St John's College
Cambridge.

1937 May 20.

Dear Fisher,

Milne's general principle is some hing to be found in a part of Mach's work that I possibly never read, and from his earlier work I should be surprised if Mach thought it important : that as mass can be inferred only from relative motion, the mass of any body is caused by the motions of other bodies. It looks to me like a lapse into a metaphysical idea of causality that Mach had already disposed of. But unfortunately in order to get a frame of reference Milne has to assume a substratum with a finite density, tending to infinity at an outer boundary, which is itself spreading out with the velocity of light ; and then he assumes that motions with respect to this substratum are small. As the substratum is unobservable I don't see that he has any justification for the second assumption. I should begin to be interested if he explained the things where the velocity of light and gravitation appear to be mixed — the three Einstein crucial tests. Judging simply by capacity for predicting observations I should prefer Eddington to Milne. On philosophical outlook my order of preference would be Einstein first, Eddington and Milne nowhere. Einstein has, I think, always made it clear that he is making suggestions that look hopeful and working out consequences that may lead to a test.

I am sending you a few early papers of mine that you won't find mentioned in any of the official relativity books ; but they constitute my reason for taking the whole business seriously.

I have taken over my information about ages of rocks mainly from Prof. A. Holmes of Durham. The only Cambrian determination I

know is in U.S.Nat.Res.C. Bull. 80 'The Age of the Earth', p.437, where a lead ratio of 0·059 is given for an upper Cambrian mineral. Late Ordovician, 0·052 ; upper Pre-Cambrian, 0·055. The corresponding absolute ages, from the graph on p.209, would be 440, 380, and 475 million years. I have no idea what the uncertainties are, but they don't seem to be enough to put things in the wrong order; the second significant figure means something, but I should not care to say how much.

The snag about converting lead-ratios into ages of sedimentary formations is that sediments are liable to lie about being eroded for a long time before an igneous rock suitable for a time-determination is poured on to them, and that this in turn may have to wait a long time before there are any more sediments suitable for giving a geological age. I have discussed this in 'Earthquakes and Mountains', but it is all more or less lifted from Holmes. So the results are usually of the form x > y > z, where y may be uncertain to 20 m.y. in particular cases, but the > may mean a difference of 1 to 100 or more million years. The geologist has to hunt round the world for cases where this uncertainty is as small as possible.

Schuchert has a chapter in the Bulletin about the possibility of using rates of denudation and deposition to give interpolated values. Rates of extinction of species may have the same kind of utility, but both need careful watching. For instance, the lower Permian in Durham follows on the highly fossiliferous coal measures, but itself is a desert deposit in which, so far as I know, nobody has ever found a fossil ; then there is a thin band of marl slate, (which is neither marl nor slate, but a fossiliferous mudstone) and then the magnesian limestone, which is fossiliferous only in occasional pockets containing beasts that look as if they had been very unhappy in life. I expect, however, that this is an unusually bad case.

Yours sincerely
Harold Jeffreys