Letters to the Editor.

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Emergent Evolution.

It is curious that while the concepts of physics have been undergoing drastic revision, the same has not happened with regard to biology. It is true, Dr. E. S. Russell has recently examined very critically what is meant by organic development, but very much more is still necessary in respect of other conceptions of biological science. Here I refer particularly to the notion of 'emergence' in evolution—by which, Dean Inge says, we assert and deny change in the same breath! The conception, as it has been stated so far, involves confusion, and it would be well worth while for someone familiar with the formal methodology of science to attempt a very critical discussion of the matter.

The notion of emergence is illustrated by the formation of water from its elements. There is nothing in the reactants, it is said, which suggests the liquidity of the resultant: liquidity, therefore, is said to 'emerge' from the reaction of oxygen and hydrogen to form water. But may we not regard these reactants as mass-points in a Newtonian medium, moving in accordance with Newton's laws, and attracting and repelling each other with forces which are functions of their distances apart. We describe such a system of mass-points by position- and force-co-ordinates. Since the mind-body problem is the same in our perceptions of the properties of reactants and resultants, may it not be regarded as cancelling out, so that liquidity in the resultant is the changes of co-ordinates? Of course, we may make an analogous statement with regard to an electronic medium.

Again, the properties of the atom are said to 'emerge' from some configuration of the elements of the atom. But that configuration, to J. J. Thomson, was not the configuration imagined by Rutherford and Bohr, and, again, not the configuration of current physics. Yet the 'emergent' properties are still the same ones. Finally, we can make systems of equations representing the thermodynamic probabilities of two or more gaseous systems and we can deduce from those equations that the entropy of a combined system is proportional to the logarithm of the combined probabilities. May not the latter equation be said to 'emerge' from the former ones, and yet does it contain any terms that were not in the equations from which it was deduced? Is not what emerges 'a relation made in the mind of the investigator'? Were not the electronic configurations simply in the minds of mathematical physicists rather than in the atomic systems?

These examples are very simple ones: what emergent evolution rather contemplates are the origins of human mentality, 'values', the religious feelings, and God. Science now, in its modesty and self-critical outlook, is being said to admit, or at least tolerate, speculations with which, in a more assertive (or truculent) phase, it would have nothing to do. Has not the time come when notions such as that of 'emergence' and 'organicism' should be dispassionately and critically (or even unsympathetically) considered in the interest of sound thinking?

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No. 3193, Vol. 127]

Embryology and Evolution.

I SHOULD like to comment on two letters by Mr. Haldane: one on "Natural Selection Intensity as a Function of Mortality Rate", in NATURE of Dec. 6, and the other on "Embryology and Evolution", in the issue of Dec. 20. In the first, Mr. Haldane criticises as "fallacious" Prof. Salisbury's argument that mortality amongst plants is mainly confined to the seedling stage and that at this period natural selection mainly works. He goes on to consider a case where two races vary as to a single character! Now, this is a travesty of what occurs in Nature. Two allied races do not differ from one another in a single character: they differ in a multitude of minute points, and it is quite impossible to say whether one or another of these points determines their survival. The 'characters', in fact, are mere abstractions. The organism is a whole, and the characters are the expression of its constitution; in a word, of the vigour of its reaction to its surroundings. The whole point of Prof. Salisbury's argument was that natural selection chooses the most vigorous, not that which possesses some special character, and this argument I believe to be perfectly sound.

In his second letter Mr. Haldane objects to four of the statements in my reply to Prof. Gates. I shall deal with these seriatim.

(1) Mr. Haldane claims that some microscopists have seen 'genes'. What they have seen are segregations of material in the stained and fixed chromosomes which they have identified as genes—a purely hypothetical conclusion. He further says that the presence or absence of a 'trabant', that is, not a gene but a small chromosome, makes a difference in the constitution of the plant *Matthiola*. This is quite possible, and I shall be glad to have it demonstrated. Prof. Gates was, I think, the first to show that an extra chromosome made a difference to the appearance of the mutant.

(2) Mr. Haldane asserts that scores of cases are known where in interspecific crosses characters behave in a Mendelian manner, that is, are due to genes. All I know on this subject is that my friends who are systematists, and have devoted their lives to the study of species and races, deny that such is the case. Of course, a mutant such as the domesticated race almost always 'mendelises' when crossed with the wild type; that is just what distinguishes a mutant from a racial character, and the case quoted by Mr. Haldane is such a cross.

(3) Mr. Haldane states that autocatalytic reactions are common in physical chemistry. By this is meant reactions in aqueous solutions which are accelerated by the products of the reaction. I put this question to three first-class chemists, all of them fellows of the Royal Society and one of them a bio-chemist, and as they were all unaware of any such case, I prefer to accept their testimony.

(4) Mr. Haldane objects to my posing the alternative of the organs being preformed in miniature in the embryo or being due to an 'unknown cause'. He says that bone is formed by an enzyme 'phosphatase'. This is a mere quibble. Enzymes are means employed by the embryo to develop its powers, and their orderly appearance is just as much a mystery as the appearance of the organs themselves.

Mr. Haldane's remarks about my refusing to take cognisance of the recent advances of science and his invitation to acquaint myself with the 'facts' of genetics and chemistry I prefer to disregard. I have quoted the authorities on whom I rely in chemical matters. As to genetics, I have served for seventeen years on the Council of the Institution to which Mr.