

BOOKS

Quantum field theory and the many body problem, by T. D. Schultz (New York, Gordon and Breach Science Publishers Inc., 1964; paper \$ 3.95, cloth \$ 6.95).

This short volume provides a very nice introduction to the more formal aspects of the many-body problem. The emphasis is on the use of quantum field theory and the diagrammatic approach. Nothing is assumed other than elementary quantum mechanics and the material is very clearly and logically developed.

The approach is through the one-particle and two-particle Green's functions. Their usefulness is explained and then the formalism is developed from the concept of second quantization up through the Dyson integral equations. The author is mainly concerned with the many-fermion system, and for applications treats the free-electron gas and the electron-phonon system at absolute zero; a short chapter at the end gives an introduction to many-fermion systems at finite temperature.

One wishes that the author could have lengthened the book somewhat, with a few more detailed applications, for the mathematical apparatus developed is much too powerful for the problems treated. The one problem that is really handled in detail, the free-electron gas, is very well done, particularly the discussion of the dielectric constant and the polarization propagator. The section on the electron-phonon system, however, is too sketchy to be of any real value. However, this book is presented as the first volume of a series on the many-body problem, so one cannot be too critical on this point as presumably the applications are to come. The series has certainly been given an auspicious start, and this volume is to be recommended as an excellent introduction to the recent advances in the theory of many-particle systems, for which it gives ample references.

John Dirk Walecka

Quanta and reality, a symposium (London, Hutchinson and Co. Ltd., 1962; 18 s.), is neither a text-book for the expert nor exactly a popular exposition for the layman. Falling somewhere between these two, it not only describes current ideas on the fundamental nature of matter — the duality of particles and waves, complementarity, the implications of the principle of indeterminacy — but also

Last month at CERN (cont.)

or -1 , and the overall value for a number of particles is obtained by multiplying the individual values together, so that it also is equal to $+1$ (even) or -1 (odd). CP invariance is then expressed by the fact that the overall value after the interaction must be the same as that before. In the case of kaons the K^0_1 , decaying into two pions, was assumed to be in an 'even' state whilst the K^0_2 , decaying into three particles, was in an 'odd' state and could therefore never decay into two pions. As described above, the new experimental results indicate either that CP invariance is not true in this interaction, so that there is nothing to stop such a decay, or that there is some force which can generate the K^0_1 component from the K^0_2 even in the absence of nearby matter.

Electron storage-ring model

During the first part of August the electron storage-ring model, CESAR, was shut down to allow the installation of new sextupole 'shims' together with two more sextupole correction magnets and other more minor changes. The current in the sextupole windings, and hence the effect of the magnets on the circulating electrons, can be varied from the control room, so that much closer control of the beam behaviour should be possible.

Since the last report in *CERN COURIER* (vol. 4, p. 34, March 1964) the

vacuum system has been baked out and the pressure reduced to a value of around 2×10^{-9} torr. The stability of the Van de Graaff accelerator, used to provide the electrons for injection at an energy of 2 MeV, has also been improved. Mainly as a result of these developments some twenty or more beam pulses can regularly be 'stacked' in the ring, to give a circulating beam which has a 'half-life' of about 1 second, that is, its intensity (initially some 1 to 2 mA) decreases by a factor of two every second. (Under similar conditions, 25-GeV protons would circulate for many hours, because their higher mass and energy renders them less liable to deflexion by residual gas molecules.)

It will be recalled that electrons injected into the ring circulate on a more or less circular, closed orbit near its inner edge and are then moved on to an orbit of larger radius by the radio-frequency 'stacking' system, successive pulses being stacked on orbits of progressively decreasing radius. Many different 'programmes' for the sequence of operations of the radiofrequency system have been investigated by means of the 7090 computer and the most promising ones then tried out on CESAR itself.

A comprehensive series of measurements on the factor known as the 'Q' of the storage ring has also been carried out in the past few months. These measurements concern the betatron (side-to-side and up-and-down) oscillations of the electrons about the average orbit and are very important from the point

of view of stability. To take one example, if Q has a value of 3, an electron disturbed slightly from its orbit (by an imperfection in the magnetic field, say) makes exactly three oscillations in one revolution and will then be subjected to exactly the same disturbance on its second time round. The amplitude of the oscillation will thus increase each time and the electron will soon be lost by hitting the vacuum-chamber wall or some other obstruction. A 'second-order resonance' effect arises with a half-integral Q (2.5, 3.5, etc.) when the electron finds itself in the same position relative to the disturbance after *two* complete revolutions. The value of Q is not the same for all positions in the ring, and in fact with the present adjustments to CESAR it increases steadily from the inner edge of the ring to the outer, having a value of about 2.75, for both horizontal and vertical oscillations, on the central orbit. In the measurements on the stacked beam, evidence was found for resonances up to perhaps the ninth order (only part of the beam being lost in such cases). It is hoped that, by using the correcting fields of the new sextupoles, the variation of Q with radius can be considerably decreased and the mean value so chosen that there is no possibility of exciting any of the lower (and more damaging) resonances. Moreover, since the prime purpose of the storage-ring model is to study the basic mechanisms involved in such processes, the Q may be varied so as to produce a desired range of values for further study of the behaviour of the beam under particular resonance conditions ●

delves further. In bringing forward some of the more philosophical and 'heretical' views about quantum mechanics, the book provides a fascinating glimpse of ideas and controversies which, though at present on the fringe of our work here at CERN, many conceivably bring about as complete a change in thought and actions as the quantum theory itself.

The book presents in written form a series of talks broadcast in the British Broadcasting Corporation's Third Programme in 1961. In his preface, the producer of the series says that its primary aim was to inquire into the layman's question; 'what are electrons really like?'. The unforeseen philosophical issues and questions of scientific 'strategy' that resulted from this apparently simple question show how big is the gap that now separates the layman from the theoretical physicist and the philosopher, although the clarity and enthusiasm of these expositions could do much to reduce it.

The contributions are introduced by Stephen Toulmin, director of the Nuffield Foundation Unit for the History of Ideas, who sets the scene by describing briefly how quantum physics came to replace classical physics, how a few physicists, notably Albert Einstein, could never reconcile themselves to the loss of 'causality' that this entailed, and how, in recent years, criticism of the 'orthodox' quantum theory has increased.

In the following two chapters, 'Particles and waves' and 'Waves and probability', the basic ideas of quantum theory are neatly explained by Prof. A.B. Pippard (Cambridge) and Prof. N. Kemmer (Edinburgh) respectively. Then Dr. Mary B. Hesse (Cambridge) provides a clear explanation of the use, and the disadvantages, of models in physical thought, and shows how the various interpretations of quantum physics are all tied to the 'wave' and 'particle' models in some way. The voice of heresy is introduced in the fourth chapter, which records a discussion between Prof. M.H.L. Pryce (Bristol), representing the orthodox view, and Prof. D. Bohm (London), who is one of the leading exponents of the need for a new 'sub-quantum' theory. Here, the main objections to the limitations of the present theory are brought out, and Prof. Bohm explains why he believes that new advances in our understanding will require fundamental changes of approach, such as the abandonment of our present ideas of space and time based essentially on the notion of cartesian co-ordinates.

A 'postscript', by N.R. Hanson, Professor of History and Logic of Science at Indiana University, recapitulates some of the arguments and goes some way further in discussing the kinds of difficulties now encountered by quantum theory in describing high-energy interactions.

Altogether, the book is entertaining on first reading, and contains much to make a second reading worth while. It should stimulate many people to enquire further into the subjects with which it deals.

A.G.H.

Chemical protection of the body against ionizing radiation, edited by Vera S. Balabukha (Oxford, Pergamon Press Ltd., 1963; 60 s.).

Research conducted by several authors in the U.S.S.R. (up to 1960) on chemical protection against ionizing-radiation injuries is reported in this volume.

The publication is divided into two parts: the first treats chemical compounds and radio-protective drugs; the second examines substances which have the property of being able

to remove specific isotopes (or groups of isotopes) from the body (particularly those that are present in the body due to fall-out from nuclear explosions).

As is well known, the radio-protective substances act only if they are administered a short time before irradiation takes place (prophylactic action) and only a small quantity of the drug can be administered. Also described in various parts of this book are the chemical and pharmacological characteristics of many radio-protective substances, as well as their modes of action at the endocellular level of biological systems (action on different intermediate metabolisms and on proteins). The authors mention particularly the compounds of the aminothiols series (molecules characterized by the presence of -SH and -NH₂ groups), their derivatives and the prophylactic efficiency of certain of their associations. Of great interest in this field are the studies on the variations of pharmacological activity of various molecules according to the relative positions of the active groups.

In my opinion, the most interesting aspect of this book is the consideration that has been given to the different hypotheses for the mechanism of the action of radio-protectors. Particular note can be made of that hypothesis which considers these substances as energy absorbers, indicating that the action of some protectors is not chemical but physical, with the protector entering into the intramolecular and intermolecular energy-transfer phenomena, especially at the level of the carbon chains in protein.

In the second part of the book, the methods of elimination of certain artificial radionuclides, for example ⁹⁰Sr, ⁹¹Y, ²¹⁰Po, and ⁹⁵Zr, from contaminated organs are briefly examined. This problem, which has been created almost entirely by the 'nuclear era' has not yet been resolved and its importance to man is quite obvious.

Some studies are reported on the possibilities of breaking the linkages between very dangerous radioisotopes and blood or tissue proteins (in which the turn-over is very slow, similar to the case of ⁹⁰Sr in bone). For this purpose, well known complexing agents, such as ethylenediaminetetraacetic acid (EDTA), cyclohexanediaminetetraacetic acid (CDTA) and cyclopentanediaminetetraacetic acid (CPDTA), in the form of sodium and calcium salts are employed. These salts are capable of making strong bonds with the above-mentioned isotopes and thus extracting them from the tissues in which they were deposited. The elimination of the complexing compounds from the tissues represents the ultimate phase of internal decontamination.

By virtue of its highly specialized nature, this volume cannot recommend itself to the general interested reader, but it will, however, find a welcome amongst specialists in radiobiology and radio-chemistry.

Antonio Pasinetti

British painting; a picture history, by John Woodward (London, Vista Books, Longacre Press Ltd., 1962; 42 s.).

Although British painting has effectively only four centuries of history, having virtually begun with the arrival of Hans Holbein (from Switzerland), its exponents in this limited time have been plentiful and prolific. Overshadowed by their more famous Continental contemporaries, and with few claims to originality of style, British painters are not so well known as they deserve to be. This book is a gallant attempt to do justice to the subject in the somewhat limited space of 160 pages, ambitiously including (as the

publishers state) 250 illustrations covering the work of 200 artists.

Undaunted, but somewhat cramped, by this problem in logistics, Mr. Woodward has organized his presentation very well indeed. Schools, styles and fashions are skilfully delineated and accurately described. The usual hackneyed procession of familiar Holbeins, Reynolds, Constables, Pre-Raphaelites and Whistlers, resembling nothing so much as a bound volume of Edwardian calendars, has been carefully avoided. A distinctly refreshing approach is created by the deliberate choice of many lesser-known works of the masters. The text is succinct, and the captions are unusually effective.

On the other hand, the actual layout of the pictures suffers from overcrowding and is — perhaps in consequence — rather unimaginative. The black-and-white illustrations are of high quality, but the lack of colour is a serious drawback. Colour is, after all, fundamental to painting; one suspects that the reaction of most artists to having their work on display in black and white would be violent. Whenever colour does appear, and there are only fifteen plates, it has the impact of an extra dimension. This effect tends to camouflage the relatively poor quality of the colour reproduction and printing.

However, this is not an expensive book. Most of the features adversely criticized stem from the exigencies of keeping down to a price. The binding is handsome, and the quality of paper and printing good. Within its limitations, it is an honest piece of work, and offers remarkably good value for money.

J. Y. F.

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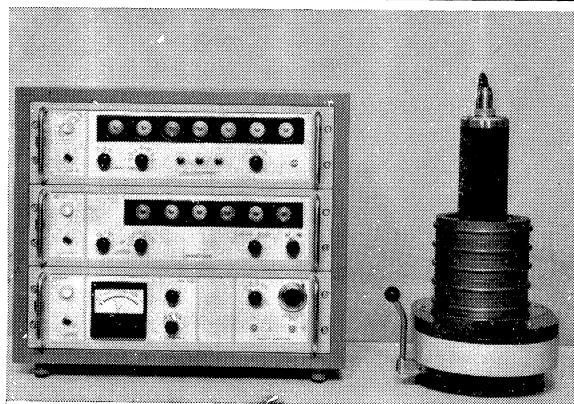
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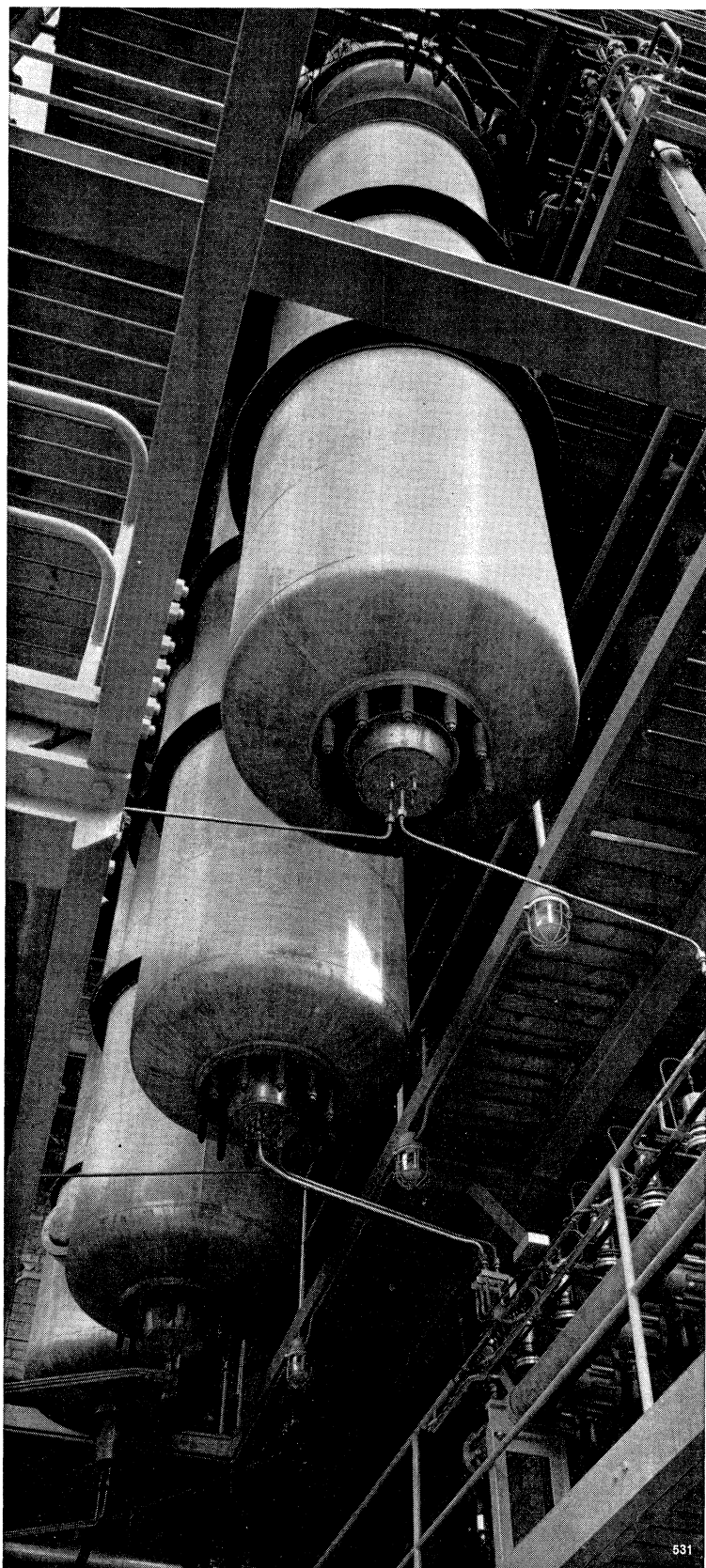
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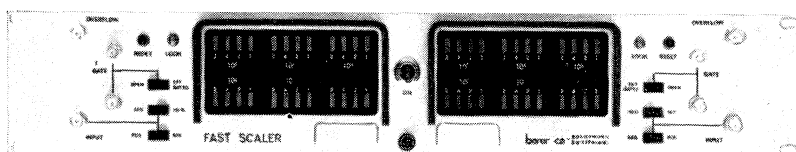
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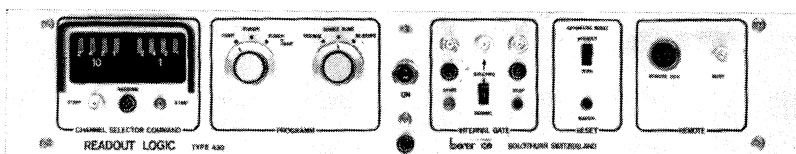
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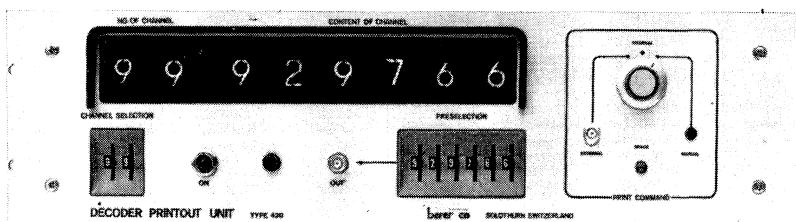
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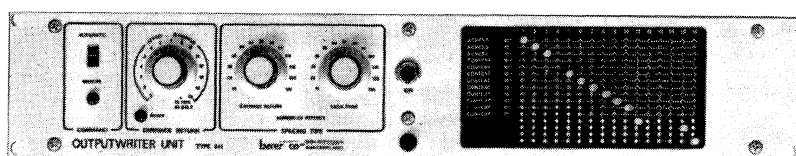
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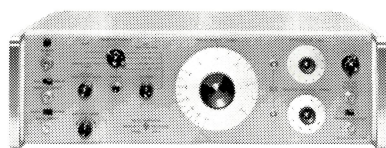
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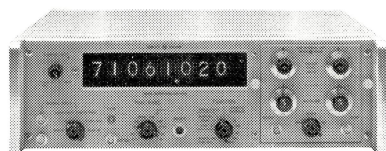
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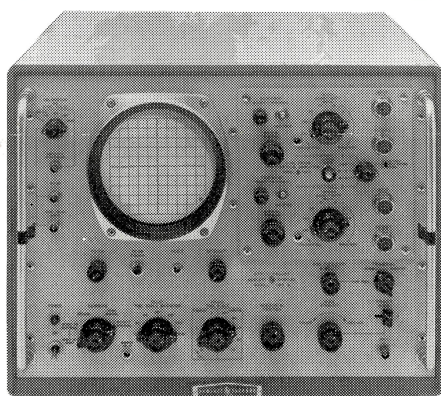
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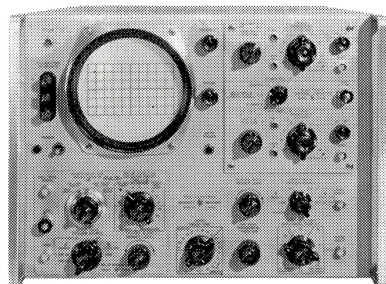
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