conformational analysis. No previous book has covered these two areas of inorganic chemistry, and the present one provides a useful compilation of data and an elaboration of the associated concepts, even though at times the author ignores others' work in presenting his own views.

The first part of the book, dealing with conformational analysis of chelate rings, is expounded clearly and with excellent diagrams. The section on optical activity of coordination compounds is an attempt to present a professional approach to the problem of absolute configurations, a subject in which there are few specialists. Hawkins does an excellent job with the empirical methods, critically examining the evidence for assignments and dealing properly with correlations. The section on nonempirical methods of determining absolute configurations suffers because the uninitiated reader may not know what the argument is about. Here the author does not, as he does in the previous chapters, present the subject from the beginning. Such a presentation would have been helpful whatever the merits of the view he takes. The last part of the book is on nuclear magnetic resonance and is interesting.

On the whole this is a good book, but in order to proceed with equanimity the reader should realize that it has both heroes and villains; the bad guys are treated with Olympian disdain.

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Astrophysics

Cosmic Gamma Rays. Floyd William Stecker. Mono, Baltimore, 1971. x, 244 pp., illus. $12.50.

Astronomy has made tremendous advances over the last two and a half decades as a result of the expansion of the observable range of frequencies from the narrow visible band at 10^{15} hertz. Now almost the entire span from the low end of the radio-frequency region at 10^{8} hz through the x-ray region at 10^{19} hz is being utilized. Radio-frequency, infrared, and x-ray radiation from many astronomical objects has been found to have a much greater intensity than had been theoretically predicted. Thus the strong radio sources, quasars, "x-ray stars," and pulsars have been added to the astronomer's lexicon.

Morrison pointed out in 1958 that, since electrons of at least 10^{12} electron volts were necessary to account for the synchrotron radiation observed from many of the strong radio sources, other high energy elementary particle reactions should also be taking place. These could be responsible for the production of the charged particle cosmic radiation and should also produce gamma rays, —that is, electromagnetic radiation above 10^{20} hz. Unfortunately for the experimentalist, in this portion of the spectrum the observed intensities have been much less than originally predicted. Although radiation has been observed up to 10^{23} hz, the experimental situation is still far from clear (Research Topics, *Science*, 24 Dec. 1971).

In this monograph, Stecker gives a very thorough treatment of the elementary particle reactions which produce high energy gamma rays and applies these to various astrophysical situations. Use is made of the recent data for p-p collisions available from high energy physics: cross sections, branching ratios, lifetimes, and so on. Above 30 Gev bombarding energy, where accelerator data are not yet available, the fireball models of meson production are used to extrapolate the gamma ray spectrum to higher energy. Inverse Compton collisions, bremsstrahlung, and matter-antimatter annihilation are the other processes most likely to produce cosmic gamma rays, and they are also adequately described. The lowest energy considered is the 0.51 Mev gamma ray from electron-positron annihilation. Not treated is the line gamma-ray radiation produced in nuclear reactions, although some of these rays are in excess of 1 Mev. Their detection would provide valuable information on stellar nuclear reactions and nucleosynthesis.

A less satisfactory part of the book is the discussion of the existing experimental data. Stecker chooses to consider only extended sources such as the interstellar gas in our galaxy bombarded by the high energy cosmic ray protons or the isotropic gamma rays from neutral pion decay at an early age of the universe, which we would observe red-shifted by $Z \sim 100$. Data in support of these processes came from experiments on the satellites OSO-3 and ERS-18, but later experiments have raised doubts about both results. The galactic radiation may be due primarily to point sources, as is the case with the galactic x-ray sources. No mention is made either of the role played by the nonobservation of gamma rays from certain objects in rejecting proposed theoretical models. For instance, the energy source for the quasar 3C 273 cannot be nucleon-antinucleon annihilation because the resultant gamma ray flux would exceed the observed upper limit by a factor $\simeq 100$.

In summary, this work will be of interest especially to the astrophysicist in providing a compendium of the relevant formulas for cosmic gamma ray production and to the general physicist by showing how the knowledge acquired in elementary particle physics in the last 20 years can enhance our understanding of the universe.

Donald Kniffen has contributed a useful appendix on the experimental techniques which have been used on balloons and satellites.

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Cosmological Physics

Relativity and Gravitation. Based on a seminar, Technion City, Israel, July 1969. CHARLES G. KUPER and ASHER PERES, Eds. Gordon and Breach, New York, 1971. xii, 324 pp., illus. $24.50.

The dust cover of this book contains the statement "This book discusses the most recent developments in the theories of relativity and gravitation, and contains contributions from the leading experts in this field." While it is true that this book does contain contributions from many prominent workers in the field of general relativity, it is also safe to say that few of the contributions have anything significantly new to say. This is not to deny that there are indeed several interesting articles in this collection.

One of the most interesting, significant, and controversial experiments in recent times has been the work of Joseph Weber in detecting gravitational radiation. Weber gives an account of his results heretofore found only in several short articles in *Physical Review Letters*. He discusses the observed events—coincidences between detectors located 1000 miles apart—and by statistical analysis rules out these events' being due to chance. He also describes the reasons why it is unlikely that the events have been produced by nongravitational phenomena: electromag-