These are some examples of what we consider to have made the review unbalanced. One of the more curious statements in the review is "Perhaps this book will encourage physicists to enter this important field. Unfortunately, there are probably few jobs waiting for such people." We were unaware that the job market was one of the criteria to be considered before writing a physics book.

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Multipacting addendum

I would like to add a note to the excellent description of multipacting in the news story on CEBAF by Bertram Schwarzschild (February 1986, page 18).

Multipacting (also known as the secondary-electron resonance mechanism of rf breakdown) is a troublesome phenomenon not only for rf and microwave components in accelerators but also for other applications of low-pressure rf and microwave power systems, which are coming into increasing use. In addition to its characteristic electron transit time between electrodes of odd integral multiples of a half-cycle and its dependence on a secondary-electron emission ratio δ greater than or equal to 1 at the electrode surfaces, multipacting has two other important characteristics. One is that as a surface-dependent phenomenon it can occur at any pressure below the mean-free-path limit for uninterrupted transits, and hence cannot be mitigated by reducing the gas pressure. The other is that the mechanism obeys a cutoff law set by a combination of electron transit phase dynamics and a secondary emission ratio δ of 1; it thus becomes inoperative below a product of frequency and electrode separation typically in the range of approximately 60–100 MHz cm. Thus one can use the cutoff law to suppress multipacting, either by appropriate selection of the pertinent parameters or by using non-loading baffles that break up the electrode gap into sub-cutoff gaps. Some useful references on multipacting are listed below.[1–3]

References

1. S. C. Brown, *Basic Data of Plasma Physics*, Wiley, New York (1959), pp. 209–221 (theory using finite secondary-electron

emission energy, correlated with experimental results).

2. M. S. Livingston, J. P. Blewett, *Particle Accelerators*, McGraw–Hill, New York (1962), pp. 345–348 (theory using zero secondary-electron emission energy).
3. A. J. Hatch, Nucl. Instrum. Methods **41**, 261 (1966) (suppression of multipacting in particle accelerators).

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Magnetosphere memories

With due respect to Jai S. Kim, the reviewer of the book *Origins of Magnetospheric Physics* (May, page 85), and to its distinguished author, James A. Van Allen, there is something to be said for the view that the development of magnetospheric physics began with the discovery of the magnetosphere. Of course, the identification of this event depends on what is understood by "magnetosphere."

Thomas Gold, who gave it the name, defined the magnetosphere as "the region above the ionosphere in which the magnetic field of the Earth has a dominant control over the motions of gas and fast particles." Before 1950 there was no knowledge that significant amounts of ionized gas existed above a few thousand kilometers' altitude. In 1953 I published the first reliable estimate of magnetospheric electron density (400 cm^{-3} at an altitude of 2 Earth radii) based on measurements of the dispersion of very low-frequency whistlers.

Subsequently, both before and during the International Geophysical Year (1957–58), much related work was undertaken and published worldwide; a short history of it may be found in Yacov Al'pert's article "40 years of whistlers" (*Journal of Atmospheric and Terrestrial Physics* 42, 1, 1980). I feel that the contributions that this body of work made to the development of the field cannot reasonably be disregarded, and that a balanced account of the origins of magnetospheric physics, which has yet to be written, would give due weight to research on magnetospheric plasma.

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Colliding beams

In the March 1985 (page 29) and September 1985 (page 13) issues of PHYSICS TODAY the first colliding-beam facilities were discussed by Leon Lederman, Sheldon Glashow and J. Haissinski. For fairness' sake, one should mention that the creation at Novosibirsk of the VEP-1 facility with e^-e^- colliding beams was started in 1958, simultaneously with the Stanford facility. Both of them were put into operation in 1963. In his reply to Haissinski, Lederman wrote that the Princeton–Stanford machine had "stored beam and had the full complement of injection, storage and collision devices designed to do physics experiments." As one can see from the proceedings of the International Conference on High Energy Accelerators in Dubna (1963, page 274) this sentence is valid completely for the VEP-1 machine.

It is worth noting that the first e^-e^- colliding beams were registered via small-angle electron scattering in 1964 simultaneously in Stanford and Novosibirsk. The first e^-e^- physical experiments aiming at testing quantum electrodynamics at short distances were also done almost simultaneously in 1965, at an energy of 2×300 MeV in Stanford and 2×73 MeV in Novosibirsk (*Proceedings of the 5th International Conference on High Energy Accelerators*, Frascati, 1965, pages 266 and 389).

Final experiments were carried out at energies of 2×500 MeV and 2×160 MeV in Stanford and Novosibirsk, respectively. In addition, the process of electron double bremsstrahlung was observed for the first time at the VEP-1 facility.

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Generalizing electrophotography

In their account of the physics of electrophotography (May, page 46) Donald Burland and Lawrence Schein considered only the photoconducting type of electrophotography. There is another electrophotography, where charges are produced locally by light and the latent image is developed electrostatically. For example, saran, a chlorinated polymer, is changed[1] in position on the triboelectric series when exposed to ultraviolet light. A p–n junction is thus produced at the border between two regions that received different dosages of radiation. The images are revealed with powders of different charges.

Another photographic process where the light-struck regions are revealed by electrostatics is daguerreotypy. Daguerreotypy was invented by Louis Jacques Mandé Daguerre in 1837. In its day daguerreotypy caused considerable excitement in scientific circles, particularly in Paris and New York. Dominique-François-Jean Arago, Armand Hippolyte Louis Fizeau, Jean Bernard Léon Foucault, Alexandre Edmond Becquerel, Jean Baptiste André Dumas, Samuel F. B. Morse and John W. Draper were especially active[2] in the field. The first astrophysical photographs, including ones showing the Fraunhofer lines and the corona of the solar eclipse, were taken by daguerreotypy. The modern camera was invented to take portraits by daguerreotypy. The wonderfully delicate photographic portraiture of the 1840–60 period remains intact in the daguerreotypes seen in museums.

In daguerreotypy the light-sensitive plate is made by subjecting a polished silver plate to the fumes of iodine, bromine or both. The thickness of the silver halide is only a few nanometers. Typically the exposure required for a brightly lit scene is about one minute. The latent image is developed by treatment with vapors of mercury at 60 °C. Apparently the image at the plate acquires a charge on exposure to light. This latent image serves as a nucleating center for mercury aerosol particles. Indeed, the mercury "droplets" on the developed images were observable with the microscopes of the time. The peculiar positive–negative effect seen when tilting a daguerreotype is due to the light-scattering properties of the mercury droplets. One can also develop the latent image by breathing on the exposed daguerreotype plate, but this can lead to destruction of the image. These so-called breath pictures, discovered by Ludwig Ferdinand Moser in 1842, are due to condensation of water aerosol particles in the breath onto the light-induced charges on the silver halide plate. Nearly a century after Moser, Chester F. Carlson used[3] the breath technique in his invention of what is now called xerography: Moisture in his breath condensed on the remaining charges of the light-struck anthracene crystal that served as Carlson's electrophotographic plate.

References

1. G. Oster, G. K. Oster, M. Kryszewski, Nature **191**, 164 (1961).
2. For a bibliography of daguerreotypy, see J. M. Eder, *History of Photography*, Columbia U. P., New York (1945), Chapter 31.
3. C. F. Carlson, US patent no. 2 221 776, 8 September 1938.

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