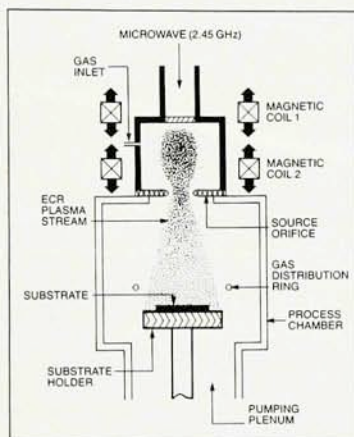


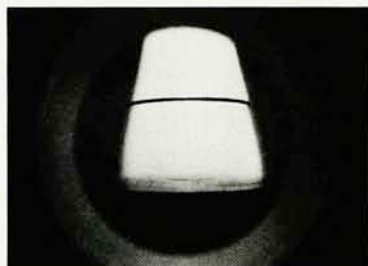
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the facts may be in the case of Exxon, PHYSICS TODAY must see itself as the only advocacy organ we physicists have. If you don't have something nasty to say about Exxon, don't print it at all.

DAVID KLICK

7/87

Chelmsford, Massachusetts

SWEET REPLIES: The news story about Exxon R&E was not intended to put my blessing or the magazine's blessing on the halving of the laboratory's staff. The story intended to take note, as the headline said, that despite the cuts, basic research had revived in a form that seemed likely to enjoy the company's long-term support.

A Very Special Theory of Relativity

John Stachel's contribution, "Einstein and Ether Drift Experiments," in the May 1987 issue (page 45) quotes an interesting sentence from one of Albert Einstein's letters in 1901 to his fiancée, Mileva Marić: "How happy and proud I will be when the two of us together will have brought our work on relative motion to a successful conclusion." Stachel then writes that "this comment raises the intriguing question of the nature of Marić's role in their collaboration. Her letters to Einstein... contain no substantial references at all to physics." In my opinion the answer to this question is rather simple: The "successful conclusion" of the relative motion of the engaged couple is their marriage.

K. SUCHY

*Institut für Theoretische Physik II
der Universität Düsseldorf*

6/87

Düsseldorf, FRG

Of Crays and Creationism

In his letter published in the May 1987 issue (page 145), Arthur S. Lodge conflates two ideas—the origins of life from inanimate precursors, and theories of evolution by natural selection—and profoundly misunderstands one of them—evolution. Natural selection explanations are fundamentally different from the example that Lodge gives: "We need wait only a fairly short time until somewhere a factory full of inanimate matter (electronic components, even) accomplishes by chance the comparatively trivial task of assembling itself into a Cray computer—in working order." Similar statements have been made elsewhere. (Fred Hoyle and Chandra Wickramasinghe,¹ for exam-

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*Source: *The American Heritage Dictionary*, 2nd ed. (Boston: Houghton Mifflin Company, 1982), p. 1134.

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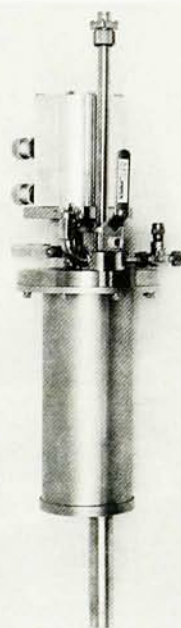
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Robert R. Borchers, the editor, is the Associate Director for Computation at Lawrence Livermore National Laboratory at the University of California.

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ple, have written that "a tornado sweeping through a junkyard might assemble a Boeing 747 from the materials therein.")

Theories of natural selection do not postulate placing components together and shaking the parts around until, in a single step, the final object appears. Rather, theories of evolution apply to cases where simple precursors reproduce more offspring than will survive, where the offspring are similar to their parents because of genetic hand-down, but not identical because of mutations, and where natural selection in the environment acts to give some of the offspring a better chance to themselves produce offspring than it gives their siblings. The essential element of the theory is the "toss and test" mechanism of many selection events sandwiched between imperfect reproductive events. (Death of individuals is also required so that raw materials can be recycled.) For this reason, Lodge's reference to the origin of the human brain as being similar to the shake-and-bake Cray is based on a profound misunderstanding of theories of evolution by natural selection.

Simple computer simulations² can easily show that the "toss and test" sandwich is immensely more effective than single-step methods (easily by 25 orders of magnitude for very simple systems, and beyond imagination for biological systems that over geologic time involved perhaps 10^{15} generations consisting of 10^{37} individuals each).

The creation of life from nonliving precursors is a much more difficult problem than explaining the similarities between now living forms. No theory of creation having even a tiny fraction of the explanatory power of any of the theories of evolution yet exists, so a pessimist might think that Lodge's shake-and-bake Cray is a valid analogy here. But life could have originated from relatively simple physical systems, such as some photoelectric minerals.³ After all, who in the 19th century would have guessed at the remarkable properties now being found in a Y-Ba-Cu-O system? To progress while staying within the bounds of science, we should assume that the physical situations (as yet undiscovered) crucial to the origin of life were basically simple, that they took the form of inanimate, nonequilibrium feedback systems and that we will someday find suitable transition steps⁴ from these first primitive systems to the genetic systems that characterize biology.

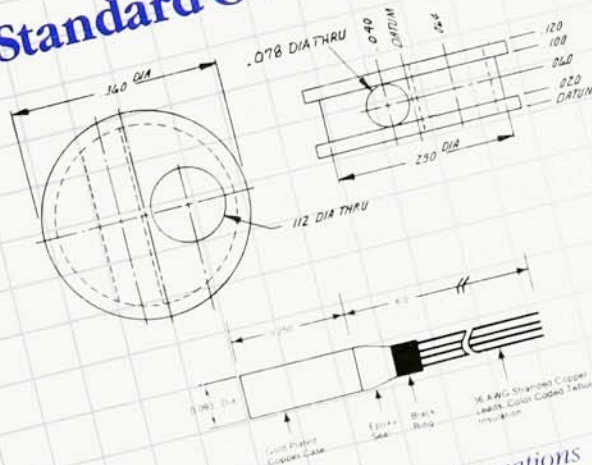
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bly the most difficult questions now current in science, it is far too soon to be pessimistic about their eventual solution.

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EDWARD H. CARLSON

Michigan State University

6/87

East Lansing, Michigan

I wish to point out to Arthur S. Lodge that Nature has indeed accomplished the task of assembling a working Cray computer entirely from initially inanimate matter. It only took 4.5 billion years or so. It might have taken longer except that Nature was clever enough to evolve *Homo sapiens* as an intermediate step in this worthy goal. If Nature had been more clever, it might have done the job sooner, and perhaps these *Homo sapiens* would not be threatening to blow up all the Cray computers with large nuclear weapons.

C. GREGORY SEAB

Virginia Institute for

Theoretical Astronomy

6/87

Charlottesville, Virginia

LODGE REPLIES: Edward H. Carlson states that I conflate "origins of life from inanimate precursors, and theories of evolution by natural selection." The only statement that I made about natural selection was "Natural selection from pre-existing species clearly cannot account for the origin of anything (perhaps *The Origin of Species* should have been more accurately entitled *The Modification of Species*)." There is no conflation in this statement, for which I claim no originality. Some evolutionists¹ apparently agree with the second part of it: Ernst Mayr stated that "Darwin failed to solve the problem indicated by the title of his work." George Gaylord Simpson stated that Darwin's "book called *The Origin of Species* is not really on that subject." Carlson's second paragraph does not deal with my letter because he writes

"at a single step" where I wrote "billions of years." Carlson's "toss and test" typing monkeys example in his second reference seems to me to involve a circular argument.

Carlson's sentence "No theory... yet exists" comes perilously close to the "best-in-field fallacy,"¹ which has produced some unconventional logic: Some evolutionists say that natural selection generates an exceedingly high degree of improbability; Julian Huxley argued that the very improbability of species' arising in this way proves the immense power of natural selection.¹

I did not use the word "evolution." I claimed that purely *materialistic* theories had failed to account for the origin of life in general and the human brain in particular. Carlson's final two paragraphs suggest that he agrees that the origin of life on Earth has not yet been explained in purely material terms, and that he has faith that an explanation will be found "within the bounds of science." What are these bounds, and is there any good reason for accepting them? The context suggests that Carlson means the bounds of materialism (although he does not use this word) rather than the bounds of scientific method. On the grounds of postulatory economy, it makes sense to develop materialistic theories as far as possible. When, however, after reasonable efforts, they appear to fail, would it not be good scientific practice to consider other theories as well? Curiously enough, reluctance to do this seems to be rather widespread; following one correspondence involving four evolutionists, all four agreed that they accepted evolution not because it could be proved to be true but because "the only alternative, special creation, is clearly untenable."² Surely scientific method could be used to investigate "special creation" and other possible nonmaterialistic theories. In fact, the main point of my letter was to suggest that scientific method in large part originated in religion and does not conflict with it. According to one evolutionist, "some degree of faith is necessary in order to accept evolution as the way in which events of the remote past, such as the origin of life, took place."³

According to one of 11 published definitions,⁴ the word "nature" means "a creative and controlling force in the universe"; this would seem to fit C. Gregory Seab's use of the term "Nature." The question at issue is whether this force is (or will ever be) describable in purely material terms or not. Seab's letter does not help us to answer this question, and

his use of the term "evolve" in this context suggests that he may be giving insufficient weight to the difficulties confronting macroevolutionary theories today.¹

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2. A. Lunn, G. Lean, *Christian Counter-Attack*, Blandford P., London (1969), p. 104.
3. G. Ledyard Stebbins, *Processes of Organic Evolution*, third edition, Prentice-Hall, Englewood Cliffs, N. J. (1977), p. 4.
4. *Webster's New Collegiate Dictionary*, G. & C. Merriam, Springfield, Mass. (1975).

ARTHUR S. LODGE

2/88 University of Wisconsin—Madison

Plaudits for PSSC Physics

I had not intended to write in regard to the article "Setting New Directions in Physics Teaching: PSSC 30 Years Later" by Anthony French (September 1986, page 30), since I felt it was so well and accurately done. However, I was very disappointed with the response exemplified by the letters published in the April 1987 issue, and I feel compelled to comment. None of the respondents whose comments were published were clearly identified as high-school teachers who had taught the PSSC course and had the opportunity to compare it with other physics courses they had taught. David S. Martin explained why he had chosen not to teach the PSSC course, though he indicated that he made use of the PSSC labs and films. His statement regarding the lack of involvement of high-school teachers does not match either the facts or my personal experiences as one of the first PSSC teachers. During the early years, we could hardly have been more involved! We were asked to evaluate the lab materials and instructions, the text materials, the problems, the tests and the films. Our evaluations included specific student responses to and difficulties with individual problems, test items, paragraphs and even sentences from the text. We saw the changes we recommended appear in later versions of the lab guides, text, tests, problems and in the teacher's guides. Over 600 high-school teachers and over 25 000 high-school students participated in the evaluation of the materials during the first three test years.

Our school was also involved in evaluation of the PSSC films, and as

early as 1960 student comments included references to widths of neckties and Eric Rogers's glasses being removed and replaced a number of times. As French suggested in his article, the primary criticisms of my present students do include haircuts and awareness of lapel widths, and the copyright date at the beginning of each film is a major distractor. At the same time, the students are aware that in space travel, as the astronauts stated, Isaac Newton still "does most of the driving"—and his film would have a copyright date nearly 300 years old.

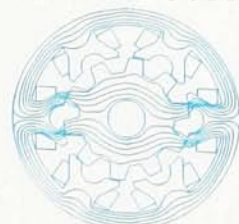
I started teaching physics in 1949, and I was quite frustrated with the physics texts, labs and supportive materials available. The topics were segmented and highly application oriented. There seemed to be no clear attempt to help a student (or teacher) answer or even ask the question "How do we know?" I was most frustrated with the lack of any overall picture of the fundamental principles and processes of physics. My own background was limited (a major in mathematics and minors in physics and philosophy), and I knew I was poorly qualified to make basic judgments about what was fundamental and what was extra. (Too many in similar situations readily criticize available materials and then "develop their own courses." The result *cannot* be better than the limited background and special interests of the developer.)

In the summer of 1958 I participated in the first PSSC Institute at Reed College, and I found much more than I had expected. Labs had been developed in which the apparatus did not obscure the principle, process or relation they were trying to clarify. "How do we know?" and "What are the limitations of our conclusions?" were the essence. The laboratory was the basic place where information was obtained, and the text was a reference source. In the institutes, PSSC teachers had the opportunity to learn why the content choices were made, and how the pieces all fit together. They learned that the text is not the "bible," and that the concept of physics as an "exact science" is at best misleading. Teachers had an opportunity to learn physics as a way of thinking, and not as an application of memorized, mechanical rules for solving problems, and were prepared to help their students do the same thing.

My comments in regard to PSSC Physics are based on 29 years of feedback from former PSSC students who are now scientists, engineers, doctors, lawyers and architects as well as accountants, businessmen

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