

BOOKS

Introduction to space science, by the Staff of the Goddard Space Flight Center (NASA), USA, edited by W. N. Hess (New York, Gordon and Breach Science Publishers, 1965, 920 pages. No price indicated).

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The book is in three parts — the Earth and its environment; Space; the Solar system and beyond. The first part covers knowledge of the earth and the region of space near the earth extending roughly to 10 earth radii. The role played by satellites in the advancement of this knowledge is emphasized, for instance, by describing the studies of aurorae and of ion and atom distributions in altitude, latitude, type and time. It has been possible to gather information about the earth in ways and with a speed that could not be achieved from the ground; for example, world wide cloud patterns, the earth's magnetic field and the gravitational potential field.

The second part considers 'Space' roughly outwards from the edge of the pear-shaped magnetic field of the earth. The region between this magnetopause and the immediate solar environment shows interesting features: collisionless shocks, turbulence, particle acceleration processes, etc... Outside the magnetopause, the region is dominated by the sun and one finds the famous solar wind.

The chapter on cosmic rays should be read by anyone interested in high-energy particle production and acceleration or who desires an introduction to cosmology. An attempt is made to cover the properties and characteristics of the cosmic rays as known in spring 1965. Although extensive air showers and experimental detection problems, for instance, are not dealt with, the chapter gives a general idea of the state of knowledge and of some current areas of research. Active investigation, particularly of the production and propagation of low energy solar cosmic rays and the solar modulation of low energy galactic cosmic rays, is under way using sophisticated detectors carried on balloons and satellites. Interplanetary dust particles, cosmic chemistry, orbital mechanics and the advent of man in space to further the physical sciences, are other chapters in this section.

'The solar system and beyond' is the third and largest part. It deals with the planets in the solar system, the stars and galaxies. Much of the classical discipline of astronomy is covered here but the book reflects the fact that, although research has started in this field, the progress has been limited. Pictures of the moon have been taken from space and more data has been obtained on the atmospheres of Venus and Mars. However, much of the work is still referred to in the future tense: probes to study the atmosphere of the sun, large telescopes put into orbit above our atmosphere, etc. This part of the book is very well worth reading. There is an excellent chapter, with surprisingly little mathematics, on the origin of the solar system.

The chapter on space astronomy describes briefly the observational techniques and space flight instrumentation. But perhaps the most exciting part of the book is located in the last three chapters about stellar evolution, extragalactic radio sources and nucleosynthesis. The thought-provoking birth and death of a star, the mystery of radiogalaxies and quasars — tentatively explained as involving the explosion of supernovae or the gravitational collapse of superstars — and the mystery of the formation of the elements during the evolution of a star are all here, including, of course, a description of the ever present neutrino process looked upon as a kind of safety valve to carry away large amounts of energy from the interior of a high temperature star.

Materially, the book suffers from few printing errors although the quality of paper and offset reproduction is not always even. These are minor points, however, considering the immense amount of information supplied. Each chapter begins with a useful introduction and ends with a list of references extending to the end of 1964; existing knowledge of Soviet work in this field could have permitted reference to wider and more recent sources outside the 'western world'. Name and subject indexes conclude this excellent volume which should be a precious addition to the private library of any cultivated person. **R. A.**

Space Science and Engineering, a collection of lectures by seven scientists of the Marshall Flight Center, edited by E. Stuhlinger and G. Mesmer (New York, McGraw-Hill Book Company, 1965, 455 pages; \$ 20).

This partial survey of space technology originated as a series of lectures at Washington University (St. Louis, Missouri) which constituted the first American course on space technology. The lectures presented the state of the art as it stood in 1961 and they have been brought up to date (early 1965) by the lecturers.

The topics discussed have been selected to cover the exploration of the universe beyond the dense layer of the Earth's atmosphere. The first 16 chapters — some of them, such as 'Cosmic Radiation' skeletal short, — describe the physical features of outer space; they treat the physics of the lower atmosphere and then introduce the reader to the physics of the higher atmosphere and to the radiation phenomena in space. The reader will find in this 'science' half of the book a wealth of data as well as numerous references; most of the information would, however, have gained from a more thorough development even if this had meant expanding the volume by some 50 pages.

The second group of 16 chapters deals with the 'Engineering'. It comprises selected topics — orbits, instrumentation for physical measurements, propulsion and power problems are discussed in some detail. Altogether they offer a broad introduction to present space technology, though communication, guidance, materials and design have been omitted, presumably again in order to limit the size of the volume. The chapter on instruments for radiation measurements comprises a list of sub-nuclear particles — including the omega minus — and descriptions of detectors usable in space, i.e. excluding bubble chambers!

This book will be of interest to students and professional workers in science and engineering, as well as to the layman who is already acquainted with some physics and mathematics. As such, it is perhaps less entertaining than the one reviewed above, but it remains quite informative to a mind open to one of the most striking scientific disciplines of our time. **R. A.**

High Energy Physics (Les Houches 1965), edited by C. DeWitt and M. Jacob (New York, Gordon and Breach Science Publishers Inc., 1965).

This book consists of the lectures delivered at Les Houches, France, during the 1965 session of the Summer School of Theoretical Physics of the University of Grenoble. The lectures contain material that will be of value to post-graduate experimental and theoretical physicists, although the school was intended primarily for advanced graduate students.

There has been a great proliferation of published lecture notes and reprints in the field of high energy physics in recent years; in fact, the growth rate of the literature often appears to outstrip that of new developments. This reviewer felt that the collection of lectures stands out both because the content is still, a year later, in the forefront of interest, and because a greater amount of pedagogical effort than usual went into the writing.

A broad range of subjects is covered. The first two chapters are concerned with symmetries and groups. G. C. Wick's contribution, entitled 'Group Theory, Invariance Principle, Symmetries', discusses space-time invariance principles, the Poincaré group and internal symmetries including isotopic spin and SU₃.

The second chapter, 'Groups combining internal symmetries and spin', treats recent developments in the search for still higher symmetry. In analogy with Wigner's SU₄ theory which combined spin and isotopic spin, the SU₆ theory combines spin and SU₃. As emphasized by Gursky, the SU₆ group cannot describe an exact symmetry of the S-matrix for arbitrary scattering processes.

The third chapter, 'Introduction to the Theory of Strong Interactions', contains lectures delivered by M. Froissart and R. Omnes. An enormous amount of material including potential scattering and analyticity properties, the Lorentz group, Mandelstam representation, and three particle interactions, is clearly and simply presented. These topics are not treated in isolation but are tied together in a manner that gives these lectures special value. 'The Analytic S-Matrix: a Theory for Strong Interactions' is the title of the fourth chapter which is written by G. F. Chew. With the previous chapter well understood, the reader should have little difficulty in following this presentation of the S-matrix theory. The emphasis in the treatment is on physical ideas rather than mathematical derivations.

Quarks are the subject of Chapter 6. These hypothetical particles could explain the 'periodic table' of the elementary particles if they exist. The lectures were delivered by R. H. Dalitz, who shows that some of the properties of many of the observed particles fit the assumption that they are composite states built up from quarks. The lectures should raise as many questions for the experimentalist as for the theorist.

The following chapter consists of two sets of lectures given by D. J. Jackson. The first set is entitled 'Particle and Polarization Angular Distribution for Two and Three-Body Decays' and its purpose is to show how a spin-parity analysis of two and three body resonances can be made from a knowledge of the distributions and polarizations of the decay products. This material should be of particular value to experimentalists. The second set is concerned with 'Peripheral Interactions' and is a short introduction to the peripheral model of high energy scattering, supplemented with a reprint of a review article by Prof. Jackson on the same subject. The 'Theory of Weak Interactions' is discussed by J. S. Bell in the final chapter. The material

covered is reasonably up-to-date and includes results from current algebras, and a detailed discussion of CP violation and the K-meson complex, as well as a good review of historical developments.

While most physicists did not have the opportunity to absorb these lectures amidst the beauty of the French Alps, they now fortunately have the chance to read them in this worthwhile book.

J. H.

Dynamical Theory of Groups and Fields, by Bryce S. DeWitt (New York, Gordon and Breach Science Publishers Inc., 1965; paper \$ 2.95, cloth \$ 5.95).

This book is based on lectures given by the author at the Les Houches Summer School in 1963. As compared to the lectures which have already been published in the proceedings of that school (Relativity, Groups and Topology; Gordon and Breach, 1964) the manuscript is enlarged by one short chapter. The form of this book is neither that of a textbook nor an introduction to current research, since only few references are given. Nevertheless, it seems to us to be very useful as it deals with subjects which are spread over many different journals and textbooks in the literature.

The different topics are discussed from one central point of view, that of invariance groups with an infinite number of parameters. These groups are called pseudo-groups by the mathematicians. Two examples of such groups are well known to physicists: the gauge groups of electrodynamics with a gauge function depending on space and time, and the general co-ordinate transformation group used in the general theory of relativity. Instead of the gauge group with scalar gauge function, the author makes use of the more general notion of Yang-Mills groups or non-abelian gauge groups. These transform particle fields at a fixed point according to an irreducible representation of a compact simple Lie group and let the group parameters vary as functions of space and time. All gauge groups necessitate the introduction of compensating fields. In the simplest example the electromagnetic potential is such a field, for non-abelian groups we obtain the so-called Yang-Mills fields. In the case of co-ordinate transformations the affinities serve as compensating fields.

The author develops a theory for the combined system of one particle field with abelian or non-abelian gauge invariance in a curved space interacting with its compensating fields, the Yang-Mills fields and the gravitational fields. His ultimate aim is the quantization of this system.

The book begins with the Lagrangian formalism of classical field theory. A review of the theory of measurement in the manner of Bohr and Rosenfeld prepares us for the transition to the later quantum treatment.

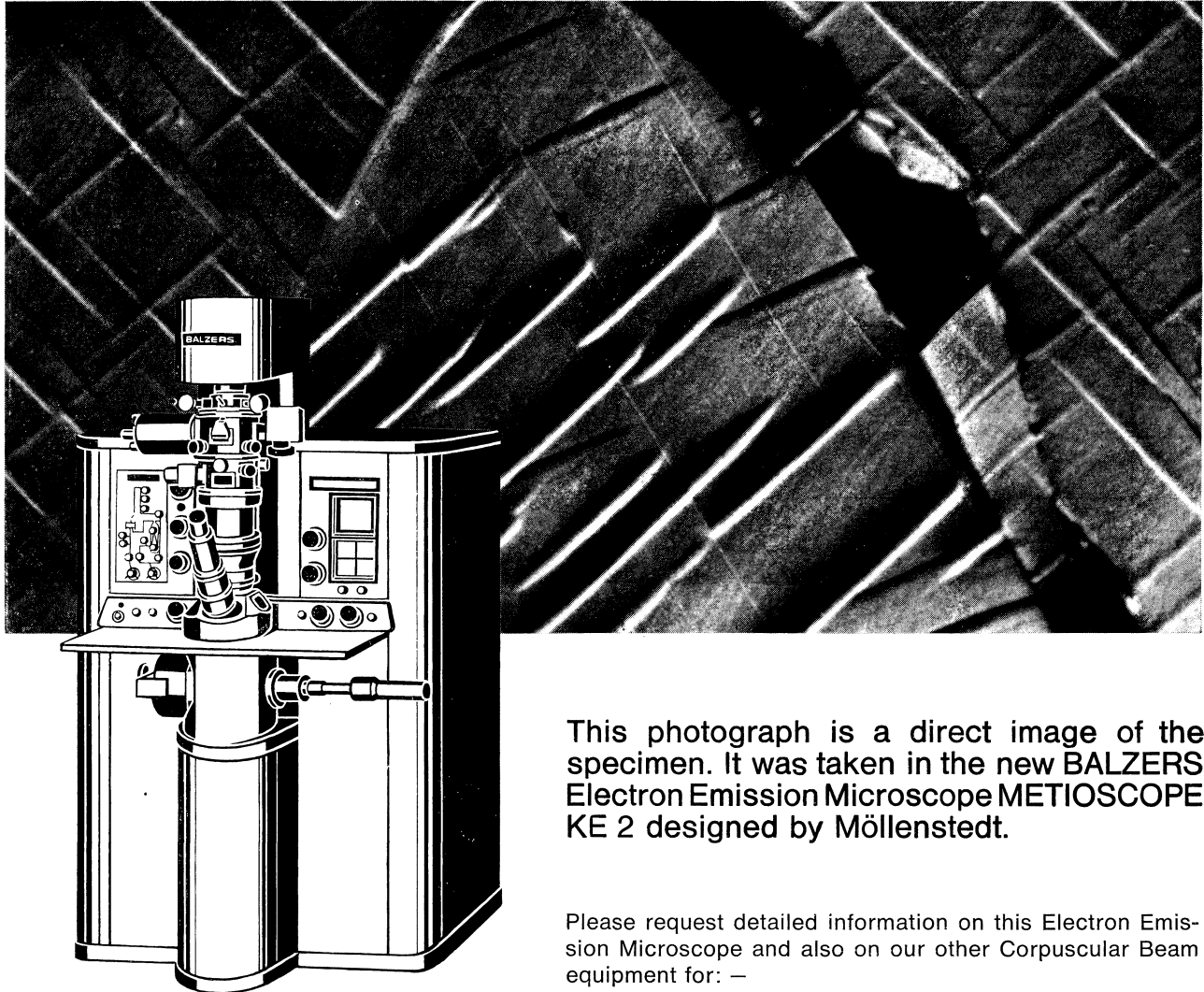
A conventional formulation of quantization of free fields, a discussion of Lie groups and their generalization to infinite parameter groups provides the language for the second half of the book. There the author studies the quantization of the field system and scattering matrix. The latter matrix is introduced by means of a LSZ formalism. Deviations from flat space-time are taken into account by perturbative methods. The main problems are connected with renormalizations when additional invariance under gauge groups is required. The problems involved are not completely solved, but interesting outlooks are given.

Finally, we remark that the book, particularly in the notations, profits much from Schwinger's work. The elegance of the notation should not, however, make the reader forget that the mathematical rigor is rather low throughout.

W. Rühl

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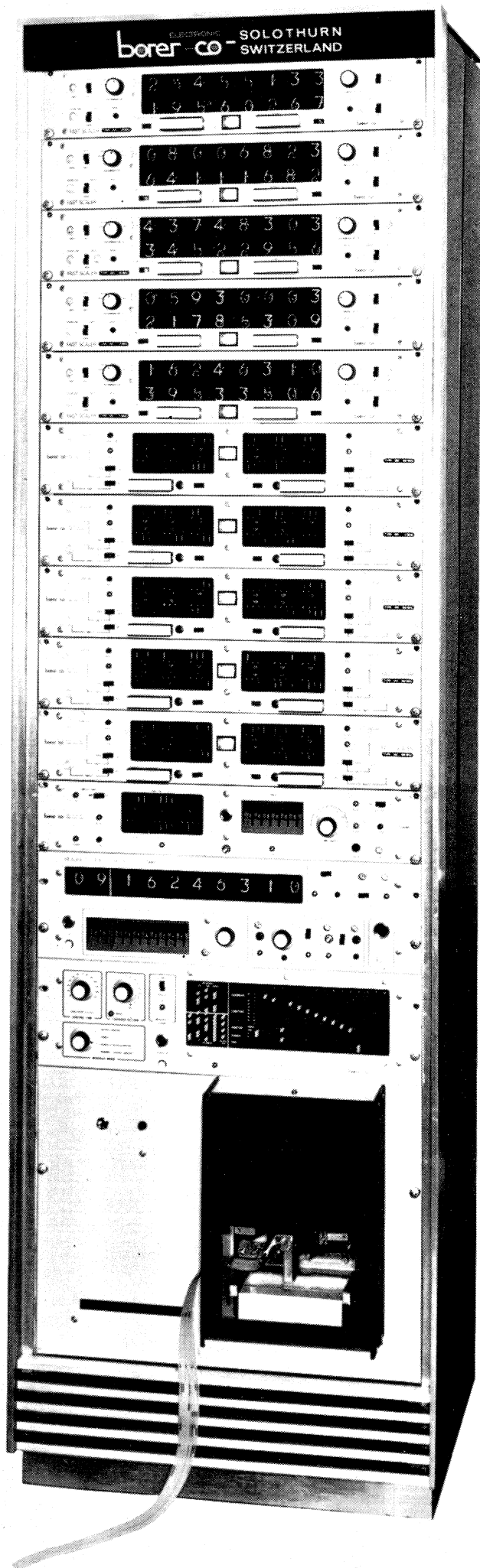
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* P. Brinckmann, Physics Letters, Vol. 15, No. 4, 305, April, 1965.

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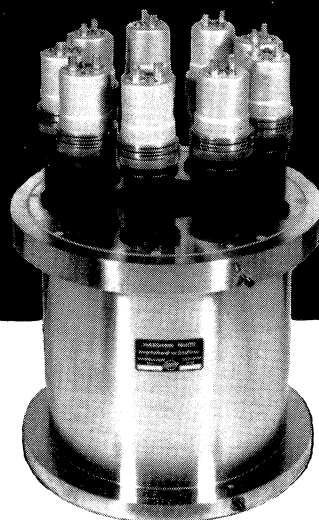
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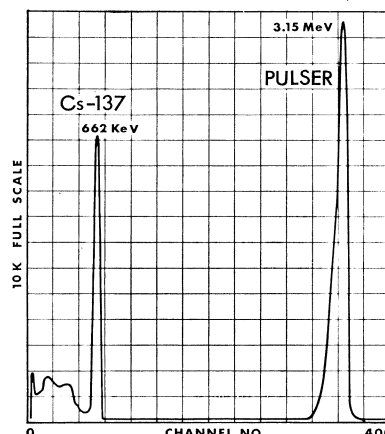
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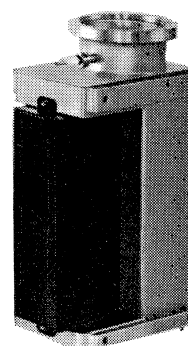
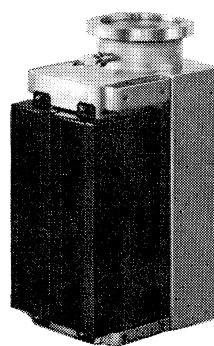
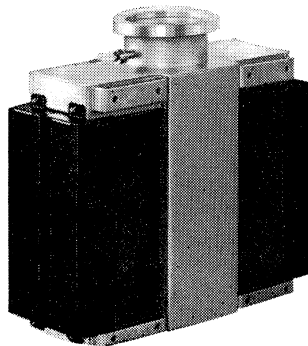
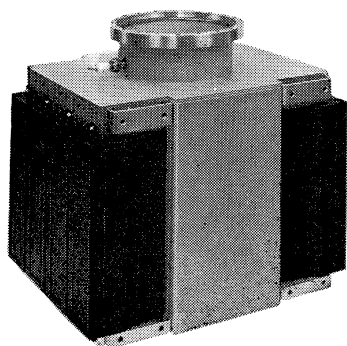


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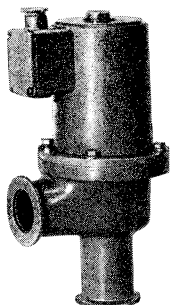
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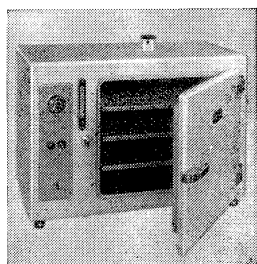
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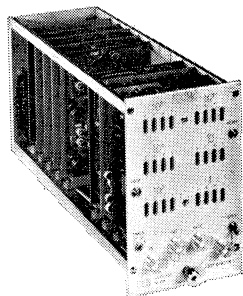
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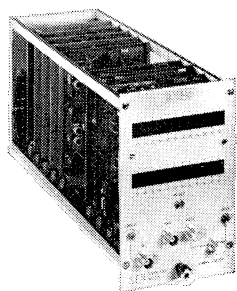
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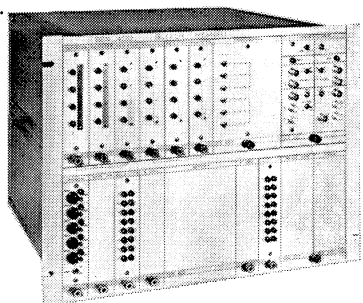
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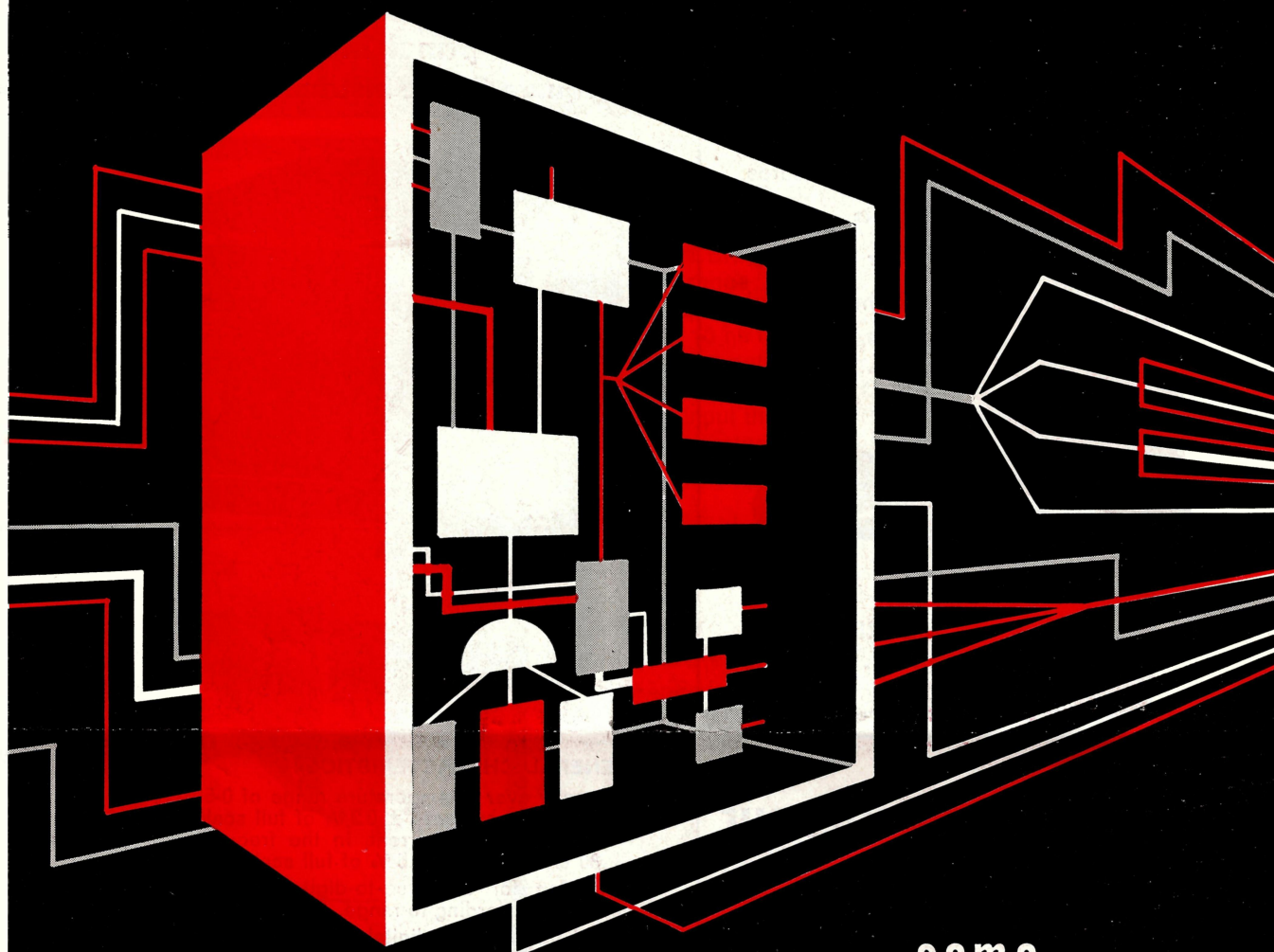
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