passing reference to sabotage, although many of us believe that sabotage is the one unanswerable question about nuclear power, that only abstinence or remote siting can resolve.

The problem of radioactive-waste storage rates six pages. Here I miss a back-of-the-envelope discussion of the magnitude of the problem. How dangerous is the concentrate? The usual issues are mentioned. Should we continue with an intricate program of "perpetual care" or try to find a place, much as a salt mine, where the wastes can be left "for ever" without contact with ground water? The proposal to use a salt mine is mentioned with approval, yet the reason salt mines seem a good repository (they have not been in contact with ground water for a million years) is not mentioned, nor is the obvious problem that the past is only a guide and does not guarantee the future. Even without human intervention, the salt might well be disturbed before the next million years are over.

Again sabotage is not mentioned. Yet a few grams of toxic plutonium, with an explosive change to dispense it, is a threat to a city more plausible than diversion for bombs and more severe than the hijacking of a loaded jumbo jet.

Nuclear fission, together with a breeder reactor, can provide energy for a hundred-thousand years. If we reject nuclear fission what are the alternatives? Fossil fuels will run out in a century or so. This leaves nuclear fusion, solar power and possibly geothermal power. Although Inglis does not note it directly, this is presumably his motivation for including a chapter on fusion and solar energy. The section on fusion is good, and is correctly cautious in predicting the future, but I would have liked a longer section on solar power. Nowhere does Inglis state directly the present problem with solar power—the cost.

The crux of the nuclear-power problem, like most of society's problems, lies in the comparison with alternatives. In this respect Inglis's book is weak. Are, for example, the problems of nuclear-reactor safety really unique in society? As time goes on, more people congregate in one city, and more fuel is stored in one place. The size of the largest hypothetical accident increases. We can have earthquakes, tidal waves, dam failures, oil-tank fires, LNG tank ruptures, and reactor accidents. Is one worse than another? Since some of these arise from alternative sources of energy, some discussions of this, however difficult, is vital to obtain a balanced view. Without it, we have a chance of rejecting an unsatisfactory source of action in favor of a far worse one.

Again Inglis argues persuasively that the nuclear-power industry can, if we are not careful, increase the risk of war and holocaust. Inglis implies that a nuclear-reactor moratorium is desirable. Yet is there not an appreciable chance of world war as we squabble over our limited oil reserves?

A way to arrive at rational decisions is by rational discussions. With the few exceptions noted, Inglis has done an excellent job of placing opposing views side by side where the reader can compare them and form his own conclusions. The book is, therefore, a more valuable source of information on nuclear power for the intelligent lay audience than any other of which I know. I hope other books will follow and fill the gaps.

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Introduction to Diffraction, Information Processing and Holography

F. T. S. Yu.
366 pp., MIT Press, Boston, Mass.
1973. $14.95

The renaissance of holography in the early 1960's, following some fourteen years after Dennis Gabor's original discovery, generated considerable excitement in optics, especially that branch of optics variously called Information Optics, Fourier Optics or Coherent Optics. Here was a technique that seemed to promise a revolution in display, microscopy, three-dimensional entertainment and other areas. A special breed of people who called themselves holographers amused and intrigued us with their holograms of chess scenes and three-dimensional rabbits.

Well, we are now in the 1970's and we still don't have holographic TV or holographic movies, and holographic microscopy is hardly talked about. There are some grumblings from former holographers that holography is a specious science. But in the main the history of holography has been a history of solid growth and good science. A lot has been learned about the formation of images. Acoustic and microwave holography offer promise of exciting advances in medicine and surveillance. A large bag of techniques has been developed that have potential industrial applications. Modern holography is only about 11 years old but it has come a long way.

The rapid growth of holography has had its effect on school curricula. Many universities offer courses in holography and coherent optics and a number of books dealing with holography and coherent optics appeared on the market. Several were poor, a few fair and one or two excellent.

Francis Yu's textbook on coherent optics and holography grew out of a set of lecture notes adopted for a two-quarter course in the electrical engineering department at Wayne State University. The book is basically written for electrical-engineering students, although Yu states in his preface that the book will interest physicists as well. Yu is an active researcher in coherent optics with significant contributions in film-grain noise phenomena and nonlinear effects in holography. The book leans heavily towards the impulse response and Fourier-analysis approach. Although there is a brief review of linear systems in chapter 1, it would help the reader to be familiar with at least the equivalent of an undergraduate course in linear systems. The organization of the book is quite reasonable: three parts, consisting of four chapters each, dealing in sequence with diffraction, information processing and holography. Most of the chapters have problem sets and references at the end although the number of problems is typically small. A few of the problems are challenging and represent significant extensions of the theory.

The first chapter is meant to be a review of elementary linear systems theory. Since much of the material in subsequent chapters depends heavily on the notion of convolution, it is unfortunate that the convolution operation is given incorrectly in terms of an

A laser hologram produced this image of a 22-caliber bullet travelling at Mach 2.5.

autocorrelation integral. The entire discussion on the sampling theorem is limited to three homework problems.

Part 1 discusses basic diffraction theory, the scalar treatment of light, Fraunhofer and Fresnel diffraction, and some salient features of the theory of partial coherence. The treatment of these subjects is standard, but at times too brief. The scalar wave amplitude function is introduced with very little discussion: Yu makes no attempt to relate it to electromagnetic field quantities. The paraxial approximation is used throughout, again with little discussion about the limits of its validity in application. I could not find any reference to the important notion of angular spectrum. Chapter 5, which deals with the theory of partial coherence, defines a set of mutual coherence functions in terms of time and ensemble averages. In the text these are equated when the fields are assumed stationary. But in fact it is second-order ergodicity that is required for the equality to hold, not stationarity.

Part 2 deals with the Fourier properties of lenses, linear optical imaging, information processing via optics, properties of photographic film, and image restoration. Yu argues that incoherent imaging is the result of using extended monochromatic sources; yet only a chapter earlier he quotes a theorem stating that *every* monochromatic field is absolutely coherent. Another point that may lead to confusion is the author's use of the "black box" in describing optical imaging systems. The "black box" notion is perfectly valid in optics *provided* that the input and output planes are designated as part of the system, because they play a role in defining the impulse response. A collection of lenses by themselves does not uniquely determine an impulse response when the input and output planes are not specified. The discussion in chapter 6 does not make this point as clearly as it should.

The discussion of optical information processing and filtering is quite limited in scope, but what it covers it does reasonably well. Two warnings: effective character recognition by correlation requires that the energies associated with the character transmission functions be equal. Also in connection with synthetic aperture radar, the unwary reader will be confused by equation 7-69 which describes the pulsed-radar echo by an infinitely long complex sinusoid without nearby elaboration. Most of chapter 8 on photographic film is good, and some of the author's own work is included here. The choice of defining the intensity transmittance in terms of a local ensemble average is awkward; it makes much more sense to define it in terms of a local spatial average. Chapter 9 on image restoration and information is adequate. A point to remember: even if the optimum inverse filter were physically realizable, one would not necessarily want to use it in the presence of noise.

Part 3, which discusses holography, includes a welcome section on holographic aberrations. One hopes that in future editions of this book a brief discussion of lens aberrations will also be included. Some of the author's own highly specialized work on nonlinear holography and optimization is included even though it could easily be omitted in a first course.

The last chapter deals with applications of holography. In fairness to the author, it should be stated that applications in holography develop so rapidly that any book on this point will be out of date on the day it appears. Nevertheless the limited number of applications discussed here may disappoint the reader. Yu disclaims being exhaustive and confines himself to optical holography, yet some of the most interesting attempts at applications have occurred in acoustic and microwave holography. Fortunately Yu gives some good references in regard to holography in these domains. Even in optical holography, the list of potential applications hardly mentioned or ignored is large. However I do not cite this as a serious criticism, since there are a number of books entirely devoted to holography and its application, whereas Yu's book is a text on the broader subject of coherent optics and holography.

When compared with some other books on the market on this subject, the book doesn't fare badly. However in its present form it is marred by too many omissions, careless statements, misprints and notational problems. With the elimination of these drawbacks in a second edition, the book would have much greater appeal.

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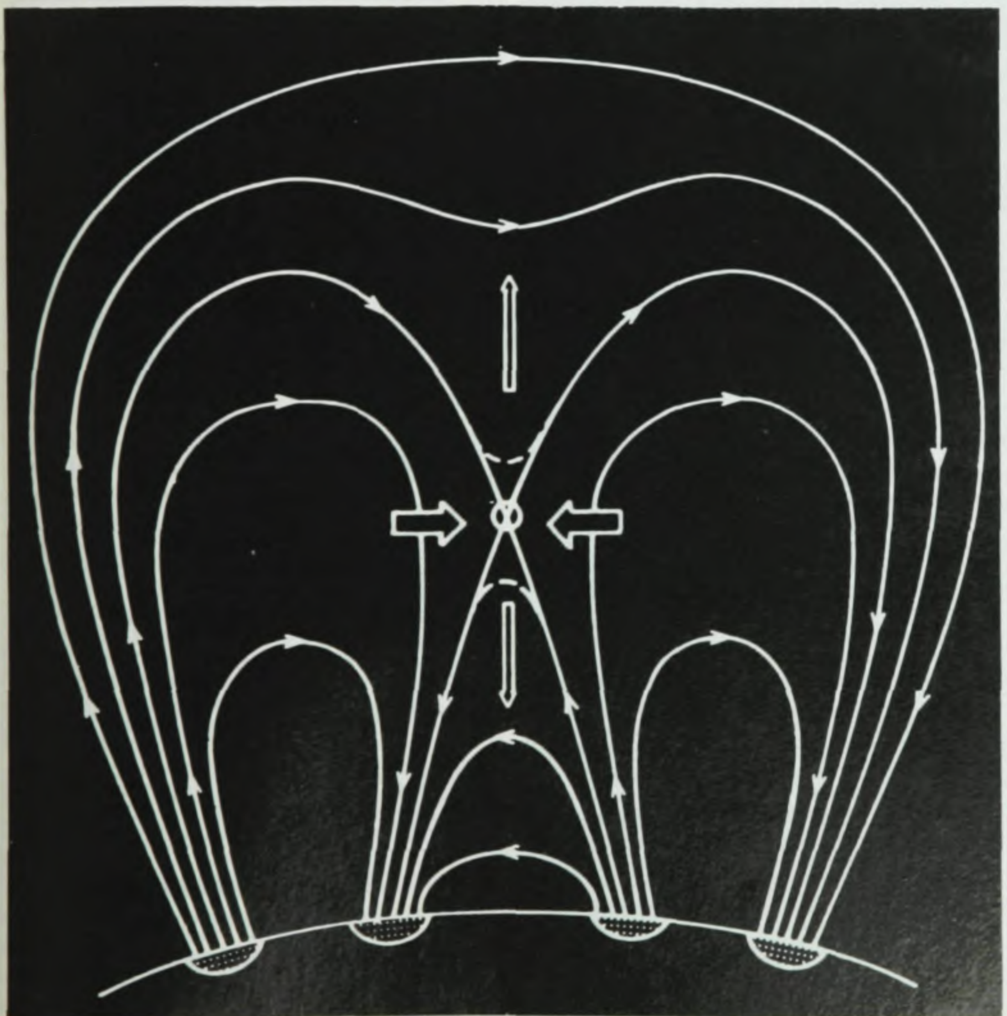
Space Physics and Space Astronomy

M. D. Papagiannis
293 pp. Gordon and Breach, New York, 1973. $14.50

A very important result of the space program is the tremendous expansion in our knowledge of the upper atmosphere, the interplanetary medium and the solar corona. Satellites can directly sample the ionosphere and magnetosphere, and ultraviolet and x-ray observations have contributed immensely to our knowledge of the active sun. The field of space physics has had an unfortunate tendency to get lost in the interdepartmental chasms of geophysics, physics and astronomy. M. D. Papagiannis's book, an introduction to space physics directed at the advanced undergraduate or beginning graduate student and the interested professional from other fields, is a welcome and well constructed bridge across this chasm.

The book covers the gamut of space physics. The first chapter, which deals with planetary atmospheres, is superficial and somewhat unrelated to the rest of the book. Papagiannis then reaches the heart of the field: ionosphere (including Chapman-layer theory), the magnetosphere and magnetotail, and the interplanetary medium. His chapters on the active sun and solar-terrestrial relations contain excellent accounts of the development of a typical active region and a typical geomagnetic storm. He finishes with a brief account of space astronomy. The book strikes a good balance between a



An instability develops at the neutral point of a moderately complex magnetic field over a sunspot group. From *Space Physics and Space Astronomy* by M. D. Papagiannis.