Surprise!

J.S. Bell

Surprises in Theoretical Physics. By R. Peierls. Pp.166. (Princeton University Press: Princeton, 1979.) Hardback \$19, £8.40; paperback \$5, £2.10.

THIS is a fascinating book. About thirty situations are presented, scattered widely over theoretical physics. The surprise is sometimes that the obvious answer is wrong, sometimes that the devastating criticism of the obvious answer is wrong, sometimes that a very great man has gone wrong, and so on. Some of the surprises are pleasant, as with the validity of the nuclear shell model, or with the simplicity of Landau's diamagnetism. Some of the surprises are unpleasant, as with the non-existence of the Bogolyubov expansion for the diffusion coefficient, or even with the difficulty of estimating the adequacy of the JWKB method in barrier penetration. Some of the distinguished men who slipped up were very distinguished indeed. Debye was quite wrong about thermal conductivity in non-metals, and the "reasonable agreement with experiment fortuitous". Heisenberg was wrong about the resolving power of his γ-ray microscope, and was corrected by Bohr. Einstein forgot his own gravitational redshift in an attack on the time–energy uncertainty relation, and he also was corrected by Bohr. But Peierls himself remains surprised that Bohm and Aharonov have successfully attacked a version of this "fourth uncertainty relation". He conjectures that the interaction they invoke "for some reason cannot be permitted in quantum mechanics".

Sometimes the important reference is to early work of Peierls himself. It is the 'Umklapp' process of his 1929 thesis which resolves the difficulty with Debye's thermal conductivity. Sometimes the surprise has been generated by colleagues in his own department. But the choice is catholic, and indeed the two longest sections in the book are concerned with two perennial surprises — irreversibility in statistical mechanics, and the problem of interpreting quantum mechanics.

It seems to me that the non-technical account of macroscopic irreversibility, contrasted with microscopic reversibility, brings out admirably the essential point often concealed in lengthier and more mathematical accounts. That is to say that the situation is intelligible when we suppose boundary conditions to be imposed in the past, rather than the future, and with no great care — or at least without the fantastic and conspiratorial care that could have ensured the exceptional decrease of entropy rather than the normal increase.

As regards the problems of quantum mechanics, Peierls begins with an account of what went wrong with the celebrated von Neumann theorem on the impossibility of deterministic hidden variables. He continues with a nicely ironical account of subsequent work centred on the notion of 'locality'. Then he takes up the infamous 'reduction of the wave packet'. To my dismay he regards it as "clear that the significance of the state function is to represent our state of knowledge of the system". But he goes on to ask "whose knowledge . . . ", and is carried down into the depths. He finally conjectures that the Schrödinger equation does not apply to conscious organisms and (if I interpret correctly) that it is in the presence of such organisms that linearity fails and wave function collapse occurs. It seems to me that the reduction is then dynamical rather than actuarial. It is not at all to be equated with the mere adjustment of odds appropriate when a candidate for life insurance is seen to be over one hundred.

The bulk of the book is occupied with quantum and statistical mechanics. But finally there is one relativity problem. It is the old question of radiation — or non-radiation — from a uniformly accelerated charge. Here (surprise) there is something quite new, from unpublished work of Boulware. He has worked out carefully (for the first time, it seems) how it looks in the accelerated system in which the charge is at rest. I would have liked to have seen my favourite relativity surprise included in this book. I will yield here to the temptation to describe it (A. Evett, *Am. J. Phys.* **40**, 1170; 1972). Two identical spaceships, identically programmed, are initially at rest in some inertial system S, one of them 100 metres behind the other. At a given moment (in S) both motors start and off they go. With identical acceleration programmes they remain, of course, always 100 metres displaced from one another (in S). The ships are initially connected by a fragile (but incombustible!) thread. This thread would like to Fitzgerald — contract as the ships speed up, but as they do not come closer (in S) the thread cannot contract — so it breaks. Or does it? My experiences with this puzzle have convinced me that most relativity courses seriously damage the minds of most students.

There are no surprises here from elementary particle theory. Is that, then, only a dull plodding sort of subject? I think not. For example, there was the big surprise of a renormalizable theory of weak interactions. And I think also of the very beautiful surprise of the 't Hooft-Poylakoff magnetic monopole. And surely there are many others.

But let us be grateful for what we do find in this excellent book. One of the nicest surprises in it is the elegant simplicity with which nearly all of these topics are presented. The essays are mostly accessible to undergraduates with a first course in quantum mechanics, and to graduates who have not forgotten. □

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Memorial to the Ghetto

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Hunger Disease. Edited by Myron Winick. Pp.261. (Wiley: New York and Chichester, UK, 1979.) \$19.80, £10.60.

THIS is an important book. It was conceived of early in 1942 by Dr Israel Milejkowski who, as chief of public health in the Warsaw Ghetto, was sure that death from starvation and disease awaited its inhabitants. Certain of this fate, and powerless to prevent it, he recruited 27 colleagues and persuaded them to undertake a scientific study of the effects of hunger that they were observing in the Ghetto. Such a study, he hoped, would be, at least, a memorial to the dead.

They had just five months to build that memorial. On 22 July 1942 the German authorities began to liquidate the Ghetto and its inhabitants. Milejkowski records that their already meagre hospital and laboratory facilities were destroyed, and, with mass deportations occurring around them, the scientists wrote up their work and prepared the manuscript that was smuggled out of the Ghetto and hidden.

It was a remarkable feat, but ironically it almost seemed as if their efforts were in vain. Though the manuscript survived the war, only limited editions were published in Polish and French, and though the title *Maladie de Famine* was often referred to in the nutrition literature, the document itself was largely unread by nutritionists.

In rescuing it from obscurity, and producing not only an English translation, but a detailed appreciation of the modern significance of the work, Professor Winick has ensured that the memorial Milejkowski intended has at last been built.

But the book must not be viewed as a purely historical document, and Professor Winick has wisely treated it as a work of current scientific merit. Of course it is a strange scientific document, exploring theories and using techniques of 40 years ago. But outmoded or not it is still of current interest, because, with the exception of Keys' *Biology of Human Starvation* (University of Minnesota Press, 1950), it is the only study in the field. Though by its brevity it is less authoritative than Keys' work, it ranks alongside it as a scientific document because it deals with some different aspects of starvation, and