Problems, problems, problems . . .

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Physics and Astrophysics: A Selection of Key Problems. By V. L. Ginzburg. *Pergamon: 1985. Pp.125. Hbk £16.75, $23.50; pbk £8.95, $12.50.*

THE era of specialization is now well advanced. The last scientists to think of themselves as "physicists" rather than "solid-state physicists" or "high-energy physicists" are now nearing retirement age. Astrophysics is rapidly progressing in the same direction; some people who study galaxies have little appreciation of current research in stellar astronomy, and vice versa. One scientist once asked me, when I first met him, "What quarter acre of ground do you plough?". And much of the scientific literature, even review articles, consists of accounts of particular quarter-acres, with no attempt to describe the bigger picture.

Ginzburg's brief and entertaining book is a welcome exception to this trend and succeeds, for the most part, in describing what the entire landscape looks like, crossing the bounds of sub-specialities and giving a working scientist or student a feeling for what the person down the hall is really doing. He selects about 20 problems, dividing them into "macrophysics" (generally condensed matter, but including two problems in plasmas and one in nuclear physics), "microphysics" (particle physics) and astrophysics. You don't need to understand the specialized jargon in each of the fields in order to understand the book. (By specialized jargon I mean terms such as quantum Hall effect or Seyfert galaxy.) Each problem is discussed quite thoroughly, with a comprehensive set of references. Ginzburg has a remarkable, and welcome, international perspective — only a third of the hundreds of references are to literature in Russian, with the rest about evenly divided between American and non-American journals.

Physical intuition plays a large part in many of the chapters. Ginzburg leads the reader through back-of-the-envelope calculations, simple, easily understood derivations which tell you how, for example, the magnetization of some material depends on temperature, without considering whether fripperies such as the square root of pi are part of the answer. It was only when I read an earlier edition of this book some years ago that I learned why my solid-state friends were going to great lengths to measure critical exponents — parameters that describe how important physical quantities change near a phase transition. A reader can understand not only what some important problems in fields far from his or her quarter acre of ground are, but why they fascinate the practitioners in that area.

Ginzburg has done an excellent job in keeping the book up to date, at least in including recent work on the problems which he originally selected. The discovery of the W particle in 1983 is in here, as is the wait for the proton to decay, as are the ultrafast pulsars. I found only one place where he missed a beat — he introduces the spectroscopic and photometric measurements which indicated a concentration of fast-moving stars at the core of the giant elliptical galaxy M87, and which were interpreted as evidence for a black hole, but he doesn't mention subsequent work which showed that the evidence doesn't require a black hole.

Anyone who tries to select "key problems" — even in a subfield — has a lot of

V. L. Ginzburg — view beyond the back yard.

courage, and Ginzburg does more than just about anyone in taking on all of physics and astrophysics rather than just one tiny part. He makes no secret that "the subjective and controversial character of this book is quite apparent and readers have been warned — although, of course, such warnings are rarely heeded". He uses the problem of selecting "key problems", and the criticism he received as a result of it, as the springboard to several discussions of the way that science is done — just what it is that constitutes a "key problem", and the nature of scientific revolutions. He never precisely defines his selection criterion, but the book's contents indicate that he is interested mostly in unusual phenomena. Problems that appear include superconductivity, X-ray lasers, far-transuranic elements, grand unification theory, black holes and neutrino astronomy.

My reaction to the selection of problems is that, at least in astrophysics, Ginzburg's choice is a perfectly reasonable one, for the early 1970s. But the book shows its age. The first Russian edition appeared in 1971, and an English edition was published in 1976. For this latest edition updating has been carried out primarily by appending text to each chapter. As a result, the discussion of these problems is quite current, but there are many hot topics which aren't in here at all. In condensed matter, I'll pick, rather arbitrarily, lower-dimensional materials and chaos as subjects of great contemporary interest which aren't included. Much of the excitement surrounding grand unified theories has been squeezed into a section originally entitled "CP invariance", but the cosmic connection between particle physics and cosmology is only alluded to briefly. The large-scale structure of the Universe, star formation, solar and stellar oscillations, the various evolutionary channels in late stages of stellar evolution, and dark matter, are other matters which are discussed only briefly, if at all.

Each reader, of course, will have his or her own list and it will undoubtedly include some problems which aren't in the book simply because those questions weren't asked when it was first written. Furthermore, the structure of the book dictates that some areas, such biophysics, are not covered. Atomic and nuclear physics are also generally left out, and Ginzburg discusses much of the criticism which he has received for that choice, which was apparently deliberate.

Some of the problems covered are a bit dated. Testing general relativity, a key issue of the 1970s, has basically been completed in the weak-field limit (as Ginzburg himself points out), and it's at least less fashionable, if not less important, these days. Ginzburg makes a big issue of attacking (correctly, in my view) those astrophysicists who want to seek new physical laws around every corner, but once again the question of whether quasar redshifts are cosmological has subsided in the face of some overwhelming evidence that the redshifts of at least some, and probably all, quasars are produced by the expanding Universe.

There are some similar books around, which are the results of official commissions or review panels. But no matter how careful the deliberation of such panels, the impersonal style of any committee document generally makes it about as inspiring to read as an integral table. Ginzburg's book, however idiosyncratic and dated, is undoubtedly a good read; his imagination and insight come through on every page, and are well reflected in the English translation. Graduate students and young scientists should get hold of it, for it is one of the few places in print where one can acquire some idea of the exciting problems in contemporary physics and astrophysics. Those of us who have proceeded too far down the road of specialization will find in it a welcome view of the physical world beyond our own back yards. □

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