"Try Simplest Cases" Approach to the Heredity-Poverty-Crime Problem

A famous "try simplest cases" approach [W. Shockley and W. Gong, *Mechanics* (C. E. Merrill, Columbus, Ohio, 1966)] explained the properties of matter by assuming it consisted of indestructible atoms of elements. This simple model, although known to be a gross oversimplification since radioactivity was discovered, remains a basis for chemistry and metallurgy. In contrast, the simple explanation of the god Thor as the cause of thunder and lightning is practically worthless. A simplest-cases approach to human population problems suggests that modern advances in medicine and technology can upset quantitative and qualitative aspects of humanity and possibly endanger the future of civilization. Developments in control of human reproduction are now openly discussed and promise to solve the quantity problem. Facts from the science of behavior genetics suggest that welfare cases may be producing an increasing percentage of the unemployable, but this quality problem, insofar as it involves intelligence and heredity and especially questions of racial differences, now seems so emotionally charged as to be intellectually unapproachable. My experience confirms the existence of the effective suppression of objective discussion (including fear of loss of employment) that has been extensively documented recently. [C. Putnam, *Race and Reality* (Public Affairs Press, Washington, D.C., 1967)]. Two eminent exceptions are the recently expressed similar concerns of D. J. Ingle (AAAS meeting, December 1966; Columbia University Forum, in press) and H. F. Harlow (reported by W. Shockley, *S.F. Chronicle*, 30 January 1967). Harlow conjectures: "It is my opinion, and it is the opinion of many psychologists, that the average intelligence scores of people labeled 'black' are lower by about one standard deviation than the average of those labeled 'white' and I believe that at least half of this difference is related to genetic variables." Analysis of recent draft test data indicates that the difference has significantly increased between World War I and now. I can identify no serious efforts either individually or collectively in the National Academy of Sciences to replace the quoted "simplest cases" conjecture with sound facts.

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"Try Simplest Cases" Prediction of a Magnetic Current Force

In addition to the force exerted upon electric currents flowing in magnetic fields (such as drives electric motors), we propose an equally real but generally much smaller "magnetic current force" $\mathbf{f}_m$ exactly of the form expected if magnetism were produced by magnetic charges that "flow" when magnetism changes. (In MKS units $\mathbf{f}_m = \epsilon_0\mathbf{E} \times (\dot{\mathbf{B}} - \mu_0\dot{\mathbf{H}})$.) A "try simplest cases" treatment of "conceptual experiments" in an "idealized limiting case" [these "search thinking tools" are discussed in W. Shockley and W. Gong, *Mechanics* (C. E. Merrill, Columbus, Ohio, 1966) and in W. Shockley, *IEEE Spectrum*, **3**, 49 (1966)] of a superconducting coaxial transmission line revealed the need for $\mathbf{f}_m$ to transfer the electromagnetic momentum (that is, $\mathbf{G}_p$ = the integral of the Poynting's vector momentum density $\mathbf{g}_p = \mathbf{E} \times \mathbf{H}/c^2$) to mechanical momentum when the center conductor acquires resistance, and energy flow dies away. Conservation of momentum again requires $\mathbf{f}_m$ for a wave packet in a medium with magnetic-energy losses. The origin of $\mathbf{f}_m$ in actual magnetic materials in which magnetism is caused by current loops, not magnetic charges, arises from a generally neglected linear momentum $\mathbf{G}_l$ that must exist even within the pattern of the spinning electron's motion. D. L. Webster has considered this momentum for examples other than current loops (personal communication). This $\mathbf{G}_l$ is the momentum of an energy flow necessarily associated with any current loop lying in an electric field (that is, $-\mathbf{G}_l = \epsilon_0\mathbf{E} \times \mu_0 I\delta\mathbf{A} \equiv \epsilon_0\mathbf{E} \times \mu_0\delta\mathbf{m}$.) This energy flow within a thin layer (or pill box) containing the current loop is necessary to avoid divergence of the total energy flux which, by the Einstein mass-energy relation ($E = mc^2$), corresponds to a mass flow; $\mathbf{G}_l$ balances the energy flow that is carried by Poynting's vector from places where the electric field opposes the current flow to places where it aids. Changes in magnetization change $\mathbf{G}_l$, and these changes appear as the force $\mathbf{f}_m = -\dot{\mathbf{g}}_l$. The energy flow for $\mathbf{G}_l$ can be understood for macroscopic models: (i) Insulated, rotating, circular disks with charged rims produce I and carry $\mathbf{G}_l$ as mechanical power flow. (ii) Charged, inertial masses produce I by sliding on frictionless tracks and carry $\mathbf{G}_l$ as kinetic energy. It is conjectured that $\mathbf{G}_l$ for electronic magnetism is the quantum-mechanical equivalent of (ii). The identity of $\mathbf{f}_m$ with the magnetic-charge model occurs because $\mathbf{G}_p$ within a magnetic charge dipole shell is mathematically equal to $\mathbf{G}_l$.

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Extracellular Evolution of a Self-Duplicating Nucleic Acid Molecule

When $Q\beta$ replicase is presented with either of two genetically distinct $Q\beta$-RNA molecules, the RNA synthesized is identical to the initiating template [N. R. Pace and S. Spiegelman, *Science* **153**, 64 (1966)]. This outcome proved that the RNA is the instructive agent in the replicative process and hence that it satisfies the definition of a self-duplicating entity.

An opportunity was thus provided for studying the evolution of a self-duplicating nucleic acid molecule outside of a living cell. It should be noted that this situation mimics at least one aspect of the earliest precellular evolutionary events when environmental selection operated directly on the genetic material.

We report experiments which asked the question: What are the evolutionary consequences if the only demand made on the RNA molecules is that they multiply? To answer these and related issues, a serial transfer experiment was performed in which the intervals of synthesis were adjusted to select the earliest molecules completed. As the experiment progressed, the rate of RNA synthesis increased and the product became smaller. By the 74th transfer, the replicating molecule had eliminated 83 percent of its original genome to become the smallest known self-duplicating entity.

Aside from their intrinsic interest, such studies can provide insight into a number of central issues. Thus, they can tell us the smallest self-duplicating entity that can be constructed by such devices and provide much simpler objects for analyzing the replicative process. Further, the sequences involved in the recognition mechanism between template and enzyme must be retained, leading to their enrichment in the smaller molecules which evolve. Finally, these abbreviated RNA molecules have a very high affinity for the replicase but are no longer able to di-