ishingly brief instant near the dawn of history, the word 'ship' will mean 'spaceship.'" If we can avoid collective suicide long enough to get the starships built, in a thousand years there will surely be human settlements orbiting a hundred suns in our corner of the Galaxy, and the race will be immortal.

Our generation may stand at a crucial breakpoint in history, for we in the presently affluent nations may be the last who can afford to open the high frontier. What we do during the next ten or twenty years may determine whether future generations will live in a humane and rewarding society, or whether they will spend their lives in desperate contention for the dwindling sustenance afforded by our limited terrestrial resources. We have reached the ends of the Earth, and there is nowhere to go but up and out. The technology is at hand for getting the costs of space operations down to a level comparable to those of a long-haul airline, and we clearly should be moving ahead much more vigorously.

It is unfortunate that there is dissension in the movement between the conservatives, who merely want an orderly investigation of the feasibility of space industrialization (for example, an investment equal to perhaps 1% of the annual US bill for imported oil, to find out whether satellite solar power stations make economic sense), and the radicals, who insist on a "lunar mine by '89" or on the priority of colonies over industrial facilities. There are even schisms between advocates of particular technologies, which is quite absurd at the present stage of development. What is important is to get the space program moving again while there is still time and funding available for it to contribute what it can to the future of Man, not whether one is a believer in the gospel according to O'Neill.

The books listed above present some diversity of opinion on these issues, but they all draw heavily on the ideas of O'Neill. For example, they all argue strongly for the use of extraterrestrial resources (lunar or asteroidal) in the construction of solar-power satellites. It is probable that, in the long run, this will make economic sense, but the power satellite is a mind-boggling concept in itself: To hold that a lunar mine is a necessary precursor is to create a program of such staggering scope as to preclude funding by a skeptical Congress.

Of the four books, the NASA Special Publication *Space Settlements* (SP-413) provides the most thorough engineering and economic detail about a particular space-habitat design (now known as the Stanford Torus). It is the report of the 1975 NASA-ASEE Summer Study at NASA Ames Research Center. The book is very well produced, with excellent graphics and artwork, far above the standard of most such reports. On the whole, though, I would recommend the book by Heppenheimer (who was a participant in the 1975 study) as the most readable and comprehensive introduction to the subject. His final chapter, a reasonable discussion of the feasibility of interstellar colonization, is particularly interesting: I wonder what the reaction is in the Department of Energy to the revelation that research on laser-induced thermonuclear fusion is directed, not towards generating electrical energy, but towards a starship drive.

The High Frontier provides a more carefully reasoned (but not necessarily more convincing) rationale for space colonization, and is useful also because of its account of the history of the movement during the last few years. Frederic Golden's book covers much the same material in a rather more journalistic fashion, and I would judge it most useful to a younger audience.

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An Introduction to Regge Theory and High Energy Physics

P. D. B. Collins
445 pp. Cambridge U.P., New York, 1977. $59.50

Physics in the angular-momentum plane (Regge theory) has undergone a remarkable explosion since its modest beginnings some fifteen years ago. We have come to understand the deep connection between observed hadron states and the power behavior of cross sections. We have learned of the beauties of duality and, through generalizations of that, begun to think of hadrons as "strings"—a concept that promises to connect Regge theory with underlying quantum field theories such as quantum chromodynamics. We have discovered how unitarity requires the familiar Regge poles to appear in kinematically rich inclusive reactions, thus providing a unifying theme to vast quantities of hadron-scattering and production data.

For the student or researcher to learn of these achievements has been a formidable task. The material is spread over years of the *Physical Review* with an occasional "up to date" review article available. The present monograph by P.D.B. Collins of the department of physics, University of Durham, UK, addresses the need for a coherent introduction, both to the tried pathways and to many of the mysterious tracks of Regge physics. The author has previously written two reviews of this subject, both valuable to workers in the field. In this book he goes out to a more general audience and provides in clear, forthright fashion the background necessary for the serious student of hadron physics to "come up to speed" as a research person, and at the same time he offers the established research person an extremely useful compendium of the important contributions and ideas made in Regge theory in the past decade.

This monograph is impressive in its completeness. Donning my reviewer's hat I set out to be enormously critical of the work. I was able to come up with several fairly trivial comments. For example, the key idea of the Pomeron is attributed to Geoffrey F. Chew and Steven Frautschi; Vladimir N. Gribov's publication of the idea in the same month (June 1961) is ignored. Also, the connection between power behavior of hadronic scattering amplitudes and resonances was very clearly made in a classic paper by Richard Blankenbecler and Marvin L. Goldberger. The absence of reference to their work seems surprising. And another trivial point: The casual surveyor of the table of contents will be most amused to find chapter 6 labeled as the "Introduction."

My major critical comment on the book concerns the order of presentation of the material. The reader is led through a very heavy dose of S-matrix theory, helicity-amplitude technology, properties of second-kind rotation functions, Sommerfeld–Watson transformations and the like before emerging in chapter 5 into the important physical facts of hadron scattering at high energies. Since the latter is absolutely fundamental to the physical interest of the former, I would have preferred the author to have presented the rudiments of the theory first, then the experimental facts, and then the heavy-duty formalism. The dedicated reader will, of course, get to all the important substance. One worries about the less hardy.

In addition I feel there should be included in each chapter several sections attempting to state in physical terms either the key ideas touched on or the reason for covering the material. Scientific writing too often follows the principle of punitive pedagogy: repeat the important points as often as the unimportant ones—once. An "Introduction to ..." should be more than a review of material past while stopping short of being a students' text. In the chapter on "Some Models Containing Regge Poles" (chapter 3) the author forbears informing the reader that a crucial ingredient in generating Regge poles is a cutoff in momentum transferred to produced particles, and comes within a micron of revealing (page 98) that a Regge pole is a generalized bound state of hadrons—with gen-

eral mass and spin. Comments like these with a sentence or two more explanation would immeasurably increase the value of this book as a pedagogical medium.

I am, nevertheless, quite enthusiastic about this book. It is the only monograph I can recall that discusses in one sweep the very important topics of inclusive reactions, multi-peripheral models, dual models, cuts in the angular-momentum plane, and Regge theory in weak processes. It provides a lucid first view into the broad scope encompassed by the ideas of Regge theory and brings to the reader valuable information on each aspect. I believe that one of the strengths of this book also lies in what it does *not* do: it does not attempt to discuss in any depth the present frontiers of research in the field. It wisely holds back from presenting the latest ideas in dual unitarization, the bare Pomeron, Reggeon field theory, and topological expansions of hadron processes. Books that insist on being up to date Δt before publication, frequently find themselves out of date Δt after. Indeed Collins exposes the reader in superb fashion to the concepts and information needed to enable her or him to decide alone on the vital, controversial, issues of the present. In my opinion that is a valuable and praiseworthy contribution.

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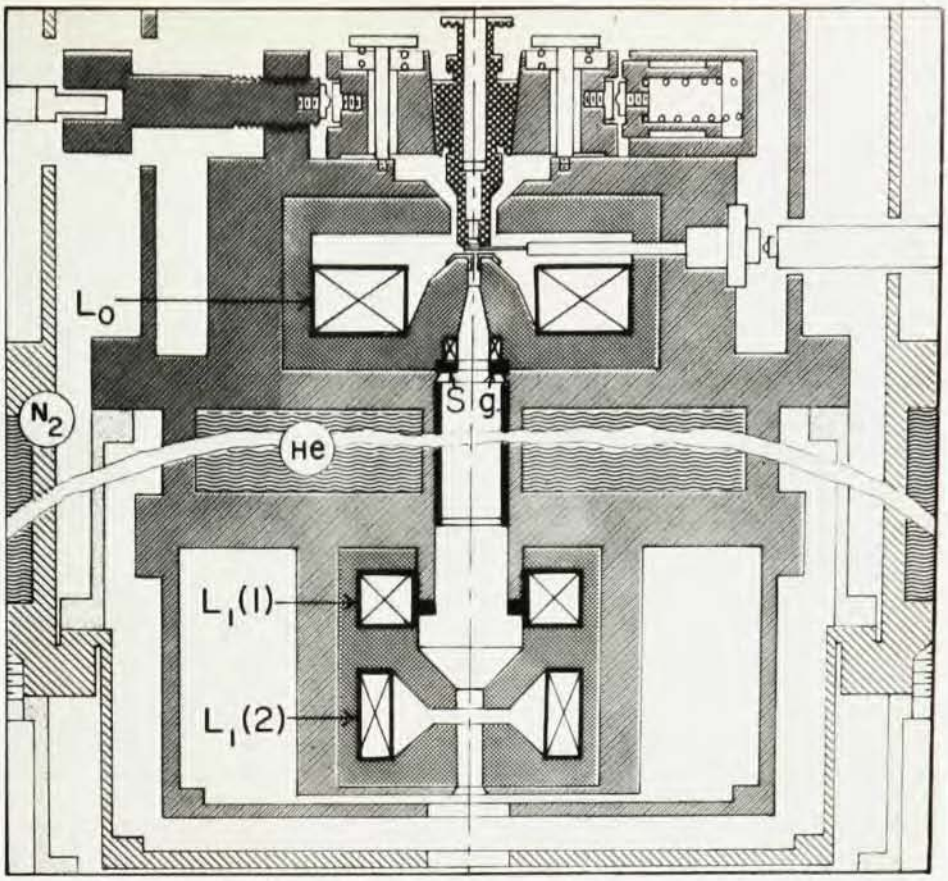

The cryostat of a high-resolution electron microscope, shown schematically. L_0 is the superconducting objective lens, $L_1(1)$ and $L_1(2)$ are, respectively, the low and high magnification superconducting intermediate lenses, and Sg. is the stigmator. (Diagram: Benjamin Siegel)

Superconducting Electron-Optic Devices

I. Dietrich
140 pp. Plenum, New York, 1976. $19.50

I. Deitrich has made a very useful and valuable contribution to the field of high-resolution electron microscopy in her short monograph on *Superconducting Electron-Optic Devices*. The field of high-resolution electron microscopy is active, and several laboratories and companies are attempting to extend the capabilities of the electron microscope to ever higher resolving powers by, in most cases, increasing the energy to which the electrons are accelerated. Here, the author makes a very impressive and convincing case for the several advantages of using cryogenic techniques for extending the resolution level of the instrument. These include not only the possibility of designing superior electron-optical lenses for high-energy electrons with superconducting materials, but also, among other advantages, the greatly increased thermal and mechanical stability that obtains at liquid-helium temperatures.

Work in this field has been sparse and diffuse, and it is very helpful to have the systematic development and evaluation of the subject contained in this volume. The only other comparable contributions of which I am aware are by David F. Hardy in the 5th volume of *Advances in Optical and Electron Microscopy* and a more recent review by Peter W. Hawkes and U. Valdré, *J. Physics E*, **10**, 309, 1977. These two contributions are valuable but are more in the nature of reviews of the subject. They provide helpful resumés and bibliographies of the published work in certain aspects of the field, but they do not have the same critical discussion or evaluation of the role and value of cryogenics in a broad range of electron-optical devices that Dietrich has provided in her volume.

Dietrich is a well known expert in cryogenics and in recent years has turned her attention to the application of cryogenics to electron optics in general, and to the high-resolution electron microscope in particular. Working at Siemens A.G. in Karlsruhe, she is in an excellent position to investigate all aspects of the instrumentation. The results that she and her collaborators have already achieved justify both her approach to the subject and the optimistic projection that she makes. The author devotes the last chapter to a proposed 3-MeV electron microscope that includes not only the superconducting shielding objective lens that she has developed, but also a superconducting linear accelerator to produce a 3-MeV beam in a relatively short and mechanically rigid system. This imaginatively designed system provides a climax for her systematic presentation.

Perhaps the main criticism of this monograph is its brevity. The material presented is adequate to enable readers who start from either cryogenics or electron microscopy to understand the potential of using superconducting electron optics. However, a much more thorough understanding in both fields will be required by any investigator wishing to utilize superconducting electron-optical devices. The necessary reference materials are available in the literature of course, and the author would have enhanced her contribution if she had provided references to selected source material. Even more welcome would have been a more extensive development of the background material, for those parts of the subject that are treated are well written and perceptive.

The book includes a brief presentation of electron optics and a resume of superconducting devices and electron lenses that have been used in electron microscopes. The most detailed discussion is given to her own system. This emphasis is quite correct, given the superior results that the author and her collaborators have achieved with their unique electron microscope. The book includes two all-too-brief appendices: one of interest to high-energy physicists, the other to in-