

BOOK REVIEWS

Fundamental questions in quantum physics and relativity—Collected papers in honor of Louis de Broglie edited by Franco Selleri, Hadronic Press Inc., 131, Palm Harbor, Fl. 34684, USA, 1993, pp. 184, \$ 60.

Prince Louis Victor de Broglie was (literally) an aristocrat and a brilliantly intuitive French theoretical physicist of the early part of this century. Born in 1892, he lived to the ripe old age of ninety-five. His greatest work in physics, the prediction of the wave aspect of matter, was contained in his 1923 doctoral thesis written under the guidance of Paul Langevin. Earlier in 1905 Albert Einstein had introduced the photon concept as well as the principle of special relativity. He followed this up in 1909 with his energy fluctuation formula for radiation, bringing out clearly for the first time the dual quantum particle and classical wave features of radiation. Louis de Broglie suggested in 1923 that, as for radiation, so for matter too there was a dual quantum wave aspect to accompany the classical particle nature—thus the wave and particle roles were switched in comparison to the photon. In his arguments he relied heavily on special relativity as well.

Not only was this idea brilliantly confirmed by the 1927 experiments of Davisson and Germer in the case of electrons, it was a precursor to and the direct inspiration for Schrödinger's development of the wave mechanical version of quantum mechanics in 1926. Einstein himself had expressed admiration for de Broglie's hypothesis in late 1924, saying that this work was "a first feeble ray of light on this worst of our physics enigmas" and "He has lifted a corner of the great veil". de Broglie won the Nobel Prize for Physics in 1928.

For the remainder of his long life de Broglie was more or less a loner, on the periphery of the active areas of physics. His unusual early attempt at a classical causal interpretation of quantum mechanics was severely criticized by Pauli and others at the 1927 Solvay Congress; it had to wait till 1952 for a revival through the independent work of David Bohm. de Broglie belonged to the distinguished company of Einstein and Schrödinger in doubting the orthodox Copenhagen interpretation of quantum mechanics. He was a gifted expositor of science for the general reader, and remained an elder statesman for French science.

The contents of the present volume, edited by Franco Selleri, are papers presented on the occasion of de Broglie's birth centenary in 1992, presumably at a workshop at Trani. Apart from the frequent problems of poor language and uneven typography which can sometimes be distracting, these ten essays generally explore ideas that de Broglie was partial to: the attempt to interpret quantum mechanics paying attention to realism, causality and locality; the extent to which special relativity theory is logically and experimentally compelling; the possibility of the photon having a minute mass; and so on. Quite a few of the pieces, by authors who are as yet relatively little known, present ideas which are rather unorthodox and outside the mainstream.

The two most interesting and substantial papers are by the mathematician Tsirelson and the philosopher of science James Cushing. The former presents a very rich and concentrated account of the general structure of Bell-type inequalities in the search for alternatives to quantum mechanics. He develops quite intricate geometrical pictures for depicting classical, then quantum, joint probabilities for results of measurements on subsystems of a total physical system. Classically the space of all such probabilities is a convex polytope of some dimension, with vertices, plane faces and extremal points. Various subregions of it are singled out as corresponding to deterministic behaviour, classical Bell inequalities, etc. Generally the space of quantum probabilities is an enlargement of the classical one, with a rounding off of edges and plane faces. Many interesting open problems are presented.

Cushing's paper is a very readable essay on the notion of local realism, its origins and role in physics. He recalls de Broglie's general philosophical views on science, and the kind of interpretation he had hoped to find for quantum mechanics: a unified continuum picture, with particles and waves simultaneously present, much more realistic than the Copenhagen approach would permit. There is an extended discussion of the meanings of explanation and understanding in science, and how these notions evolve in time; also an acknowledgement that what constitutes an 'acceptable' interpretation of a formal physical theory depends to some extent on consensus. Cushing relates these problems to the attributes of the human brain and ingrained modes of thinking. He leans towards a realist mechanistic view of quantum phenomena, continuing the attitudes of Maxwell and Kelvin. It is fair to say that in all this we are all groping, unable to say clearly in advance what will satisfy us; and whether we will immediately recognise an acceptable explanation if one is presented! There is a discussion of action at a distance

versus by local contact, the ideas being traced from Greek times through Descartes and Newton to the problems of quantum nonlocality.

Some of the other pieces explore the possibility of local realist explanations for the results of Aspect-type experiments to test Bell's inequalities, classical Newtonian principles explaining the physics of the atom—no need then for quantum theory!—a Galilean invariant electrodynamics, and whether the photon may have a small mass and variable speed. In the analysis of the Aspect experiment, the proposed solution envisages two kinds of probabilities for phenomena: one for a system "to be" in various states, another "to be seen" in them. Such solutions while logically admissible appear somewhat desperate, yet one must give room for them. Selleri presents a discussion of various methods for clock synchronization based on a set of linear space-time transformation equations which include Lorentz transformations only as a particular case.

Overall the quality of the papers is rather uneven and modest. One could say quite fairly that the Prince merited a better volume in his honour.

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Introduction to nuclear science by M. N. Sastri, East West Press Pvt Ltd, 104, Nirmal Tower, 26, Barakhamba Road, New Delhi 110 001, 1994, pp. 153, Rs 75.

These days markets are flooded with books catering to the examination-oriented students. The more serious among the students, who look for the concepts and the connecting ideas and the logic behind them, are left high and dry and often run after foreign books. Against this backdrop, it is indeed gratifying to see a book which fills this vacancy and goes beyond the pale of the examination framework.

The book on nuclear science, true to its title, covers a vast area—nuclear physics, chemistry and biology—although the emphasis is mainly on the physics aspects. The subject matter is concise and complete at the introductory level. Each chapter is succinctly presented with remarkable clarity. Many sections are lucid in their style with the language smooth and flowing. The concepts are well explained and the facts are accurately presented. The basic principles underlying the phenomena are neatly brought out and very well substantiated with copious numerical examples including derivations wherever necessary.

The author has undoubtedly anticipated many of the doubts which would invariably arise in the minds of the students and has taken pains to explain them with utmost clarity. [This is exemplified specially in the sections on binding energy (Ch. 2), reaction cross section (Ch. 4), detection of radiation (Ch. 7), etc.]

The idea of presenting explicit calculations in the text itself is an added feature of the book. [For example, impact parameter (page 5), c^2 value (page 8), Coulomb barrier (page 43), etc.]. This would certainly help the student to get a better perspective of the subject besides motivating the brighter ones to undertake similar calculations.

Generally, the subject matter is well absorbed and assimilated when presented along with examples, graphs and tables of values. This is meticulously followed and exhaustively given in this book. This makes the book self contained and thus, I believe, even an expert would love to treasure it in his shelf.

The questions and problems at the end of each chapter have a good distribution and are well selected to test the understanding of the student. Only the heading 'Problems' is not wholly appropriate and may have to be changed to 'Questions and problems'.

The author's special taste for the historical developments (including the family relationships of the scientists) is clearly evident in the book. The quotations at the beginning of each chapter are spicy and at the same time thought provoking.

Some specific comments and suggestions

1. The contents of different chapters by themselves are neatly and clearly presented. However, no serious attempt seems to have been made to link them. Thus the chapters stand isolated and coherence is reduced. The natural link that exists in the nuclear phenomena should be brought out for an overall comprehension of the subject.
2. The schemes presented in support of Yukawa's theory of nuclear forces (page 12) needs some explanation and should not be left entirely to the reader. Or else, the scheme may be dropped altogether.
3. The *shape* of the nucleus must have been included (page 13) as it is one of its important properties. This is also needed for the completeness of the subject.
4. The important characteristic of the fermions and the bosons, viz., the half-integral and the integral spin values, respectively, should be included (page 13).
5. The origin of the number 537 in equation 4.7 (page 48) may be explained.
6. Page 3, line 20: "This hypothetical particle"

Comment: This sentence, read with its previous one, is misleading since the (actual) neutron is not a combination of an electron and a proton.

7. Page 9, line 22: "Additionally, there are *sixteen* naturally occurring radioactive isotopes... with $Z < 83$ ".

Comment: Actually this number would be enormous (not sixteen), if one includes radioisotopes due to β^- , β^+ , and electron capture processes, apart from α -active isotopes.

8. Page 11, Para 2: "there are three possible types of forces between nucleons...."

Comment: $n-p$, $p-p$ and $n-n$ are *not* three types of forces. There are three varieties of two-nucleon combinations interacting through the nuclear force alone (in $n-p$ and $n-n$) and nuclear + Coulomb force (in $p-p$).

9. Page 16, last para: "a model in which ... collective model".

Comment: This statement is erroneous. The liquid-drop model is a part of the collective model which is a strong interaction model. This collective model is different from the shell model which comes under the independent particle type. However, it is the 'unified model' which incorporates the features of both the collective model and the shell model.

10. Page 44, line 5: "Out of every 1000 α particles, only one will lead to"

Comment: This should perhaps read as "out of every 1000 α particles inducing a collision, only one will lead to"

11. Page 46, para 1: "The different reactions that occur... *compound nucleus*"

Comment: For a beam of *certain energy*, different kinds of *mechanisms* are not, in general, involved. However, different *reactions* would occur. When the incident energy is around 50 MeV, CN formation is *not* the most important reaction. CN formation is dominant at a much lower energy of around 8 MeV.

12. Page 47: "In a particle-particle.... 1-4 amu."

Comment: This appears to be a loose statement for describing a particle-particle interaction. It may be replaced by "In a particle-particle reaction, one of the particles of the target nucleus interacts with one (of the) particle(s) of the projectile and yields a product...."

13. Page 91: "Force of repulsion $\propto \{Z(Z-1)\}/R_{p-p}$ ".

Comment: Force is *not* $\propto 1/R$ but to $1/R^2$. It should have been 'repulsive potential'. Similarly, the 'nuclear attractive force' is to be replaced by 'energy due to the surface tension'.

14. Page 148, (answer to Ch. 2, problem 11, line 4.) "1/2—"

Comment: The correct answer is $9/2 +$, as predicted using the shell model scheme and as measured experimentally.

15. A couple of printing mistakes have crept in here and there. For example,

6th neutron	for 5th proton	(p. 18, Table 2.4)
$t = N_0 - N = \dots$	for $\Delta N = N_0 - N = \dots$	(p. 29, line 14)
(n, λ)	for (n, γ)	(p. 44, line 17)
$A Z$	for $\Delta A \Delta Z$	(p. 48, Table 4.1)

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The mathematical legacy of Hanno Rund edited by J. Vladimir Kadeisvili, Hadronic Press, Inc., 131, Palm Harbour, Fl. 34684, USA, 1993, pp. 430, \$90.

This collection of 24 research articles is brought out in memory of the great mathematician Hanno Rund (1925–1993) whose interests spanned a wide spectrum of mathematics and its applications to physics. He rode as a colossus in the propagation of mathematics through his writings and lectures, and has main contributions in several topics of algebra, geometry, quantum mechanics and relativity. The articles by various authors constitute a nice presentation covering the foundational aspects up to the current level of advancement in the topics inspired by Hanno Rund such as representation theory of groups, quaternionic projective spaces, manifolds, superalgebras, integral surfaces, pseudo-Euclidean spaces, Riemannian geometry, quantum mechanics, Minkowskian geometry and Lie–Santilli theory.

The volume begins with a historical sketch on Hanno Rund by Larry Grove giving us a glimpse of the great mathematician and lists his work of 11 monographs and 117 research articles. The wide range of interests of Hanno Rund is also reflected in the 24 articles included in the book, of which the first 22 have already appeared in the journal *Algebras, Groups and Geometries*, Vol. 10, 1993, and the last two articles are on applications of mathematics to physics.

A brief summary of the articles is given below:

1. J. M. McShane and L. C. Grove—Polynomial invariants of finite groups, pp. 1–12. The authors prove that the algebra of polynomial invariants of a finite subgroup of the full linear group over a field of characteristic 0 is Cohen–Macaulay and hence possesses a subalgebra of finite Krull dimension over which it is a free module of finite rank.
2. J. D. D. Perez—On certain real hypersurfaces of quaternionic projective space. II, pp. 13–24. This paper contains the classification of real hypersurfaces of quaternionic projective spaces under side stipulations.
3. N. Kamiya—A construction of Kac–Moody algebras from Freudenthal–Kantor triple systems, pp. 25–35. An explicit construction by means of the standard imbedding Lie algebra is given.
4. Y. C. Kim and H. M. Srivastava—The Hardy space of a certain series and its applications, pp. 37–52. The authors give a derivation of various conditions for a one-parameter additive family of operators to map star-like and convex functions into the Hardy space of analytic functions.
5. J. E. Majorino, W. A. Rodriguez and J. N. Zeni—The relationship between 2-spinors and rotations, pp. 53–72. This paper deals with the relations between 2-component spinors and rotations based on the Cliffordian algebra or Euclidean vector spaces, using methods of group theory.
6. A. K. Aringazin and A. L. Mikhailov—Invariant tensors of a vector nonmetric space, pp. 73–76. This paper contains the results on Weyl conformal and projective tensors, together with invariant properties.
7. J. Ord—The group properties of local loops and odules, pp. 77–86. This paper contains the results on a local geodesic loop in a manifold with affine connection and its applications to relativity.

8. D. Pickrell—Extensions of loop groups, pp. 87–134. This article contains the classification of smooth reparametrization invariant central extensions of loop groups over connected compact Lie groups.
9. C. P. Johnson—Sub-neofields of finite neofields, pp. 135–148. This article contains results on determining conditions when subgroups become subneofields in the finite case.
10. R. S. D. Thomas—Geometric compatibility conditions of third order for a three-dimensional surface vector field, pp. 149–167. This paper contains third-order geometric compatibility conditions for vector fields over moving surfaces.
11. A. Micali and Ph. Revoy—Sur les algèbres de Lotka–Volterra, pp. 169–180. This paper contains applications of non-associative algebras to discuss systems of differential equations using Lotka–Volterra theory.
12. A. C. Serrano, J. A. Cuenca Mira and C. M. Gonzalez—Applications of ternary H^* -algebras to associative H^* -superalgebras, pp. 181–190. An application of the structure theory of ternary H^* -algebras to two-graded associative H^* -algebras is dealt with in this paper.
13. A. Kaidi, D. M. Barquero and C. M. Gonzalez—Socle fine characterization of Artinian and Noetherian rings, pp. 191–197. This paper contains the descriptions of some socle fine classes characterizing Artinianity and Noetherianity.
14. I. A. Filanovski and V. D. Liakhovsky—Branching rules for regular injections of classical Lie algebras, pp. 199–213. This article contains recurrent formulae involving decompositions of classical Lie group representations.
15. M. S. Molina—Abelian regular Jordan pairs, pp. 215–225. This paper contains results on when a regular Jordan pair is actually abelian.
16. C. Baikoussis, T. Koufogiorgos and F. Defever—Coordinate finite type integral surface in S^5 , pp. 227–239. This paper contains classification of the coordinate finite-type integral surfaces of the unit sphere in the six-dimensional space.
17. Y. Zheng—Complete hypersurfaces with constant mean curvature in a Riemannian manifold, pp. 241–251. This article contains conditions for complete hypersurfaces with constant mean curvature to be totally umbilical or isometric to a sphere.
18. L. Hui–Li—Rotation surfaces of finite type in pseudo-Euclidean space, pp. 253–261. This paper contains results on flat rotation surfaces reducing to surfaces of known type in pseudo-Euclidean spaces.
19. K. K. Wan and J. J. Powis—Nonlocality of quantum mechanics and geometric quantization, pp. 263–272. This article pertains to the illustrations of the nonlocal nature of quantum theory.
20. R. M. Santilli—Isonumbers and genonumbers of dimensions 1, 2, 4, 8, their isoduals and pseudoduals, and “hidden” numbers of dimension 3, 5, 6, 7, pp. 273–322. This paper contains theories of isonumbers pertaining to nonlocal interactions in several branches of physics.
21. A. U. Klimyk and R. M. Santilli—Standard isorepresentations of isotopes/ Q -operator deformations of Lie algebras, pp. 323–332. The authors give an account of equivalence between irreducible representations of Lie algebras and quantum algebras.
22. J. R. Clay and H. Kiechle—Linear codes from planar nearrings and Mobius planes, pp. 333–344. This article contains results on linear codes of 2-designs which are embeddable in Mobius planes.
23. J. V. Kadeisvili—An introduction to Lie–Santilli theory, pp. 345–381. This article is a nice overview of Lie–Santilli theory written in an attractive expository style.
24. R. M. Santilli—Nonlocal-integral, axiom-preserving isotopies and isodualities of the Minkowskian geometry, pp. 383–430. This is a descriptive article studying various geometrical departures caused by physical media from Minkowskian geometry.

In toto, the 24 papers included are of high standard and good mathematical depth inspiring every reader. Some of the articles are very challenging and the assimilation of the details by the reader is an event of mathematical bliss. A copy of this collection should therefore be made available in every library.

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Recombinant and synthetic vaccines edited by G. P. Talwar, K. V. S. Rao and V. S. Chauhan, Narosa Publishing House, 6, Community Centre, Panchsheel Park, New Delhi 110 017, India, 1994, pp. 512, Price not stated.

The volume under review is an excellent reference tool on the current status of research and field application in the area of vaccinology. The book consists of 9 sections containing a total of 64 papers contributed by eminent scientists from all over the world.

The first section deals with concepts and recent advancements in the development of recombinant, live and peptide vaccines against diseases of veterinary importance. In the first paper, Yilma discusses the development of recombinant infectious viral vaccines for rinderpest which is the most important disease of the livestock in developing countries. Musoke *et al.* and Grewal *et al.* describe development and field trials of two vaccines against Theileriosis in cattle. Contributions by Fred Brown and Zheng *et al.* illustrate identification of an immunogenic peptide in the capsid protein VP1 of foot and mouth disease virus and its use as peptide vaccine against FMDV. The paper by Tripathy *et al.* describes a recombinant fowl pox virus vaccine for poultry industry. An interesting paper by M. R. Valle *et al.* describes the use of recombinant protein Bm86 from the gut of cattle tick *Boophilus microplus* produced in the yeast *Pichia pastoris* towards the control of the diseases caused by cattle ticks.

The second section containing seven papers deals with vaccine strategies against hepatitis and HIV. Rao and Mishra *et al.* describe two peptide vaccines against HBV based on the immunogenic epitopes on HBsAg. A recombinant anti-HBV vaccine and its clinical trials in Cuban children are presented by Muzio *et al.* The papers on HIV provide useful information on the biology of HIV and prospects for development of a peptide vaccine against HIV. One paper in Section V and another in Section IX are also related to HIV vaccines.

The third section describes various strategies of vaccine development against different stages of the malarial parasite. A series of papers by Patarroyo, Etlinger, Chauhan, Labo *et al.* highlight the use of peptide sequences from the surface proteins as malarial vaccines. Other targets for malarial vaccine include the merozoite surface protein 1 (Holder *et al.*), surface epitopes on the intrahepatic forms of the parasite (Mazier *et al.*), circum sporozoite proteins (Udhaykumar *et al.*) and antigens for transmission blocking against sexual and mosquito midgut stages of the parasite (De Zoysa *et al.*, Targett *et al.*, Kumar *et al.* and Carter).

The fourth section comprises 15 papers devoted to the control of fertility based on anti-hormonal and anti-gamete vaccines. hcG-based vaccines for women are described by Talwar's group and by Griffin. Lal *et al.* describe anti-FSH vaccine for use in males. Potential use of GnRH-based vaccines for contraception in males as well as females, for treatment of prostatic hypertrophy and immunocastration of animals is described by Salunke *et al.* The potential of synthetic oligopeptide as a vaccine against riboflavin carrier protein is exemplified by Adiga *et al.* and Mahale *et al.* A series of papers by Herr *et al.*, Isojima *et al.*, Naz, Suri *et al.* and Sheth *et al.* highlight sperm antigens as excellent targets for immunocontraception. On the other hand, Sacco and Yurewicz, Tung *et al.*, Gupta *et al.* and Koyama *et al.* present Zona pellucida antigens surrounding the mammalian egg as targets of fertility control. Roy Curtiss III *et al.* also describe the use of live recombinant *S. typhi* as antifertility vaccine in humans (Section V).

With the advent of AIDS, several diseases like tuberculosis which have been considered to be of less relevance in the western countries are re-emerging as serious health problems. As the original BCG vaccine is far from satisfactory, Collins and Jacobs (Section V) discuss new approaches to develop recombinant vaccines against tuberculosis. Section V presents valuable information on the status of vaccines against infectious diseases. Live recombinant bacterial or viral vaccines have several advantages over inactivated or subunit vaccines. Roy Curtiss III *et al.* discuss the use of avirulent as well as recombinant live *Salmonella typhi* as anti-HBV vaccine. Fouts *et al.*, using the same vector, describe the development of anti-HIV vaccine. While Leroy and Saliou describe a live

recombinant canary pox vaccine for measles, Mittal *et al.* point to the use of adenovirus-based expression vectors for recombinant vaccines. Schmaljohn *et al.* present a vaccinia-based vaccine against Hantaan virus. Toxoid vaccines have proved their effectiveness in preventing lethal infections. Neal Burnette and Ruth Arnon elegantly describe development of recombinant toxoid or peptide vaccines against pertussis, cholera, shigella and influenza.

Because of the cost and practical difficulties involved in administering multiple doses and their follow-up studies, a vaccine given at a single contact point but having the effect of delivering multiple doses is preferable. In Section VI, Hogan *et al.* and Singh *et al.* emphasize the use of biodegradable microspheres for encapsulating the vaccine entities. Clasen *et al.* describe an alternative approach of using the GRAS organism *Lactobacillus* as a probiotic carrier with several advantages over other live vaccines, for oral and systemic immunization.

Carriers and adjuvants are invariably required for the success of peptide vaccines. In Section VII, while Peter Lachmann reveals the merits of PPD as a useful carrier, Babink *et al.* highlight the potential of using the empty capsids formed by recombinant VP6 of rotavirus in conjunction with the interacting VP4 peptide as carriers for generating high immune response. Advantages of using min genes carrying multiple copies of the protective gene sequences in live recombinant vectors are described by Lindsay Whiston. Sdraffa *et al.* discuss the possibility of using analogous erythrocytes as effective carriers of the vaccine.

For any vaccine, adjuvant is often necessary for optimal induction of immune response. In Section VIII, Morcin *et al.* discuss the well-known adjuvant properties of Iscoms. Potential use as adjuvants of three new agents, namely, steroidal squalene (Bona), nonionic block copolymers (Hunter) and Gamma inulin and Algammulin (Cooper *et al.*) has also been described in this section. The last section provides some important concepts in fertility control. Identification of conformational epitopes on proteins (Nataraj *et al.*), a novel strategy for contraceptive vaccine based on cytokine-mediated reproductive failure and strategies for generating mucosal immunity in the male urogenital tract and its usefulness against HIV (Anderson) are exemplified in this section.

The volume contains numerous contributions by reputed scientists from all over the globe, and hence constitutes an important source of information and reference in the area of vaccinology that is of extreme public health importance.

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