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Biology as Analysis of a Game such as Chess

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The science of biology can be likened to the analysis of a complex game such as chess, in which the playing pieces (genes) are replicators, and at first of a size that keeps them outside the range of the senses of the analyst. All that can be perceived at first are the strategies, and combinations of strategies (traits and collections of traits), that make up the game itself (the game being the whole individual, including its social life). Even the individual moves of the pieces (initial gene products) are not yet available to the senses of the analysts. (In living organisms the pieces not only replicate themselves, but move themselves, and the strategies come from the interactions of the pieces, evidently without the intervention of a "player" such as the human player in a game of chess.)

For this comparison one must suppose as well that every game of chess is slightly different because the individual pieces and their moves vary from game to game (organism to organism), and that every so often there is a shuffling of the pieces (genes, shuffled every generation) used in different games so that every succeeding game (organism) is novel as an entire game, but the strategies are the same, just used in different combinations. Rarely, the moves of individual pieces are altered randomly with respect to their usefulness in winning, producing new strategies and usually (but not always) resulting in the game being lost. When one game has been finished half its pieces are exchanged with half of those from another game, to make up a novel set of pieces for the next game.

When the analysts become aware of the individual pieces, they may believe, as with theoretical physicists discovering fundamental particles, that they have discovered the real truth. In a sense they have. In another sense, however, they have not. Physicists are more likely to be correct in such an attitude than are biologists or analysts of chess because the number of synergisms or unpredictable consequences of combining non-living particles is minuscule compared to those involved in the makeup of living organisms. The development (ontogeny) of the organism and its history -- the emergent qualities of life as a consequence of its hierarchical organization -- are still unfathomably complex. So is the history responsible. The parallel from chess -- which on this account becomes potentially confusing -- is the strategies employed in different games by the players using the pieces.

Chess obviously is not to be understood solely from knowing even all the pieces and their moves. More starkly, molecular biology is yet not close to identifying all the pieces. Typically, it relies upon a sample of the pieces -- most often something like .001% of the genome.

All of the playing pieces contribute to a chess game, and their roles are intertwined so that no individual piece operates independently of any other piece. Every ploy -- every strategy or combination of strategies -- depends on all pieces. Likewise, every aspect of the organism -- its traits or its phenotype -- depend on interactions of all its genes. As one of the greatest of all evolutionary geneticists (Theodosius Dobzhansky) said, “Heredity is particulate but development is unitary. Every gene affects the action of all other genes.” This aspect of the organism parallels the overall strategy of a chess game.

Suppose someone knew the moves of only a tiny fraction of the playing pieces for chess. From these alone he compares one game of chess with another and decides they are different -- or alike. Now consider someone who does not know the moves of any chess pieces but does perceive the strategies used. Which one understands the game of chess better? Which one is more likely to be correct in assessing the similarity or difference in the two games?

Now suppose someone knew all of the moves available to every chess piece but nothing else. Although the game of chess as played today eventually arose out of such knowledge, knowledge how to play the game expertly does not exist instantaneously, any more than the knowledge of the temperatures at which water boils and freezes, and when it expands or contracts, is immediately available from examining hydrogen and oxygen separately.

The game of life involves hundreds of thousands of separate playing pieces, and strategies of a complexity predictable from this fact.

Traditional traits of organisms -- morphology, physiology, behavior -- are thus better samples of the underlying genome than are individual components of the genome. Individual genomic components hold secrets, but, like the hydrogen and oxygen making up a water molecule, so do the traits genomic components produce by acting together as a whole.

These facts, and the still rudimentary state of our knowledge of the playing pieces in the game of life, are why organismic biology and social biology are unlikely to be superceded by molecular biology in even the far distant future.