Reminiscences in Physics

Early History of Cosmic Ray Studies. Personal Reminiscences with Old Photographs. YATARO SEKIDO and HARRY ELLIOT, Eds. Reidel, Dordrecht, 1985 (U.S. distributor, Kluwer, Hingham, MA). xvi, 444 pp., illus. $89. Astrophysics and Space Science Library, vol. 118.

That extraterrestrial radiation, other than sunlight and starlight, was striking the earth was not suspected at the beginning of the present century. Although it was known that the air had a small electrical conductivity, even in fine weather and at sea level, that suggested the presence of ionizing radiation, the conductivity was attributed to terrestrial radioactivity, which was a newly discovered and exciting phenomenon. However, as some of the radiation was found to be too penetrating (and perhaps too abundant) to originate from known sources, studies of its altitude-dependence were carried out to test the idea of an extraterrestrial source, notably with manned balloons in Austria and Germany. In particular, balloon observations carried out by Victor F. Hess in 1912 resulted in the discovery of the cosmic rays, later officially recognized by the award of a Nobel Prize to Hess in 1936.

If one characterizes the period before 1912 as cosmic ray prehistory, then the term "early history" in the title of the book under review could describe the period of exploration to about 1930, when the use of cloud chambers and coincidence counting techniques made possible the detailed study of the secondary particle content of cosmic rays (including the discovery of the positron in 1932 and the mesotron, now called the muon, in 1937). Or one might include the early studies of the electronic and nucleonic cascades produced by the primary cosmic rays, which supplemented laboratory nuclear physics in providing the observational basis for our current understanding of the elementary particles. In that case, one might expect the book to conclude with 1950; indeed, most of the book is concentrated on the period 1930 to 1950, but about a third of it is concerned with more recent developments, including the discovery of the strange particles, with geophysical and astronomical aspects, and with space exploration.

Some of the book's 35 papers are reminiscences only a few pages in length, whereas others, also personal in character, are detailed and original enough to qualify as valuable minihistories. Among the latter are papers by Rudolf Steinmaurer (reminiscences of Hess, in German), Dmitri V. Skobeltzyn, Carl D. Anderson, Bruno Rossi, Georg Pfotzer, Serge A. Korff, John G. Wilson, George D. Rochester, and John A. Simpson. (Those by Skobeltzyn and Anderson have been published before.) The papers mentioned are well edited, but the reader should be warned that some of the others contain an unusual number of misspellings, misprints, and foreign locutions, in spite of the fact that one of the editors is English. The idea of having some older cosmic ray workers publish their recollections originated at an international cosmic ray conference in Kyoto in 1979. By the time the editors wrote their preface in 1982, five of the contributors had died (though, on the whole, cosmic ray workers seem to be an especially vigorous group). The collection is a truly international one, with 42 authors from 14 countries. It is a book to be read selectively and to be browsed through for the many fine old photographs, most of them not previously published, that show well-known physicists like Hess, Robert Millikan, and P. M. S. Blackett, often with their equipment in hand, and convey some of the romance and exoticism of cosmic ray research in the pre-Sputnik days.

The flavor of the enterprise can be suggested by a few examples. When the Japanese group, under Yoshio Nishina, built their first cloud chamber in 1931, according to Masa Takeuchi, "nobody in the laboratory was convinced whether cosmic ray tracks could be obtained." Wilson recalls Blackett's "exceptionally expensive" cloud chamber installation at Birkbeck College in London in the mid-1930's, costing about 1000 pounds, and how the work there ended on the day he "lifted the gold bar from the cloud-chamber, wrapped it in a sheet of notepaper, and walked . . . to the bullion merchant from whom it had been bought." It was always a problem to find a large enough current source to drive the heavy magnets that were used for the momentum measurement of the cloud chamber tracks. Erich R. Bagge relates that whenever Paul Kunze operated his magnet in 1933 the whole town of Rostock lost its electric lights. Nishina's group had to move their cloud chamber to the Yokosuka Naval Arsenal in 1936 to use a generator that was normally employed to charge submarine batteries.

In the Soviet Union in 1937, under the leadership of V. I. Veksler, cosmic ray work was done on Mt. Elbruz at 5300 meters, using donkeys loaded with packing cases or, where even donkeys could not pass, persons to carry the equipment. Similar stories are told for various parts of the world, and of course many of the high-level balloon flights, and after the Second World War airplane flights in the stratosphere, were equally dangerous and thrilling. Devendra Lal, Yash Pal, and Bernard Peters describe the balloon launching of "a very valuable [photographic] emulsion block" from Delhi in 1954 which failed to be released on schedule from the balloon, so that they had to helplessly watch it drift off to Nepal. A month later they received a letter "on self-made rice paper sent by messenger to the Indian border and on by mail." A villager had found the emulsions and gave instructions how to reclaim them: two days' bus trip from the Indian border, two days on ponies, and three days' walk. They did get the block back, though not by that method.

I conclude with Antal J. Somogyi from Budapest, who writes about "the collective game of doing cosmic ray research":

> It has been a game worthwhile playing and worthwhile the efforts spent on it. Not only for the results, but also because it has been collective. It has brought together many people inside and from outside of national boundaries, and joined them in working for a common goal . . . Is not this as important as the results themselves?

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Particles and Fields

Perspectives in Particles and Fields. MAURICE LÉVY, JEAN-LOUIS BASDEVANT, DAVID SPEISER, JACQUES WEYERS, MAURICE JACOB, and RAYMOND GASTMANS, Eds. Plenum, New York, 1985. x, 598 pp., illus. $95. NATO Advanced Sciences Institute Series B, vol. 126. From an institute, Cargèse, France, July 1983.

The Cargèse summer institutes are among the most prestigious schools in particle physics. The lecturers present very advanced topics in high energy theory and experiment to a selected international audience in an atmosphere of interest and participation. The beach nearby offers needed relaxation in the intervals between the lectures. This volume of proceedings of the 1983 institute cannot bring to the readers the breeze of the Mediterranean, but it certainly conveys a clear idea of the high quality and depth of the lectures given at the school.

The theoretical lectures cover topics ranging from gauge theories to supersymmetry.

Lectures by Zinn-Justin and Parisi give a very accessible introduction to lattice gauge theories and to the numerical methods that have profitably been used in the last few years to obtain non-perturbative results. Somehow more formal, the lecture by Baulieu on algebraic properties of gauge theories requires a lot of effort on the part of the reader not already familiar with the field. Lectures by Nanopoulos on supersymmetry and supergravity go through a labyrinth of models in which the superficial reader may easily get lost. Simple and informative, lectures on hadronic spectroscopy and Kaluza-Klein theories by Martin and Wetterich are pleasant to read. The last theoretical lecture, by Glashow, gives a nice overview of the field.

The experimental lectures occupy a larger portion of the volume. In them the physics of e^+–e^- collisions is prominent. An account by Wu of the experimental results obtained at PETRA, the electron-positron accelerator at the DESY laboratory in Hamburg, is a book within the book. More contained but also very informative, lectures by P. Franzini and J. Lee-Franzini give a good panorama of e^+–e^- experiments at the Cornell storage rings. Photons, muons, and neutrinos capture the stage in the remaining lectures, by Treille, Smadja, Turlay, Guyot, and Charpak, which present excellent detailed accounts of a variety of recent important results.

Conspicuously absent from the experimental lectures is a contribution on hadronic collisions, and this precisely in the year when, as the editors remark in the preface, the experimentalists were "proud to announce" the discovery of the intermediate vector bosons, $W^{\pm}$ and Z^0, at the p-$\bar{p}$ collider at CERN. The overall presentation of the experimental lectures thus appears heavily tilted toward leptonic physics. An even bigger sense of imbalance is derived from the disparity of extent of the various lectures. The editors are hardly to blame for this: the writing of lecture notes is a burdensome task for lecturers who are heavily engaged in research. The outcome is necessarily conditioned by the material already available, and reducing a previously compiled review may be as time-consuming as writing something new. Still, the fact remains that a volume in which the contributions were better balanced in scope and detail would have been more satisfactory. Leaving this consideration aside, the reader will find in the present volume a very useful and informative account of some of the most active topics in particle research.

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Vertebrate Evolution

Evolutionary Biology of Primitive Fishes. R. E. FOREMAN, A. GORBMAN, J. M. DODD, and R. OLSSON, Eds. Plenum, New York, 1985. viii, 463 pp., illus. $79.50. NATO Advanced Science Institutes Series A, vol. 103. From a workshop, Bamfield, British Columbia, April 1985.

This volume attests to widespread interest in the earliest radiations of vertebrates. The term "primitive fishes" as used by the editors refers loosely to forms that retain many primitive characters; in practice, the living agnathans (lampreys and hagfishes) are a particular focus of the book. The book's 23 chapters are written by authors from many fields. Much of the emphasis, however, is on comparative physiology and biochemistry.

Nearly one-third of the book concerns comparative endocrinology. These chapters cover many recent ideas on the evolution of vertebrate endocrine systems. For example, Gorbman and Tamarin point out that the agnathan adenohypophysis does not form via a Rathke's-pouch–like invagination but rather by the budding off of cells from the roof of the nasopharyngeal canal, a process misunderstood (or at least misrepresented in diagrams) by previous authors. Noting that the adenohypophysis of hagfishes develops from endoderm, whereas that of lampreys and all other vertebrates arises from ectoderm, they suggest this as possible evidence of the homology of the vertebrate adenohypophysis and the ascidian subneural gland. Nozaki presents new immunocytochemical data on the tissue distribution of neuropeptides in agnathan brains and pituitary. Here again, there are some striking differences between the two lineages: lampreys show most of the pro-opiocortin–related peptides, whereas hagfish do not. Fontaine's chapter is a general review of the hormonal peptides of vertebrates. Several chapters (Vigna; Plisetskaya; Emdin, Steiner, Chan, and Falkmer; and Thorndyke and Falkmer) concern the hormones of the brain-gut axis and the increasing evidence of the great antiquity of many of these systems. In this context, Emdin *et al.* present three alternative models of the origin of the insulin gene from a serine protease gene.

Reviews of other topics in comparative physiology are another strong point of the volume. These include thermoregulation (Prosser), respiration (Burggren, Johansen, and McMahon), reproduction (Dodd and Dodd), osmoregulation (Griffiths), urea synthesis and retention (Brown and Brown), metamorphosis (Youson), blood (Fänge), and cardiovascular function (Nishimura). Agnathans and chondrichthyans are the focus of most of these contributions, although some authors—in particular, Burggren *et al.*—make broad and detailed phylogenetic comparisons to help identify primitive and derived states for multiple sets of characters. This is very helpful. There are many highlights in these chapters, and all of them provide critical summaries and direct access to the extensive literature of these subfields.

In the book's only microevolutionary analysis, Beamish notes that nonparasitic freshwater lampreys are believed to originate from parasitic ancestors either directly from anadromous forms or through an intermediate freshwater parasitic form. Beamish favors the latter hypothesis, but, as he points out, either case requires major reorganizations of development and metamorphosis. Because freshwater forms have evolved more than once, this might be a fruitful area for ontogenetic and phylogenetic studies.

Mallatt summarizes his analysis of alternative models for the evolutionary origin of vertebrate feeding systems. In one, the larvae are depicted as suspension feeders, while the adults are predators. In the other, the larvae are predatory, while the adults are suspension feeders. Support for the first idea comes from the observation that the earliest vertebrates had well-developed sensory systems, as proposed three years ago by Northcutt and Gans in their analyses of the origin of vertebrates. Although the Northcutt-Gans hypothesis retains much of its appeal, Mallatt argues that adult suspension feeding is in better accord with the fossil record of agnathans.

Northcutt reviews a great deal of information on the comparative anatomy of the nervous system and sense organs of agnathans and discusses his results in a cladistic framework. Loaded with new facts and interpretations, this chapter is important because it makes so many specific phylogenetic predictions. As a general conclusion, many of the confusing features of the nervous system of hagfishes appear to be autapomorphies that do not offer much insight into the conditions in the earliest vertebrates.

In their introduction, the editors state that one goal was to produce "a picture of the probable line of evolution of the prototype primitive fishes." Though the book makes progress, that goal is not realized here because systematic and phylogenetic considerations are seriously deemphasized. Gans, writing in the first chapter, states a critical point: comparative biologists must explicitly match their findings against cladograms before constructing evolutionary scenarios. Few of the authors do this, however, and such key topics as relationships among agnathans—as paraphyletic a group as any—