

28 October 1958

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Dear Schroedinger,

Thank you very much for the complimentary copy of 'Mind and Matter', which I received some time ago from the C.U.P. My wife and I both enjoyed it very much, from different angles.

Although you and I differ in some opinions, I believe that our views about objective reality are similar. This is confirmed by your book, if I read it correctly. But this is, after all, only natural. I am but 10 years younger than you, and so belong practically to the same generation — a generation which accepted objective reality so easily that it did not know it was accepting anything !

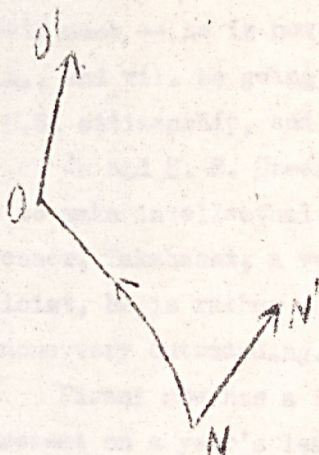
I make great efforts to establish intellectual contact with those modern quantum physicists whom I encounter from time to time; I want to know how they really think about things. But there seems to be a barrier which cannot be crossed. I blame them — perhaps I am to blame. But it is not, or should not be, a question of blame. The deplorable fact, for me, is that I find myself cut off from what must be a most exciting domain of thought. It is not a question of mugging up a lot of formulae, although that must be done, I know, before one can hope to get a real grip of things. The trouble is, I cannot begin — because objective reality seems to be cut away from beneath my feet.

However, as the years slip away, I have to realise that it is perhaps better to be content with the things one can understand. I remember saying to you one time when we were walking down together to lunch in Trinity, that I would like to destroy the general theory of relativity. At that time I was probably addicted to Whitehead's theory. Now I have turned my back on Whitehead, for two reasons. First, his theory does not cope with continuous media, as Einstein's does; secondly, G.L.Clark worked out the twobdy problem according to Whitehead's theory, and found a secular acceleration of the mass-centre.

At present I am full of great enthusiasm for the exploration of general relativity in terms of invariant quantities, and I believe that I have got something rather interesting. I hope that further thought and



calculation will not blow it all up. It is a question of the red-shift of distant nebulae, and I shall risk boring you by telling you something about it.



NO is the world line of a light-signal proceeding from nebula to observer.

NN' is the unit tangent vector to the world line of the nebula (its 4-velocity), and OO' the 4-velocity of the observer.

Now of course each nebula will have its individual behaviour, but we expect that it should be possible to think of an average nebula, and I understand NN' to be the 4-velocity of this (idealised) average nebula.

In the absence of knowledge, how would we expect NN' to be related to OO'? I mean that we should ask this question with open minds, not with any preconceptions about 'expanding universes'. To me it seems that there is only one simple answer, viz. that NN' is parallel to OO', for propagation along NO.

If that is admitted (and perhaps it is a big admission), then I find that there will be a spectral shift. It is possible that it might be a violet shift (I have not completed the rather lengthy calculations), but I have a feeling that it will come out red. And its magnitude is

$$\frac{\delta\lambda}{\lambda} = K \frac{m D}{r^2}$$

where K is some numerical factor (of the order of 2 or $\frac{1}{2}$ or something like that — it will be found by calculation), m = mass of nebulae expressed as a length [sun = 1.5 km], and r the radius of the nebula. On looking into Tolman, it seems to be the right order of magnitude. It is not possible to say more, because a few years ago the distance-scale of the universe was revised, and I don't know whether the astronomers have got a new one which may be regarded as reliable.



As regards local news, Brück has gone to Edinburgh as Astr. Royal, and is replaced by Allison, a Trinity graduate. Cosmic Physics has gone in heavily for contracts with the American Air Force, and McCusker travels much — he is now in Australia. Lanczos spent six months in the U.S.A., and will be going out again. But I think he is going to lose his U.S. citizenship, and take on Irish instead.

We had H. S. Green from Australia for six months, but I was not able to make intellectual contact with him. We have now an Assistant Professor, Takahashi, a very pleasant Japanese, but being a quantum physicist, he is rather out of my reach. We have a fair set of Scholars, but none very outstanding.

Pirani now has a Lecturership at King's College, London, and is at present on a year's leave of absence in the U.S.A. (Air Force money, I think). The Provost (McConnell) has formally given up his chair of Natural Philosophy in Trinity, but continues to lecture because they has not been able to find a replacement. Pirani could have go ~~to~~ this job in 1957, but he withdrew. Now he has changed his mind, and perhaps he will get it if they appoint someone next summer. Balazs also wants it, but of the two I would favour Pirani. Another possible candidate is Hamilton, who was once a Scholar at the Institute and is now in Cambridge.

Talking of the name of Hamilton, someone started the idea that a commemorative stone should be put up on the bridge where the idea of quaternionic multiplication occurred to W. R. Hamilton. De Valera pushed the scheme and Hackett handled the details — the stone with $ijk = -1$, etc., is to be unveiled sometime next month; it is set into Broome Bridge.

Thanking you again for the book, and with very kind regards from both of us to you and Mrs. Schroedinger,

Yours sincerely,

