the more is the slip subdivided; until (in the limit) when the molecules approach the infinitely small, we have the perfect fluid, and slip ceases: i.e. shaft rotates in the (transformed) oil as a straight vortex core in a perfect liquid? As there is no friction in the latter case: may the above consideration possibly illustrate or throw any light on the principle on which lubricants act? Is the matter more complicated and (a point of practical engineering, as it is) not yet worked out?

I am, with regards

Yours very truly

11/71

S Tolver Preston

* I am so far aware that lines of magnetic force about a ring electric current occupying the place of the vortex ring, represent — as to their magnetic force — in direction and magnitude, the velocity of the fluid at the corresponding points of the fluid.

Prof. G. F. Fitzgerald FRS.