

9th November 1967.

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Dear Wad,

I would not want to get into a long correspondence with you on the subject of vitalism in biology, because I think we really both agree on almost all the points involved, and the only differences between us are probably matters of emphasis. However, having had the opportunity to read your review again I thought I would write to make one or two points. Most of these are necessary because of the inadequate explanation in my book, which, as you may have suspected, was written rather rapidly. To take a very minor point first, the lectures were called "Is Vitalism Dead?" and I was very keen to have the book published with this title, but the University of Washington Press assured me that the term 'vitalism' was not understood in the States, and it was for this reason that the rather vague present title was chosen. I now think they were wrong, and we should have stuck to the original one.

atomic
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Now about the question of quarks. One of the points I should have made in the book but did not was that the structure of the nucleus is almost completely irrelevant for biology. This is because the energies involved in altering nuclear structure are enormously greater than anything found in everyday chemistry, upon which almost all biology is based (I admit I hardly mentioned quantum theory, but I certainly consider that chemistry is solidly based on it, even though in a lot of molecular biology we do not seem to need to get involved in quantum mechanical calculations). Of course one has to make an explanation of the effects of radiation, but I doubt if these are very fundamental for large parts of biology, even though in the laboratory one is always using radiation traces as an indispensable research tool. In short I do not think the question whether quarks exist is likely to have any important repercussions on biology. Of course one cannot be completely dogmatic on this point, and in fact I see that at the top of page 11 I have allowed myself a small loop-hole.

Since I wrote the book I have come to put vitalists into

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three classes. The first class is the obvious sort, who believe in some sort of soul, which can in no way be explained by chemistry or physics or any elaboration of them. The second class of vitalists does not necessarily believe in a soul, but he does believe in so-called biotonic laws, although he is often rather vague as to what these are. I think if anything deserves to be called a biotonic process it is the mechanism of Natural Selection. Whether there are other biotonic processes of equal importance I rather doubt, but it might be fun to try to draw up a list of possible candidates. To be included the phenomenon must differ very considerably from any possible analogy found in the inanimate world. I do not think Elsasser's argument about the immense number of combinations which have to be considered amounts to much in practice, because I think if one is studying the reproducible behaviour of organisms one is mainly concerned with the average behaviour, and not by rather rare freak events, just as one is in the physics of gases. I think he would have a point if he applied his argument to the course followed by evolution, since many of the ~~subjects~~ ^{steps} involved there seem only to have occurred ^{once}, and may well have depended upon rather minor accidents in the environment. However, I have not read his latest book, which you mention, so I suppose I shall have to get hold of a copy to see what he now thinks about this point. We did correspond about his earlier book, but I didn't seem to be making any headway with him.

The third type of vitalist (although he is so little of a vitalist that he hardly deserves the name) is the person who believes that radically new laws of physics or chemistry are likely to be discovered from studying biology. I have been astonished to learn that Max Delbrück falls into this class, and that this hope was his strongest motivation into going into biology. I have really nothing against this point of view, except that I suspect the discovery of such laws is rather unlikely.

I think there may be a real difference between them in the point that you make about the subjective nature of awareness. Of course I am familiar with this argument in a general sort of way, but I confess that not being a philosopher I have never really thought about it in detail. If I examine my attitude of mind on this subject, I think it goes somewhat as follows. There is no doubt that awareness makes us uncomfortable, because we do not seem to have any adequate explanation of it. I would regard an adequate explanation as something which removes this undeniable feeling of discomfort. I suspect that it will be removed, not for philosophers but for ordinary people, when we can describe the objective correlates of some particular fragment of awareness. If I had to use an analogy I would point to the recent development in the study of dreams. The philosopher could

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easily argue that we can never know when somebody is dreaming. In practice we have strong reason to suspect that when a person is a certain sort of sleep involving rapid eye movement he is probably dreaming. I am sure you are familiar with the sort of evidence that supports this hypothesis. Accepting this we can then answer questions such as does everybody dream every night, and for how long? I think that consciousness or awareness will cease to be mysterious when we can describe the patterns of nervous impulse, in particular parts of our brain, and can show in a detailed way that certain patterns are associated with certain thoughts. You could still argue that this would not solve the problem since it lies in a different logical realm, but I think it would illuminate our present difficulties to such an extent that nobody would be particularly bothered about the philosophical difficulty.

There are a number of other points I could make. I do agree with you that we really ought to know a lot more about Natural Selection, and that there is constant temptation to use it in a rather loose way to explain almost everything. I also agree that some topics such as the time when the soul enters the human foetus have been rather fully dealt with before, though I think you will find that there still exist intelligent people who worry about that sort of thing (my secretary is one of them!).

Finally, in case you think I am making rather a fuss I should like to thank you for what is really a very friendly review of the book, which should help to sell quite a number of copies, but for the fact that the dock strike has made it unobtainable in England, and I have been hard pressed to find even a spare copy for myself!

F.H.C. Crick.