

ity with the work of earlier philosophers and religious leaders. But I hope he will not feel that I am insensitive to the threatened condition of the human race if I, and sizable numbers of others, demonstrate rampant apathy (as Tom Lehrer would say) toward the Prometheus Project.

Some will be unable to get past page 23, where the author acknowledges that "it is understandably difficult for many people to become concerned about distant goals when people are starving and the survival of humanity is at stake." But he defends his own concern with more remote problems by concluding that "most of our immediate problems will be solved in a relatively short time by the march of technology and the worldwide spread of those aspects of Western culture that are responsible for our high living standards." The impending world population crisis, for example, is "relatively short term," because "some form of birth control seems likely to remove that contingency." As I was a reviewer, I forced myself to keep going.

Second, many may question Feinberg's understanding of politics, that is, people acting collectively. He rejects dependence on governments for his scheme (despite their implied spectacular performance in the next few decades); he wisely notes that it is at least impractical to depend only on scientists and other intellectuals. Participation must be worldwide and involve "a sizable portion of the human race." I suggest he examine the suc-

cess of Moral Rearmament in the Soviet Union and China as a reasonable test of the prospects.

Third, Feinberg gives relatively little attention to the problem of implementation of policies derived from goals. There is considerable evidence in our own land that this is a more important problem than the setting of goals. (Every American raised in the Judeo-Christian tradition would vote for elimination of ignorance and poverty as a goal, and we certainly have the wealth and knowledge to do so.) Perhaps it is in this respect that the religious prophet has more promise of effectiveness than the Prometheus Coordinating Agency.

Fourth, I get the impression that Feinberg has not successfully resolved an important conflict within himself. His last page states the premise on which the book is based: "The search for goals described in this book is my expression of ultimate belief in the existence and power of human rationality." Indeed so must we all be, if the future of homo sapiens is to be determined by the votes of Feinberg's Prometheans (from the Greek meaning "foresight") in the last third of the 20th century AD. But back on page 50 we see the agony of the intellectual leading to Promethean (bound) temptation to seek "radical changes in human beings in order to produce a more ideal state." "My own feeling," writes Feinberg, "is that the despair of the conscious mind at the recognition of its own finitude is such that man can not achieve an abiding contentment in his

present form or anything like it. Therefore I believe that a transformation of man into something very different from what he is now is called for. But I do not know to what extent my fellow man will agree with me here."

Well, here's one fellow man ready to answer. "Not one bit," I say. My faith in the ultimate rationality of man is not so strong that I would trust myself—or any other mortal—to undertake this Frankensteinian project. It is man's rationality that separates him from animals—the limited nature of that rationality that separates him from God.

So I plead for one goal for man's long-range future: Keep his options open, and keep variety in the gene pool. As a short-range goal, I suggest humility. It may not provide intellectually satisfying solutions to man's dissatisfaction with his nature, but it's very good for keeping the vultures away from his liver.

* * *

Formerly director of the Joint Institute for Laboratory Astrophysics at Boulder, Colo., Lewis Branscomb was recently named head of the National Bureau of Standards.

Math and physical insight

Elektrodynamika kwantowa (Quantum electrodynamics). By Iwo Bialynicki-Birula i Zofia Bialynicka-Birula. 394 pp. Państwowe wydawnictwo naukowe, Warszawa (Poland), 1969. Zl 69.00

by OLEXA M. BILANIUK

As an experimentalist, I have for some time looked for a book on quantum electrodynamics in which I could read up on the subject without losing interest too soon. I have found such a book. In it the mathematical formalism is infused with physical insight throughout; tedium has been successfully banished from this comprehensive, up-to-date text. I am glad Polish is no handicap for me, because that is the language of the book—it has been written by a husband and wife team of eminent Polish physicists at the Institute of Theoretical Physics in Warsaw, Poland. Those who do not read Polish will have to wait for a translation.

The first part of the book could be profitably studied these days by a theoretically-inclined college senior, be-

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cause knowledge of classical electromagnetism, basic quantum mechanics, and advanced calculus are sufficient prerequisites. The first five chapters contain a summary of the classical theory of electromagnetism (including such rarely treated topics as nonlinear theories of electromagnetism with their canonical formulation), a discussion of the Green's function description of the scattering process, interaction of classical sources with a quantized electromagnetic field and the Feynman approach to the problem of electrons moving in an external field.

The second part (chapters 6-8) is more difficult, hairy as far as I am concerned. It is intended for graduate students writing dissertations in quantum field theory. I am not qualified to say how effective the authors are in this second part, but judging from the first part it should be excellent.

Its subject matter includes advanced treatment of the theory of interacting electron and photon fields. Starting from the field equations, the authors give a detailed discussion of the S matrix in terms of propagators. The discussion of renormalization is based on a novel method developed by the authors with various applications presented in the last chapter. The nine appendixes are most helpful. I hope that an English translation of this excellent textbook will not be long in coming.

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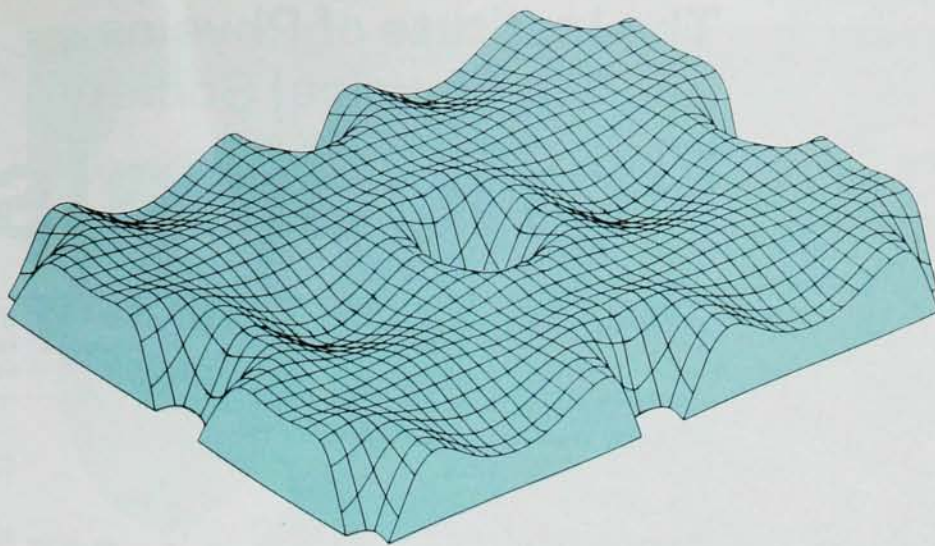
Olexa M. Bilaniuk is an associate professor at Swarthmore College, Swarthmore, Pennsylvania. He is primarily a low-energy nuclear physicist with a strong interest in foundations of physics and was coauthor of "Beyond the Light Barrier," PHYSICS TODAY, May 1969.

A band-wagon map

METHODS IN COMPUTATIONAL PHYSICS, VOL. 8: ENERGY BANDS OF SOLIDS. Berni Alder, Sidney Fernbach, and Manuel Rotenberg, eds. 300 pp. Academic Press, 1968. \$16.00

by NEIL ASHCROFT

More than 40 years have elapsed since the first tentative "band structures" of solids were presented to physicists who were then still reacting with caution to the radical changes confronting them both in the "new mechanics" and the "new statistics." The realization



CONDUCTION ELECTRON DENSITY on a 110 plane in aluminum, calculated by the pseudopotential method. This is a sketch of a three-dimensional plot in which electron density is plotted vertically as a function of position in the plane. The calculation is described by Walter A. Harrison in *Pseudopotentials and the Theory of Metals*, W. A. Benjamin, New York, 1966, page 216ff.

that electrons in solids were accommodated not in discrete atomic-like states but in quasi-continuous bands of states goes back first to Arnold Sommerfeld. In his early model of the metallic state, he exposed the curious properties exhibited by a dense uniform collection of electrons.

The crucial observation of William Bragg and his coworkers that the electron distribution was *not* uniform (and in fact followed the crystalline array of ions revealed by x-ray scattering) was incorporated into the theory by Felix Bloch and A. H. Wilson in 1928. They demonstrated that electrons (at least in the one-electron approximation) are arranged not in a single band but in many.

The present volume is devoted to solid-state physicists' great ingenuity and inventiveness in constructing methods for extracting the band structures of solids. The debt to John C. Slater cannot be underestimated; indeed this emerges very clearly in almost every section of the text. He not only provided a sweeping and highly effective approximation for incorporating exchange into the one-electron periodic potential (which nearly all the methods exploit), but he also provided one of the most successful procedures for calculating energy bands ever devised. Slater's method of augmented plane waves, and its refinements between 1937 and the present, is described in the longest of the

articles. It is given excellent coverage by L. F. Mattheis, J. H. Wood and A. C. Switendick, who in some detail show how one is led to a secular relation between energy and wave vector. Questions of convergence of the energy eigenvalue with order of the secular equation are, with present techniques, of no great concern.

Perhaps even more rapid convergence is now obtained with a second method, the Korringa-Kohn-Rostoker or Green's-function method. It is described at length by Benjamin Segall and Frank Ham, who are well known in the literature for their accurate applications of the method.

Both methods rely on the nonoverlapping or celebrated muffin-tin approximation to the potential. Both can now be corrected for their inherent deviations from the real situation. The other methods in the book do not make the approximation but do of course make others. Frank Herman and others give a very full description of their thorough and systematic calculation of band structures using the method of orthogonalized plane waves (Conyers Herring, 1940). These are almost entirely first-principle calculations apart from last-minute refinements imposed on the electron-ion potentials by the dictates of experimental fact.

An interesting contrast to the orthogonalized-plane-wave and the other two methods is provided in the re-