

the untouched work of a carver of the glacial period."

"It is claimed that polluted water containing proteins and ammonia can be readily distinguished from pure water."

"In a fatal case of calendine poisoning in which the chemical and the botanical examination gave negative results, ultraviolet light produced a marked yellow fluorescence in the intestines which was similar to that produced by the juice of calendine."

The method has yielded exceedingly interesting results in legal and criminological work relating to the identification of inks, finger-prints, stains, seals, adhesives, erased writing, forged signatures, repairs and over-painting of old pictures, drugs in body fluids, etc.

The book deals with these practical applications in an exhaustive fashion. The references have been carefully shifted and are up to date. The authors, however, very rightly point out that though "in the early days the results were so encouraging that this method was hailed as rapid, accurate . . . and for many purposes, indispensable to the analyst . . . maturer consideration showed that the accuracy was limited and the reproducibility dependent on strict standardisation of working conditions."

With this caution, this book may be recommended for use not only to all analytical chemists, but also to pure scientists who are interested in the interaction of light and matter.

J. C. GHOSH.

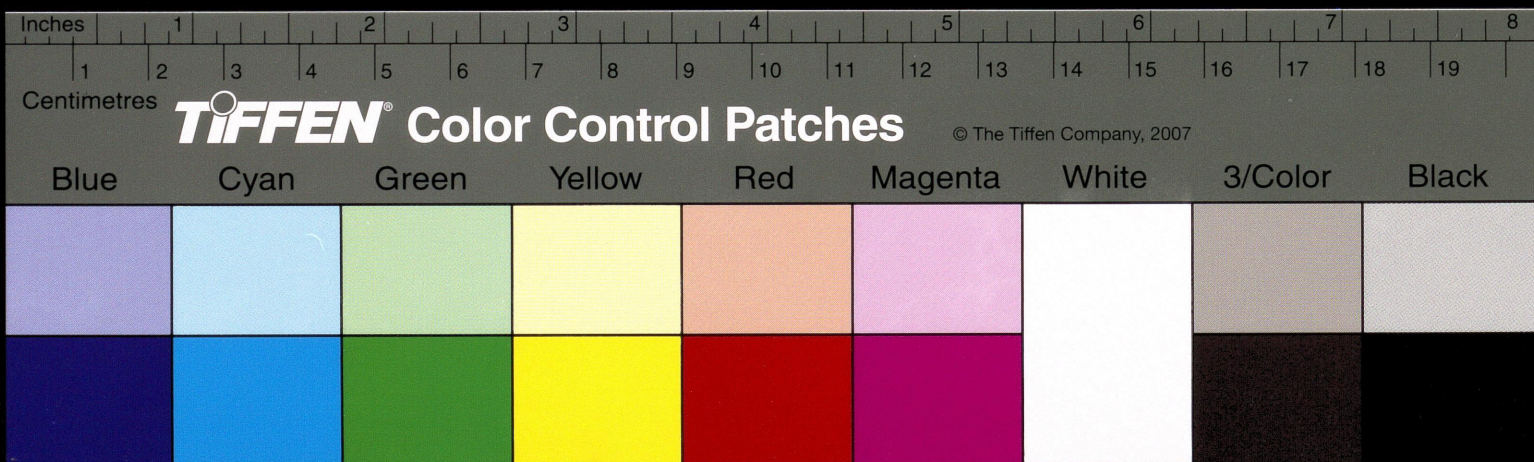
A Text-Book of Heat. By H. S. Allen, M.A., D.Sc., F.R.S., and R. S. Maxwell, M.A., B.Sc. Part II. (Macmillan & Co., Ltd.). Pp. 531-848. Price 10sh. 6d.

It is with intense pleasure that I have read the II Part of this beautiful book on Heat. It starts with the Laws of Thermodynamics and after dealing with convection and radiation, proceeds to treat of statistical methods and the quantum theory. The treatment of the First Law of Thermodynamics is lucid and adequate, and calls for no special remarks. Chapter XXIX begins to explain the Second Law—admittedly more difficult—and deals with the pioneer work of Sadi Carnot, whose argument was described by Joseph Larmor (1918) as "perhaps the most original in physical science, whether as regards simple abstract power

or in respect of grasp of essential practical principles". It is well stated that whilst the first law asserts the equivalence of heat and energy the second is concerned with the 'method' by which heat can be transformed into mechanical work, and the 'direction' in which natural processes occur (p. 603).

The law is given in its negative form, and since it is proverbially difficult to prove a negative, we have to be satisfied with the assurance that the law is in harmony with our general experience (p. 604). Later on, however (p. 628), Clausius is quoted, stating the law in its positive form in the famous words: "The entropy of the world tends to a maximum", which are equivalent to Lord Kelvin's dictum: "The available energy of the world is tending towards zero" (p. 631). Now, since the available energy in the universe has not yet reached zero, one is led to conclude that either the world must have had a beginning, or its energy must be infinite, or an outsider must have interfered with the cosmic processes. But if the world's available energy is infinite, it is somewhat difficult to understand how it can tend to zero. Therefore, excluding the third hypothesis, one would say that the world is not eternal. The authors seem to have been afraid of these metaphysical depths, and have tried to save themselves by subscribing to G. N. Lewis's assertion that increase of entropy "corresponds merely to a loss of information with regard to a state of a system and is thus a purely subjective concept" (p. 815). These are dangerous words, and one wonders what would remain of physical science, if they were followed to their last conclusions. Apparently less sweeping is R. A. Millikan's remark that from the second law we cannot deduce the 'heat-death' of the universe (and its corresponding beginning), for it is not legitimate to make a sweeping generalisation from man's experience on the surface of the earth to the universe in all its parts (p. 815). Hence one would say that there are parts of the universe where, what Oswald calls perpetual motion of the second kind is not impossible (cf. Planck's *Treatise on Thermodynamics*, transl. by Alex Ogg, 1927, Part III, pp. 79 and ff.).

The authors state very clearly Boltzmann's relation between entropy and probability, and explain that Boltzmann's constant is to be regarded 'universal', i.e., having the



species had to be printed to complete the information.

The descriptions of various species are very detailed, and, in most cases, are illustrated by drawings of all genera and, if possible, of typical species. In addition, two coloured plates at the end of the volume add to the value of the work. A very detailed bibliography of almost 100 pages, arranged under various orders, is included at the end of the publication.

This volume on the Sporozoa should further stimulate work on this very important group of Protozoa, and both the author and the editor are to be congratulated on a very valuable addition to this valuable series on the Fauna of India.

B. P.

Scoliodon (The Shark of the Indian Seas). By E. M. Thillayampalam. *The Indian Zoological Memoirs on Indian Animal Types*, II. Second Edition. (Lucknow Publishing House, Lucknow), December 1938. Pp. xiv + 126, 94 text-figs. Price Rs. 2-8.

Over 10 years ago, when this excellent Memoir was first published, it was rightly praised in scientific journals for the great deal of original work and wealth of general information contained in it. In the revised and enlarged edition, now published, Dr. Thillayampalam seems to have spared no pains to bring the work up-to-date by carefully pruning the existing material, by incorporating the results of latest investigations on Elasmobranchs, and by a rearrangement of the matter and its division into definite chapters. The thought and care thus devoted has rendered the treatment of this difficult subject much more lucid and comprehensive.

In the revised edition Professor Grace White's classification of Elasmobranchs replaces the older and more familiar classification of Garman, but fortunately the family position of *Scoliodon* remains unchanged. Of particular interest is the inclusion of a summary of the very valuable results of the investigations of Professor J. Gray on the locomotion of fishes. The nomenclature of blood-vessels has also been revised in the light of Dr. C. H. O'Donoghue's work. Additional information on such subjects as the physiology of blood-vascular system adds to the utility of the Memoir.

By limiting the bibliography to a few important references to publications within the easy reach of university students and by increasing the number of text-figures the usefulness of the Memoir has been greatly enhanced.

If any general criticisms are to be made, they are that the introductory chapter should have been entitled "Introduction and Classification", since this section deals mainly with the classification of fishes, particularly of Elasmobranchs, and with the distinguishing characters, and includes a key to the Indian species and history of the genus *Scoliodon*. In using 'Ventral median fin' instead of the popular term 'anal fin' some better argument should have been given than merely saying that "this name is not appropriate".

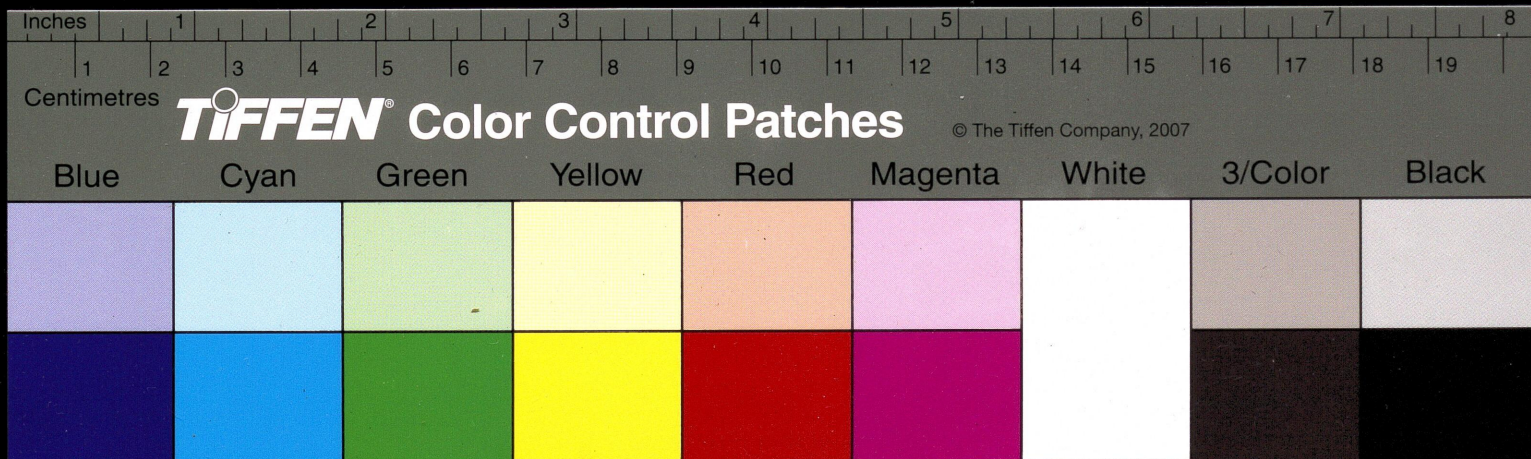
The revised and greatly improved edition of the Memoir on *Scoliodon* will not only be of use to Indian students in their laboratory work, but should also be invaluable to research workers all over the world interested in comparative studies of the various Elasmobranch types. The reviewer will be lacking in his duty if he failed to congratulate Dr. Thillayampalam and the Editor, Professor K. N. Bahl, for this excellent production in a series of extremely valuable memoirs.

S. L. HORA.

La Probabilite dans les differentes branches de la Science. By G. Castelnuovo. (Actualités Scientifiques et Industrielles No. 563. Hermann & Cie., Paris), 1937. Pp. 61. Price 12fr.

In this brochure Prof. Castelnuovo gives a general account of the meaning of probability and its applications to Statistics on one hand, and to Theoretical Physics on the other. In the first chapter the two kinds of probability—*a priori* and *a posteriori*—are introduced and explained. The Gaussian error law is discussed in the second chapter. The third and the fourth are devoted to the applications to statistics and theoretical physics respectively. The exposition is throughout in that clear and direct style so characteristic of Prof. Castelnuovo's writings and is enlivened by judicious and opportune historical references. The book may be heartily recommended to all who wish to obtain a bird's-eye-view of this increasingly important subject.

V. R. T.



Stellar Dynamics*

THE recent publication of the book with this title by Prof. Smart can well be considered as a landmark in the development of this very important branch of Astronomy. Books written on a rapidly growing subject can be placed generally in two classes, those of a pioneering character, and those of a consolidating nature. Two remarkable books of former type on the two important subjects of Astrophysics and Stellar Dynamics have been written by Eddington, and are well known to workers in Astronomy. These books written early in the history of the development of the subject were in no small measure responsible for its further rapid progress, and for this very reason have become rather out of date as *text-books*. This is specially true of Stellar Dynamics since Eddington's book *Stellar Movements* was written just a decade after the birth of the subject itself, and the last quarter of a century has brought great and important additions to our knowledge of the subject. In so far as Astrophysics is considered, the want of text-books of a consolidating type has been met by the books of Rosseland and Unsöld. For Stellar Dynamics, the gap is now admirably filled by the book under review.

One finds some nearly three hundred references, in the footnotes, to papers published in several journals by the foremost workers in the field. This vast amount of material is suitably condensed and in many cases improved upon so as to suit the logical presentation of the subject. The author has achieved striking success in presenting, for the first time, a systematic account of Stellar Dynamics, and there is no doubt that this book will be extremely helpful in encouraging further research in many directions.

The book could be roughly sub-divided into three parts, *viz.*, Stellar Kinematics, Stellar Statistics and Stellar Dynamics, with an introduction devoted to the essential preliminary notions of Astronomy. The book is complete by itself, and does not presuppose any preliminary knowledge on the part of

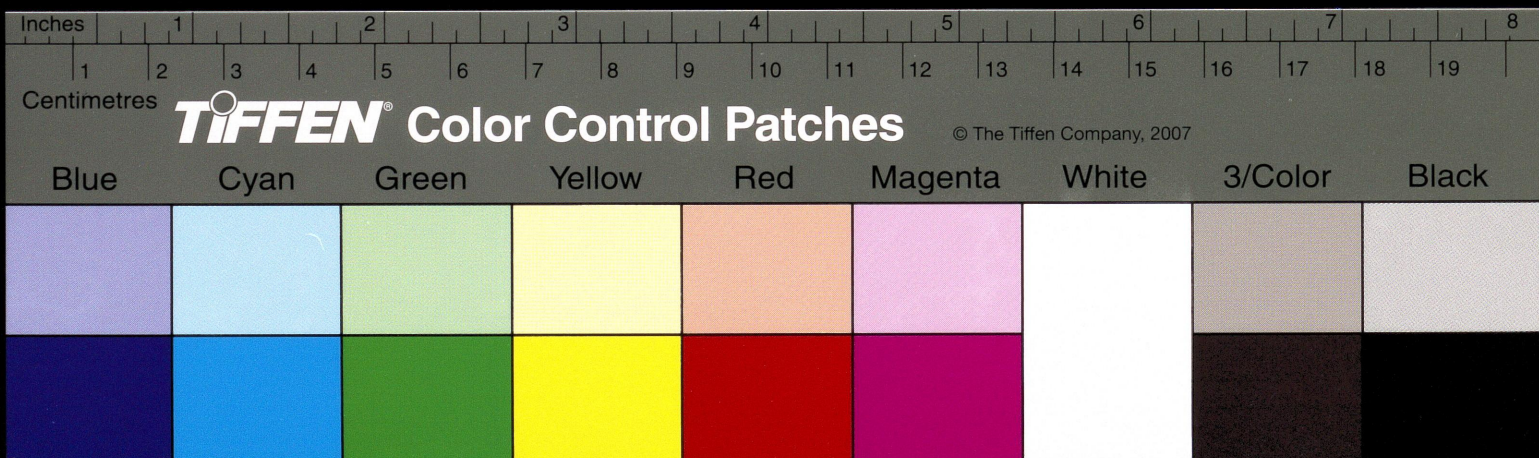
the reader except, perhaps, an acquaintance with a text-book on Astronomy like the excellent one by the author himself.

The Introduction, though short, is quite comprehensive, and contains all the necessary preliminaries. A general description of the galactic-system is followed by the explanations of the fundamental notions of modern Astronomy like spectral type, stellar magnitudes apparent and absolute, parallaxes, proper motions, radial velocities, masses, solar motion and galactic latitude, stellar evolution and the time-scale. It is quite appropriate, as an emphasis on the importance of the subject, that the author should include in the introduction itself a treatment of statistical notions like the correction of observed frequency curves, and mean values.

The next four chapters deal with the kinematical part, and exhaustive investigations are given of the theory of two star-streams, Schwarzschild's Ellipsoidal theory and the solar motion. The mathematical treatment is greatly simplified by prefacing the discussion with a chapter on a single star drift, and the work in this chapter on the mean stellar speeds, T , R , W , and the formula for the drift curve by a Fourier series greatly facilitate the presentation of the two-star stream theory. In discussing this last theory special attention is given to technical details relating to the analysis of observational material. Probably the chapter on the Ellipsoidal Theory is the most beautiful in the book, while that on the solar motion is the most complete. Particular mention might be made of the general treatment of proper motions on the Ellipsoidal Theory, and the illustration of the analysis from a particular region of the sky, as also the determination by Smart and Green of the solar apex, and solar motion.

The statistical part consists of two special investigations followed by a chapter on general theorems of stellar statistics. The particular characteristics of stars, *viz.*, statistical parallaxes, and the space distributions of stars are first discussed by making suitable assumptions regarding the law governing the distributions of these characteristics. The important work of the author on the treatment of the density law of space

* *Stellar Dynamics*, by W. M. Smart, M.A., D.Sc., Regius Professor of Astronomy in the University of Glasgow. (Cambridge University Press), 1938. Pp. 1-429. Price 30s.



distribution on the ellipsoidal hypothesis is presented here in full detail. General theorems on stellar statistics are brought together in the eighth chapter, which explains the important work in this field done by Schwarzschild, Kapetyn, Eddington, Van Rhign and others.

The fundamental work of Jeans and Eddington on Stellar Dynamics is dealt with in the tenth chapter. The fundamental principles of the subject, the fundamental equations in several systems of co-ordinates, the theorems of Jeans and Eddington, the cases of spherical and cylindrical symmetry, the hydro-dynamical equations, the recent work of Shiveshwarkar, and the deduction of the possibility of star-streaming are some of the topics in a chapter which is rich in theoretical investigations and suggestions for further work.

The culminating portion of the book is, of course, the topic of galactic rotation. This is treated from the observational standpoint in the eleventh chapter whereas the last chapter deals with the theoretical aspects of galactic dynamics. This last chapter is undoubtedly the most important, and contains all the recent work on the galactic system. The relation between galactic rotation and star-streaming, and the derivation of the ellipsoidal distribution of stellar

velocities are beautiful examples of the application of the general theorems of Stellar Dynamics to galactic rotation. The proof of the asymmetry of stellar motions by pure dynamical theory can well be considered as one of the triumphs of Stellar Dynamics. The limitations of the theory are also brought out in the investigation of the differential effects for radial velocities and proper motions, and the direction of star-streaming as consequences of the rotation of the galaxy about the galactic centre. The book concludes with an account of Oort's work on the density of dark matter in the neighbourhood of the Sun—a typical example of what modern Stellar Dynamics has been able to achieve.

A very useful appendix of astronomical constants is to be found at the end of the book, where it is very gratifying to find the Oort's constants A and B in company with aristocratic constants like the constant of gravitation, and the velocity of light!

Dr. Smart has written an extremely well-balanced book without omitting any relevant important work or without going off at peculiar radial speeds in particular directions. We might say with a zero "factor of exaggeration" that this book will at once become the standard work on the subject and remain so for a long time to come.

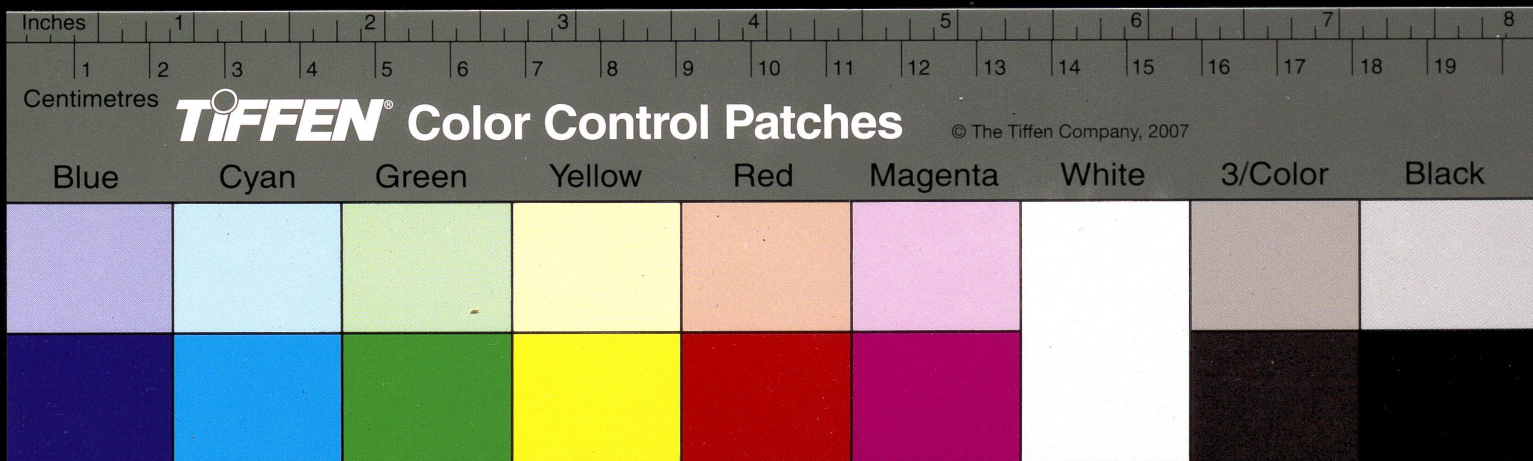
B. S. MADHAVA RAO.

Theosophy and Science Shake Hands*

IN the *Current Science* for August 1938, I had noticed the first volume of the series entitled "Where Theosophy and Science Meet" issued under the general editorship of D. D. Kanga, in which the ground, scientific and theosophical from "Macrocosm to Microcosm" had been surveyed, and the second volume under notice sketches, as it were, the progress from "Atom to Man". The volume opens with a contribution on "Matter and the Atom" by G. Monod-Herzen who points out that neither theosophy nor science "is yet complete", but both reveal the factor of progress, "an infinite succession of ignorances". The claim is advanced that "Theosophical observers revealed the existence of isotopes before the physicists

did so" (p. 26). The second article is contributed by D. D. Kanga in which an attempt is made to show "where and how far Theosophy and Chemistry meet" (p. 29). After explaining the "septenary system" on which the Universe, according to Theosophy, is based, the author examines what Chemistry has to say, summing up the epoch-making discoveries of modern science". 49 sub-planes constitute the physical universe and man. Of these, scientific activity and research are restricted to just *three*. "It is only there that Theosophy and Science can meet" (p. 56). Then follows an article on "Physics" (Light, Sound, etc.), by R. D. Kanga. The author points out or claims that the modern "physicists have unconsciously entered into the region of metaphysics" (p. 86). The next contribution on "Relativity" is by Shyama Charan, as also the succeeding one on "Modern Mathematical Thought" in which the strange

* *Where Theosophy and Science Meet*.—Part II. Edited by D. D. Kanga. (Published by the Adyar Theosophical Library), 1938. Pp. 169. Price Re. 1-14-0.



REVIEWS

Lectures on Quantum Mechanics, Vol. I.
By M. R. Siddiqi, Professor of Mathematics,
Osmania University. (Osmania University
Publications), 1938. Rs. 6 or 8s. 6d.
net.

This is the first Indian publication of a text-book on Quantum Mechanics, and can certainly take its place among the best of the elementary books written on the subject. The author intends to deal with the advanced portions in a second volume, and we hope that this will be published early so that the two volumes might go a long way in popularising the study of this most important subject in our Universities. We had had too much of Statics and Dynamics, Attractions and Potential, Spherical Astronomy, Theory of Elasticity, Celestial Mechanics, Classical Electricity and Magnetism and subjects of a similar nature in the curricula of special subjects for the Honours and Master's degree examinations of our Universities, and it is time that we taught something more modern in outlook, offering wider possibilities for investigation and research. The book under review written on a subject of this type by one who has made a thorough study of the subject, and is conversant with Indian standards will prove very useful for this purpose.

The book consists of eleven chapters of which the first four are of an introductory nature dealing with special relativity, classical mechanics and physical notions of atomic structure and reaction theory. The author has made a departure from the usual practice in presenting relativity theory before dealing with the general Hamiltonian theory of classical dynamics. This is certainly simpler since it makes it easier to introduce naturally the notions of the relativistic Lagrangian and Hamiltonian. In fact, the author has taken advantage of the notorious difficulty, not yet overcome, of the introduction of the methods of transformation theory into classical relativity. A welcome feature of the chapter on the structure of the atom is the mention of the discovery

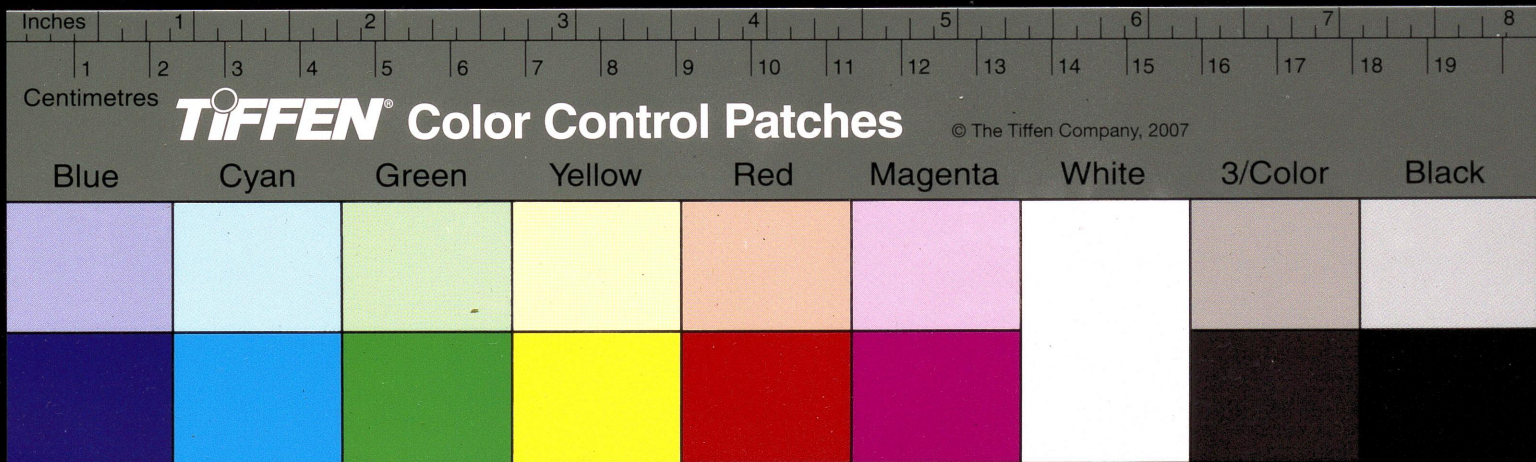
of the positron and neutron, and the great simplification introduced in nuclear physics by Heisenberg's conception of the structure of nuclei as made up of only protons and neutrons. The fifth chapter is devoted to Bohr's transitional theory, the sixth to Heisenberg's matrix mechanics, and the seventh and eighth to Schrödinger's wave mechanics. The perturbation theory which is most important in all applications of quantum mechanics is given in the ninth chapter from both the wave and matrix points of view. The tenth chapter is philosophical in outlook, and contains an excellent critique of the concepts of indeterminacy and causality. The last chapter contains Dirac's theory of the electron, and in view of the fact that there is really nothing inherently difficult in this theory, the author has wisely decided to include it in the first volume of the work.

We might notice some special features of the book. The development of matrix analysis, the explanation of the notions of eigen-values and eigen-functions, and the proof of the equivalence of the wave and matrix methods are all extremely well done. The essentials of the theory of the neutral helium atom are presented in a simple and lucid manner. The deduction of the uncertainty relation as a consequence of the quantum condition is presented at great length unlike many other elementary books.

The great difficulty in writing a book on quantum mechanics is the question of choice of material. The applications are so important and so numerous that in trying to present as many of these as possible, one has to sacrifice the logical development of the fundamental notions. Dr. Siddiqi has carefully kept this in mind when writing the book, and the result is an eminently readable, well reasoned out and nicely balanced text-book.

The printing and get-up are excellent, and the book is moderately priced.

B. S. MADHAVA RAO.



REVIEWS

Protective Coatings for Metals. By Burns, R. M., and Schuh, A. E. (Reinhold Publishing Corporation, New York; Chapman & Hall, Ltd., London), 1939. Pp. 407. Price \$6.50.

The art of coating of metals with a view to affording protection against corrosion as well as for ornamental purposes has been practised since antiquity. It is only in recent years that the mechanism of protective action has begun to be understood, as a result of which the number of available types of coatings, both organic and inorganic, has rapidly multiplied. In this book an attempt has been made to cover the whole field of protective coatings that are employed in the various branches of present-day industry. The field is so wide that each chapter of the book could well be expanded into a full-sized volume. The authors have, however, succeeded in condensing the material in such a way as to present a well-balanced account of the various aspects of the subject-matter, without sacrificing the essential details.

The book opens with a lucid and masterly summary of the mechanism of corrosion of metals, which serves as a guide to the general understanding of the subject-matter of the rest of the book. Then follow eleven chapters dealing with inorganic metallic coatings of various types, such as zinc, cadmium, tin, nickel, chromium, copper, lead, aluminum, brass, cobalt, tungsten, tantalum, noble metals, etc. Each of the types of coatings is discussed from different points of view—historical, technique of production, properties, field of application, limitations and defects, safeguards to be adopted against defects, etc. One of these chapters is devoted exclusively to the surface preparation processes applied prior to coating and another to the methods of testing serviceability of coatings.

Organic coatings of the paint and varnish type have been disposed of in three chapters, which deal with the composition of paints, varnishes, lacquers, etc., mechanism of film formation, testing and evaluation of protective films, painting practices, etc. Although this section of the book is somewhat brief, from the point of view of the importance

and extent of the subject-matter, yet it cannot be denied that the material dealt with has been presented in a lucid and useful manner.

The final chapter is devoted to a brief discussion of other miscellaneous types of protective coatings not covered by the earlier chapters; these include electrolytic oxide coatings on aluminum, slushing compounds, chemical dip coatings, vitreous enamels, etc.

Throughout the book, literally hundreds of references are cited to original literature, which immensely increases the value of the book for use of students, research workers, and technologists engaged in industry. Author and Subject Indexes are also included.

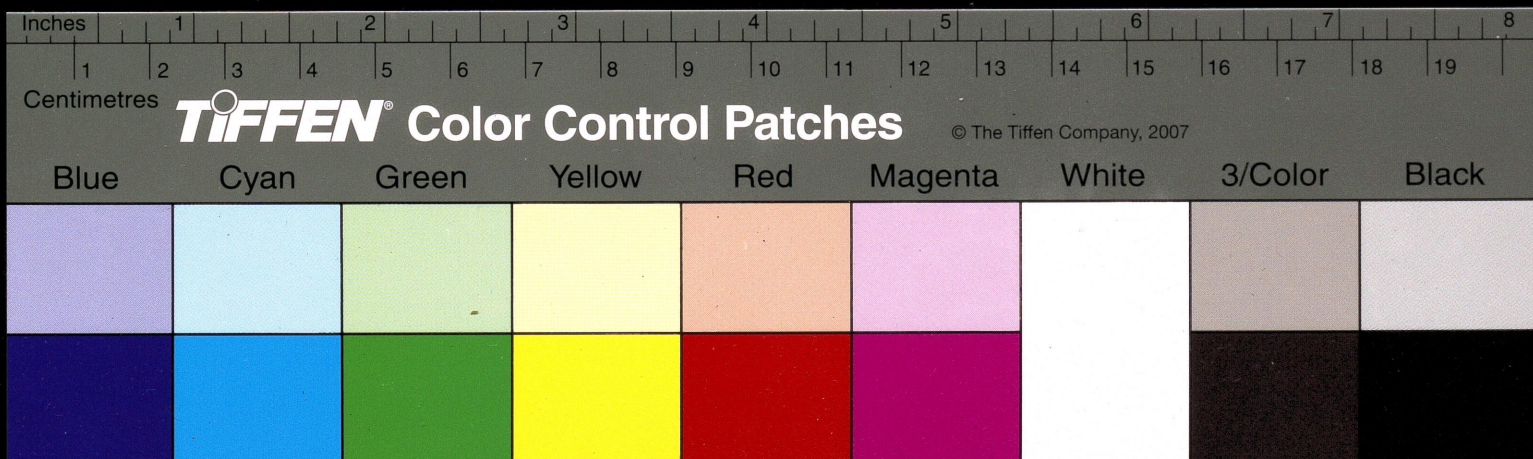
The book as a whole is well-planned, well-written and faultlessly produced with very few, if any, typographical errors. No technological or scientific library can afford to do without a copy of such an excellent book.

L. C. V.

Application de la Methode du Champ Self-Consistent aux Noyaux Atomiques. By M. Matricon. (*Actualités Scientifiques et Industrielles*, Hermann et Cie, Paris, No. 654), 1938. Pp. 1-83.

In the theory of the heavier nuclei which is not susceptible to rigorous treatment, the first approximation is the statistical method; but the results obtained by this method are more of a qualitative than of a quantitative significance. The next higher approximation is the Hartree method of the self-consistent field which is the topic systematically dealt with in this book.

After a short introduction to the principles of the method, the author establishes the general systems of equations for the determination of the individual wave functions, and the exact form of the energy expression. In addition to the self-consistent field arising on account of the Coulomb interactions, there is also a systematic consideration applied to an assembly formed by two sorts of distinct particles acted upon by exchange forces. The equations and the energy expression are obtained in a convenient form so as to bring out clearly the modifications they undergo when simplifying assumptions are made regarding the individual wave functions,



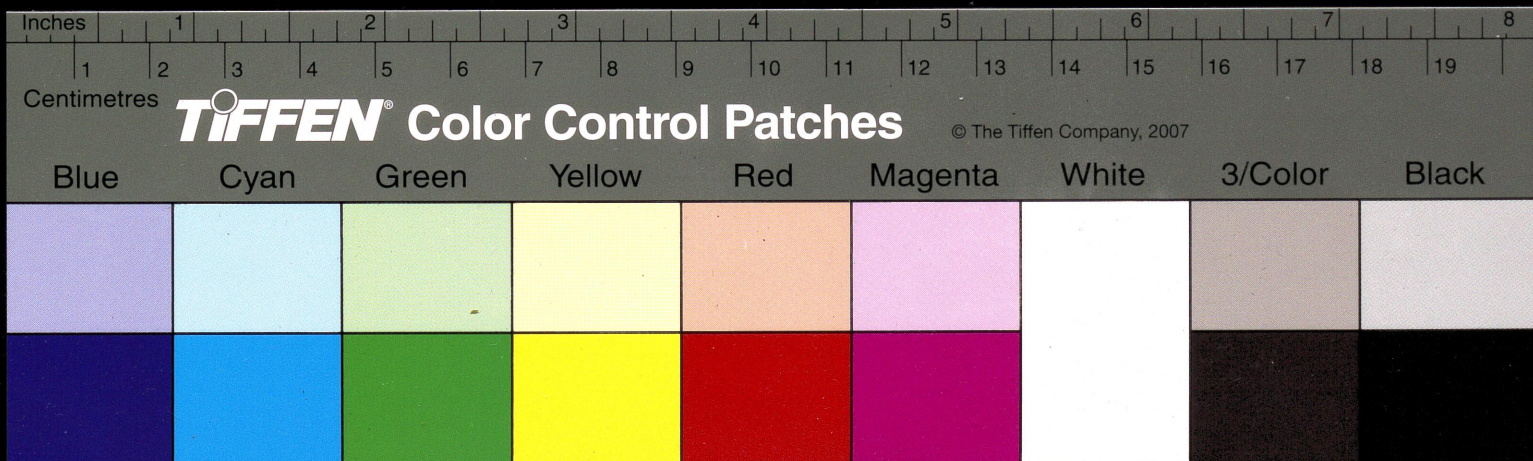
future in the Forest Research Institute. Further, in the note issued by Mr. L. Mason, President of the Forest Research Institute, to which reference was made in your last month's sub-editorial on "Ascu" wood preservative, it was stated that "No adverse reports have yet been received with regard to Ascu-treated timber used for general construction work or fence posts, nor any adverse reports came to hand regarding Ascu-treated electric transmission poles installed a few years ago in Mysore State". From a perusal of the appendices of the *Ascu Forest Record*, which has now been withdrawn, it would appear that the Forest Research Institute sent 3 ft. long fence posts to all electrical inspectors in India for testing in order to judge the efficacy of Ascu for the treatment of electrical poles. If no adverse reports have been received on fence posts treated with Ascu after 7 years experience with Ascu, and all that the Forest Research Institute has found is that poles with very shallow penetration and insufficient amount of Ascu have failed, it is not at all clear why the Forest Research Institute has taken the very drastic and unprecedented step of withdrawing what is avowedly an interim report. Without stating a single fact in the note issued by the Forest Research Institute relating to failure of any properly Ascu-treated timber pole or fence post, the action taken and the recommendation made by the Forest Research Institute is most bewildering. Any industrial or chemical process if faultily applied cannot give satisfactory results and Ascu process is no exception. To say that "new factors have been brought to light" by the failure within a year and a half or two years of poles which have been faultily treated is very unconvincing because if there is no Ascu penetration, no new factors of a mysterious character which could not be foreseen during the first 5½ years of the existence of Ascu can be brought into relief. The most obvious reason for the failure of these poles is because they received only superficial treatment with Ascu. It is strange why no reference has been made by the Forest Research Institute to the excellent condition of Ascu-treated poles

treated under low pressure. The note, as drafted, is most misleading.

In a report on Ascu-treated wood for engineering construction printed and published by the Government of the United Provinces, it has been stated that "The Forest Research Institute, Dehra Dun, feels, therefore, justified in recommending Ascu to all Provincial Governments and non-official inquirers and has stated that Ascu appears to be, so far, the most efficient and economical wood preservative known". I feel, very serious issues of considerable public and scientific interest have arisen as a result of the publication of a note casting grave doubts on the efficacy of Ascu by the Forest Research Institute in which they announce the withdrawal for the first time in the history of the Institute, a research publication. The situation created by the action of the Forest Research Institute becomes all the more bewildering, as for the very purpose for which Ascu has been condemned for general use by the Forest Research Institute after Ascu had been in existence for 7 years, the largest pole using concern in the world, the American Telephone & Telegraph Co. of U.S.A. (which purchases annually 9 lakhs of treated wooden poles and which has the world-famous research organisation, Bell Telephone Laboratories, functioning under it) has recently purchased the patent rights for Ascu in the U.S.A. and Canada for a lakh of rupees for treating only electrical poles. As far as India is concerned, pole users are now in a dilemma as creosote has been already condemned to be unreliable and there is no wood preservative that the Forest Research Institute is prepared to recommend for general use. Imported steel poles are the only alternative. The unprecedented withdrawal of the *Ascu Forest Record* and the Institute's going back on their recommendation of Ascu based on failure of palpably improperly treated poles cannot enhance the confidence of the public in the Institute.

S. K. PILLAI,

Office of the Director of Development,
Trivandrum,
February 14, 1940,



REVIEWS

Uses and Applications of Chemicals and Related Compounds. *A guide to the current industrial uses, potential applications and sales possibilities of 5,167 products.* Compiled and edited by T. C. Gregory. (Chapman & Hall, Ltd., London; Reinhold Publishing Corporation, New York), 1939. Pp. 665. Price \$10.00.

A bewildering variety of chemical products, both synthetic and natural, are now produced in commercial quantities and employed in various arts and industries. The immense and rapid developments in the latter, through extensive fundamental and applied researches, have involved quite frequently the use of even common chemicals in new and unexpected directions. Sales executives, research directors, manufacturers, dealers and others, are naturally interested in these present-day uses of the several chemical products, each from their respective points of view, rendered readily accessible, but which they could hitherto find scattered in the published literature, not always easily available. To meet this demand, since 1922, there have been appearing in the pages of *Oil, Paint and Drug Reporter* a series of surveys covering the uses, potential applications and sales possibilities of chemicals and related products. In the present book is made available all this subject-matter after proper rearrangement, amplification and editing. The choice of items has been mainly based on their commercial importance, and they are arranged in alphabetical order according to their common names rather than according to their strict chemical names. However, the various synonyms and foreign names are given for each item. The applications are classified into appropriate subheadings, e.g., for antimony pentoxide, the uses are grouped under ceramics, chemical, glass, metallurgical, paints and varnish, pharmaceutical, rubber and textile dyeing and printing.

The book is undoubtedly a compendium of useful information. M. A. G. RAU.

Astronomy. By R. H. Baker. (Macmillan & Co., Ltd., London), 1938. Third Edition. Pp. 517. Price 16/- net.

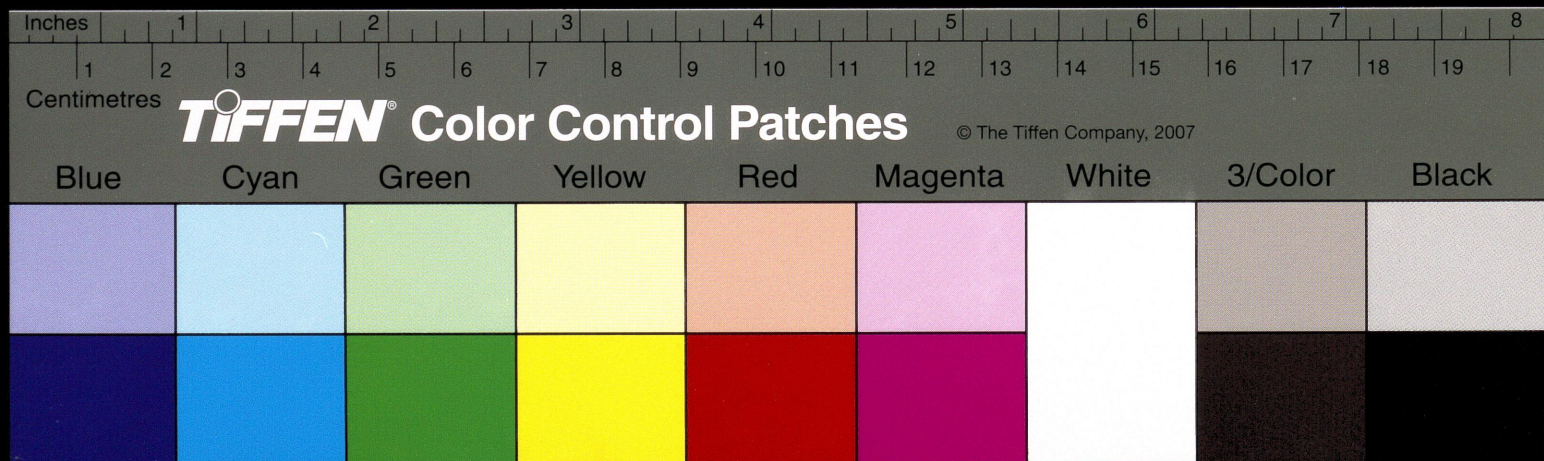
The volume before us is the second printing of the third edition of the

well-known book on Astronomy by Prof. Baker, of Illinois University. It is easily the most comprehensive elementary text-book on Astronomy designed for use by college students, and would serve as an admirable introduction to more advanced treatises on the subject. Nearly half the book is devoted to the solar system, and the other half to stellar astronomy. The book has been brought absolutely up to date inasmuch as all recent advances on Astronomy which are capable of being presented in an elementary treatment have been incorporated. As examples we might mention the binary hypothesis of the origin of the solar system (p. 261), Baade's summary of supernovæ (p. 488), rotations of the stars (p. 386), reflection nebulae (p. 448) and the problem of interstellar absorption (p. 465), clusters of external systems (p. 497). One will also notice rearrangement in the matter in several chapters, specially in the account of the galactic system. In discussing the source of stellar energy the author mentions the theory of Atkinson that the source is to be found in atom-building in the interior of stars, and the statement that this theory represents the prevailing view seems to be almost prophetic in view of Bethe's recent confirmation of these ideas.

If one is to find any fault with the book at all, it must be its very comprehensive nature which makes it rather unwieldy for use as a text-book by students. As a consequence of the size of the book, one finds, in a number of places, that explanations are not as full as might be desired, and many statements appear somewhat dogmatic.

As a book of reference, however, the book is most admirable, and is a veritable mine of information. For workers in other fields who want to get acquainted with the recent developments of Astronomy without wading through the technical journals one can hardly find a more suitable book. The only other book in the English language to which this work may have to give pride of place is perhaps the famous Russel-Dugan-Stewart, and that is sufficiently high praise.

B. S. MADHAVA RAO,



REVIEWS

Concise General Astronomy. By O. R. Walkey and H. Subramania Aiyar. (Sri-dhara Printing House, Trivandrum), 1940. Pp. 442. Price Rs. 5-8-0.

Popular works on Astronomy published in India are very rare. Probably there is none. If so the present work is a pioneer in the field, and is to be warmly welcomed on that account. Its special feature, and in our opinion, its most valuable feature is the very interesting information it contains about Hindu Astronomy, and the incorporation of this information in a general scheme gives one a proper perspective regarding the achievements of Hindu Astronomy. The first three appendices make, from this point of view, fascinating reading indeed.

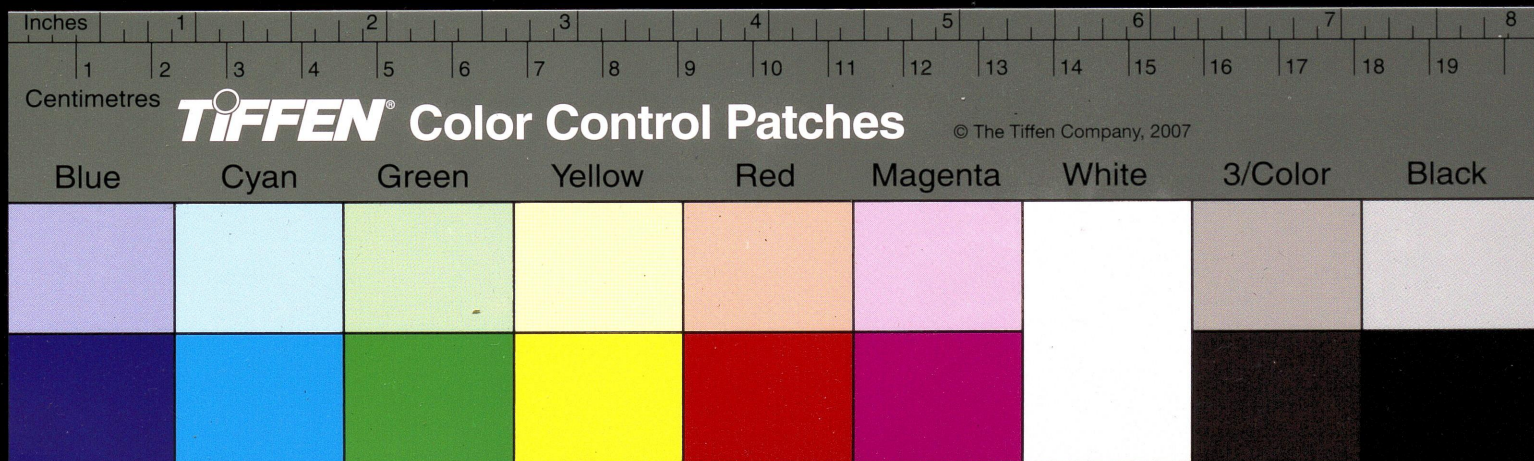
The other appendices contain information on such diverse topics as Arabian, Chinese and Egyptian lunar mansions, sundial design and map-projections, all subjects of a practical interest. The several tables brought together in one place from a large number of sources and arranged in a definite order are bound to be of great value even to those who are not merely "laymen". It would have been better if the source of information had been indicated in each table, for in this rapidly growing subject new data supplant the old ones with astonishing quickness. One is, however, constrained to say that the star maps on pages 414 and 415 are very bad, indeed the second map definitely disfigures the page.

The book proper consists of twenty-seven chapters, three of an introductory and historical nature, nine devoted to the solar system and the remaining fifteen to the study of stellar systems. Four out of these fifteen chapters give descriptions of the several constellations, and will be found to be of great use to amateur sky-gazers. The authors have taken pains to be up-to-date in the information on the several topics dealt with in the book. As examples in point we might mention the Lyot device for solar coronal observations, the number of satellites of Jupiter, the elements of Pluto's orbit, the mention of supernovæ, galactic rotation, the local cluster, Trumpler's stars, the physical constitution of planetary atmospheres and several other data regarding galactic and extra-galactic

nebulae and star clusters. The book is an accurate and reliable guide to the lay reader in understanding the great developments in Astronomy that have taken place in recent years on the observational side. The numerous facts and figures are arranged clearly and succinctly, and presented in a racy and vigorous style, highly reminiscent of a popular evening lecture.

This idea of the popular appeal has throughout been kept in the forefront in the book, but, we are afraid, it is a little overdone. One such instance is the rather too frequent reference to the Creator whose aid is invoked even on occasions when it is not quite imperative. Thus, for example, the authors remark on p. 205 that the source of stellar energy cannot be accounted for on any known laws, and one has only to acknowledge the direct interposition of the Creator. In view of the recent work of Bethe and Gamow on the nuclear theory of stellar energy, it is difficult to justify such a stand. Even from a general point of view, such an attitude spells an air of superficiality about it and appears out of place in a book which is entitled as a *Concise General Astronomy*, and which is scientifically accurate in the details of the subject it gives.

Nor are the references to the theory of relativity quite happy. It is unfortunate that the book should contain a sort of a contemptuous reference to the "mathematician's square-root-of-a-negative quantity and purely imaginary concept of some fourth or other inside-out dimensional existence", for this gives an entirely erroneous impression that the concept of time in relativity is purely imaginary. The reference to "a mathematical explanation of the sudden disappearances of angelic beings after delivering their messages" (p. 51) is unworthy of a place in a scientific book on general astronomy. Also the relativistic explanation in §295 of the meeting of two bodies as meaning the agreement in their space and time co-ordinates is definitely wrong since it contradicts the relativity of simultaneity as can be shown by considering the Lorentz transformation. We consider it an error of discrimination on the part of the authors to mention (p. 280) Sulaiman's



of its presenting an accurate, up-to-date, systematic, lucid and admirable survey of catalysts and their uses in the laboratory and the factory.

R. S. THAKUR.

The Chemistry of Synthetic Surface Coatings. By Wm. Krumbhaar. (Reinhold Publishing Corpn., New York; Chapman and Hall, Ltd., London), 1937. Pp. 200. Price. \$ 4.00.

Upto comparatively recent times, the art of paint and varnish-making was entirely in the hands of skilled craftsmen some of whom had been considered masters in their fields. Even to-day, some operations such as gum-running are considered to require a highly specialised type of experience and skill. Lately, however, scientists have diverted their attention to the multifarious problems in this field, which stand in need of elucidation. A good measure of success has been attained in this direction and as a result the scope and possibilities of the paint and varnish application have been considerably extended. Dr. Krumbhaar, who has wide experience in this field in more than one continent, has presented in this brief book a short summary of the up-to-date knowledge on the subject.

The complicated reactions taking place in the varnish kettle, the catalytic action of driers, the physico-chemical surface reactions taking place at the pigment-medium boundary, the significance and control of physical properties of the protective coatings have all been dealt with systematically in separate chapters. A final chapter on printing inks is of particular interest inasmuch as printing inks have so much in common with paints and yet the performance demanded of them imposes conditions quite different from the latter. The Appendix deals with examples of specific formulæ for paints and varnishes based on synthetic resins. In view of the fact that we in India are interested more in the utilisation of natural products, the specific reference to synthetic resins may not prove to be technically useful to those interested in paint trade in this country. The main value of the book, however, lies in the fact that the subject-matter has been dealt with in a fundamental and scientific manner. It is, therefore, equally valuable for technologists interested in natural or

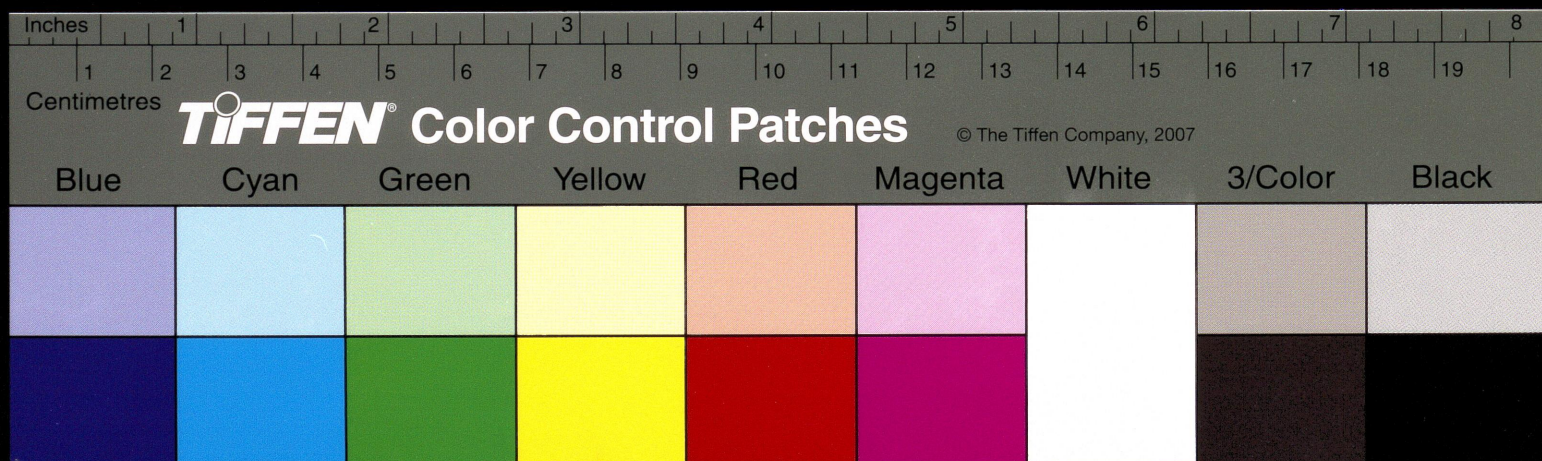
synthetic products and to scientists interested in the application of fundamental knowledge to industry. Scattered throughout the book one finds a number of suggestions regarding problems which await solution. But unfortunately no references to current literature have been cited, which would have been of great assistance to the student and the research worker. The relatively concise treatment of the subject would permit a great deal of expansion and we hope that Dr. Krumbhaar would be able to undertake the task in the near future.

L. C. V.

Clowes and Coleman's Quantitative Chemical Analysis. Edited and revised by D. Stockdale and J. Dexter. (Published by J. & A. Churchill, Ltd., London), 1938. Fourteenth Edition. Pp. 616; 130 illustrations. Price 18 s.

Clowes and Coleman's *Quantitative Chemical Analysis* has been one of the standard text-books in analytical chemistry, and its fourteenth edition has been published after an interval of nearly seven years. The original book has been considerably improved by the revisers D. Stockdale and J. Dexter. The type has been reset and a considerable part of the text has been rewritten, the general arrangement of the volume remaining unchanged. Omissions from the last edition have been few. "The additions include accounts of the estimation gravimetrically and volumetrically of aluminium and magnesium by 8-hydroxyquinoline, the colorimetric estimation of aluminium by 'aluminon', the use of the chromate radical in the estimation of barium, lead and sulphates, ferrous phenanthroline as an internal oxidation-reduction indicator, a brief introduction to the use of ceric sulphate, and the analysis of cupronickel by salicylaldehyde". The section on the analysis of non-ferrous alloys and that on the valuation of manures has been revised and extended. Each section is given a theoretical introduction.

A brief account of the use of the common indicators is given. The use of adsorption indicators like Fluorescein, Tetrazine, Eosin, Rose Bengale, Di-iodofluorescein and Pheno-safranin has been referred to. The use of chloramine-T in quantitative analysis has been described. The chapter on the electrometric and electrolytic estimations,



towards an explanation of this phenomenon by Newton's theory, he remarks that all such efforts have so far been quite unsatisfactory.

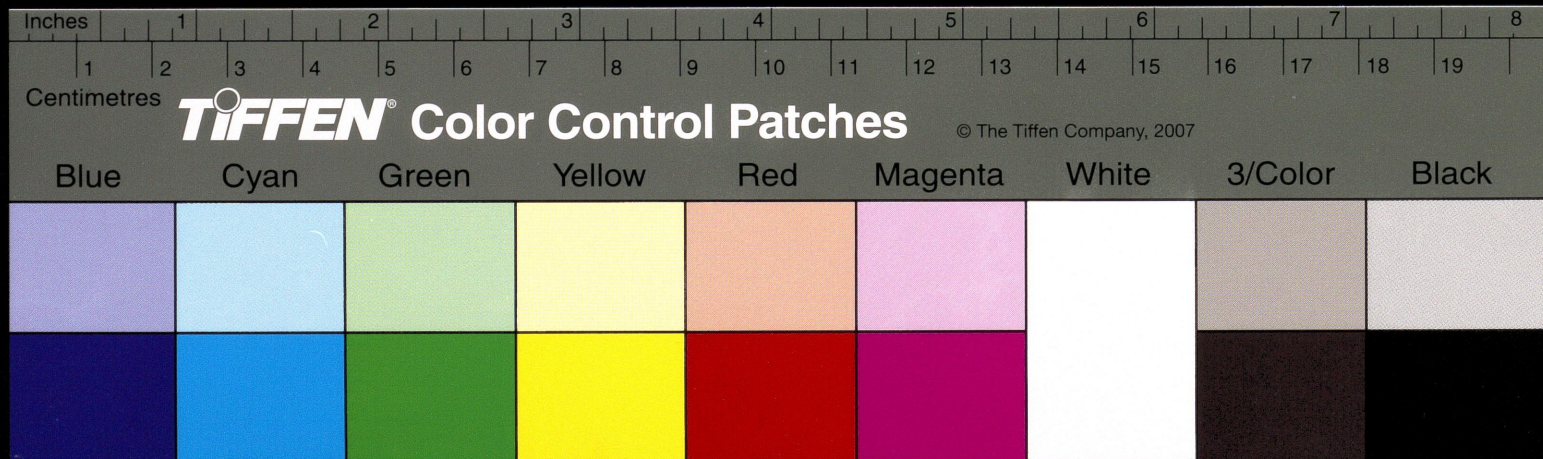
It is, however, the author's critical and philosophic evaluation of the theory that does not appear to us quite convincing. In the introduction to the very first volume of the series, we are told that the main idea is to examine the question whether the systems of co-ordinates in relativity are not privileged, and the conclusion that is drawn is that they are so, contrary to the very fundamental claims of the theory. This question has been examined in the third volume for the systems in special theory, and in the sixth for those of the general theory. The author's division of physical quantities into intrinsic and relative appears misleading, and the definition of mass as measuring the quantity of matter, on which this division is based, is certainly not the correct definition. Equally unconvincing is the division into localisable and non-localisable magnitudes, as well as the assertion that the privileged system used in special relativity is that with respect to which the observer is at rest. It is suggested that an observer measuring a rod in this system S by means of a metre-scale in S' which is in relative motion gets a "false" measure because the rod and the scale are not in the same time, and that all such diverse scale readings measure a single objective magnitude correct only in S . The explanation of the Michelson-Morley experiment by introducing this proper system is claimed to be simpler than the usual derivation, but a little scrutiny will show that it is a hotch-potch of classical and relativistic ideas.

The conclusions regarding the existence of privileged systems in the general theory are quite similar although not expounded at such great length as in the case of the special theory. It is pointed out that the Schwarzschild system of co-ordinates is a privileged system for the description of the observable universe, but it is difficult to see the point of the criticism when it is remembered that the whole of Schwarzschild's investigation is relativistically invariant. The introduction of an objective universe as would appear with its absolute elements to an omniscient physicist is entirely foreign to relativistic ideas, and it is no wonder that conclusions derived from

this absolute standpoint should contradict relativistic principles. It is therefore easy to understand the conclusion that, as far as generalised notions are considered, the general theory of relativity does not deserve the name given to it.

In the last volume which is a critical essay on the doctrine of relativity, the author brings his objections against relativity in a collected form and formulates his conclusions regarding the attitude to be adopted towards relativity. This theory is shown to be inspired by positivism to which he does not fully subscribe. The new definition of time, the postulate of relative motion, and of complete equivalence, the idea of geometry of the universe, and the explanation of phenomena by means of a field theory are mentioned as concepts which cannot be introduced *à priori*. The example is given of the classical movements of gravitation being presented by E. Cartan as spatio-temporal relations obeying a covariant law other objections are that the theory is not harmonised with quantum phenomena; the experimental verifications do not appear to be absolutely decisive; none of the objections in principle against the classical concepts is decisive; even if the relativistic theory is true its philosophic and critical basis is fragile and in principle the complexity of physical phenomena cannot well be explained by simple rigorous theories as is claimed by relativity. To explain the equality of dynamical and inertial mass, the author suggests a curious explanation, which he calls as anthropomorphic but nevertheless legitimate, as follows:

"L'Ordonnateur du Monde voulant, après avoir établi des masses de diverse grandeurs, les soumettre à des forces, et décidant, *parceque c'est le plus simple*, que, quelles que soient les forces appliquées, les accélérations subies seraient toujours inversement proportionnelles aux grandeurs mêmes des masses, sans aucun autre coefficient pouvant varier d'un cas à un autre." One might well ask why, if the simplicity be the sole criterion, the "Ordonnateur du Monde" should have made physical laws so complex as not to be capable of being explained by simple theories—as the author himself asserts. The final conclusions are that for the present it would be as unwise to declare the relativity theory true and definitive as it is to declare it



Address spoke upon the benefits as well as the evils of the present system of higher education. He said that Government should take immediate steps to introduce free and compulsory education throughout India. Technical and industrial education should be based on a minimum of sound general education. "Unrestricted admission to the army and the navy, Government assistance to indigenous industries and a close association between the universities, the industrialists and the educational authorities," are all necessary for a satisfactory settlement of the problem of unemployment.

The following are some of the important resolutions passed at the Conference.—(1) Secondary School Education should be divided into well-defined stages complete in themselves and should have arrangements for diversified courses, which will equip the pupil, along with a cultural education, with the necessary qualification to meet the requirements of modern industry and commerce. (2) The Conference disapproves of the proposals of the Central Board of Education to have separate secondary school and special examinations for recruitment to the various subordinate services. (3) In order to get expert advice for diversified courses in secondary

education, the Conference recommends that selected Indians closely connected with Educational work and possessing high educational qualifications be sent abroad for additional training, if necessary. (4) In view of the great urgency and importance of adult education in India and the necessity for co-ordinating the activities of the different Provinces and States in this direction, it is resolved that an All-India Adult Education League be formed under the auspices of the All-India Federation of Educational Associations with headquarters at Calcutta or any other convenient place.

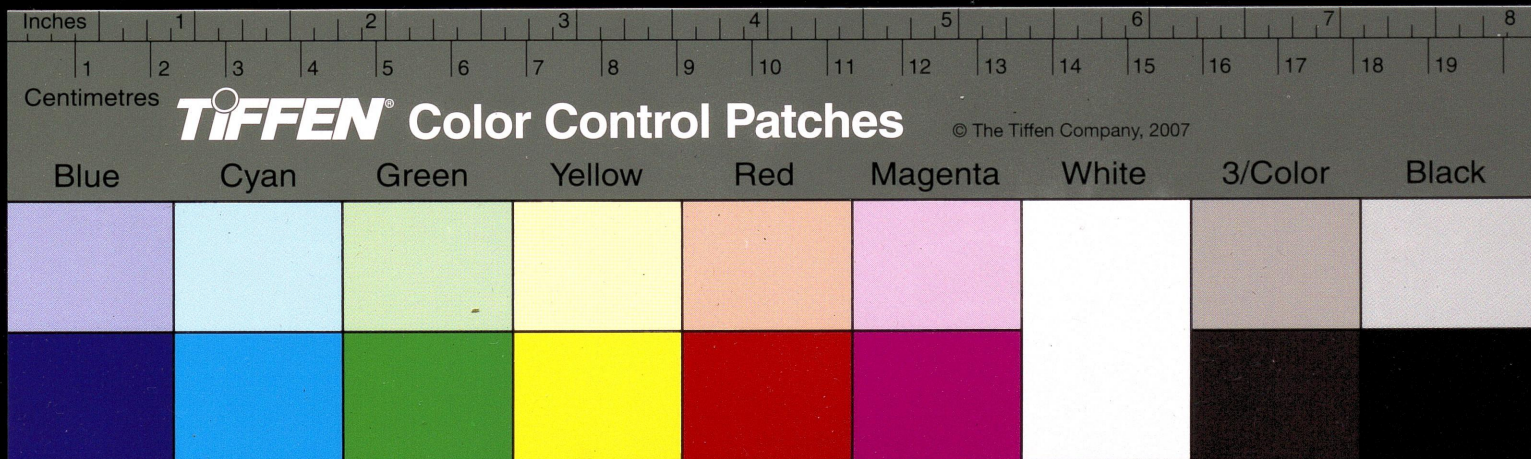
The Conference, further, appealed to the Government for the immediate establishment of an Institute of Education and Psychological Research on an All-India basis. A committee was appointed to investigate the possibility of adopting a common language and script for the country. Another resolution was adopted regarding the celebration of Education Week throughout the country to give the public an idea of the work and the needs of educational institutions. Another important resolution of the Conference favoured the idea that handicrafts should form an integral part of all education—primary and secondary stages.

Post-Graduate Work in the Indian Universities.

THE Inter-University Board has published a pamphlet containing information regarding the Doctorate Theses in Science and Arts accepted by the Indian Universities from January 1930. The brochure is drawn up with the specific object of providing guidance to post-graduate research students, and it contains reference to investigations in Science and Arts pursued in the Universities. Dealing with the three oldest Universities, we find that during the years 1930-35, Calcutta conferred the Doctorate Degree on 48 candidates from whom the University received 120 theses, while Madras during the same period awarded similar degrees to 10 candidates submitting 10 theses, and Bombay offered to one. Some of the comparatively younger Universities like those of Dacca and the Punjab have conferred degrees on 12 and 13 candidates respectively. Nearly 7 Universities in India do not offer doctorate degrees. Candidates from these Universities will have to migrate to other centres if they wish to obtain doctorate degrees, and when they have to do so, the book gives them no information regarding the colleges where facilities for special types of research work exist. The Indian Universities have not adopted a uniform denomination in respect of the doctorate degrees, for example the Ph.D. degree of the Aligarh University is a science degree, while that in the Universities

of Calcutta, Dacca, Madras, Lucknow, represents an Arts degree for which Allahabad and Benares have adopted D.Litt. Practically all the theses accepted by the Universities for the doctorate degree are published either in foreign and Indian scientific Journals or in the University magazines, and they will always be available for the 'Scientific World' and for reference by students in the libraries of the Universities which are equipped for post-graduate research work leading to the doctorate degree. However, all research scholars will appreciate the labours of the Inter-University Board in producing this pamphlet which is a sort of made-easy of reference work. We think that diligence in finding out reference to literature on problems under investigation is an index of the students' aptitude for research, and frequently a hunt for special information through heavy volumes results in the discovery of fresh problems and in stimulating new ideas. Does the pamphlet favour this?

In the pamphlet we could discover more than seventy titles of theses without any information as to their destiny. We are not referring to those which are specifically mentioned as not published. "The Scientific World" would wish for more detailed information regarding these important researches than is provided in the pamphlet.



Reviews.

Relativity. By F. W. Lanchester, LL.D., F.R.S. (Constable & Co., Ltd., London, 1935.) Price 12s.

This contribution to relativity from a man who learnt it from Minkowski and Runge deserves serious notice. Lanchester is famous for his power of physical insight which is so conspicuous in his fundamental researches in Aerodynamics. An equally characteristic trait of his work is the lack of mathematical developments. As Prandtl* once remarked, this absence of mathematics does not make his writings easy reading but on the contrary "Lanchester's treatment is difficult to follow, since it makes a very great demand on the reader's intuitive perceptions". These characteristics of the author's work are to be abundantly found in the book under review. It is described as "an elementary explanation of the space-time relations as established by Minkowski, and a discussion of gravitational theory based thereon" and is addressed "to the young student who has yet far to go in his mathematical training". The description can be taken to be true as far as Part I of the book is concerned. Here the underlying principles of the special theory of relativity have been made clear by geometrical methods, almost "*visibly*," as the author puts it, by the aid of diagrams. In fact, the treatment is so simple and beautiful that an enthusiastic reviewer of this book has somewhere remarked, if our memory is right, that the arguments could be grasped even by a sixth form student! Such a sixth form student would indeed be a marvel!

Part II, on the other hand, makes a little difficult reading not because of any mathematical formalism, not even because of the complexity of the physical concepts, but on account of the lack of fulness in the treatment of the several topics dealt with and the failure to take arguments to definite conclusions. Perhaps, the value of the work lies in this very weakness. The author has thrown out brilliant and original suggestions for others to pick up and knowing the history of Lanchester's previous work in Aerodynamics, it would be certainly extremely rash to dismiss the author's

*Prandtl, L., "Wilbur Wright Memorial Lecture," 1927, *Journal of the Royal Aeronautical Society*, August 1927, 31, No. 200.

suggestions as idle speculation without bringing them to a finality by applying mathematical methods. Among the numerous suggestions throughout the book we might choose, as an illustration, the topic of rotation in space-time in Chapter X. The remark that the spin of the electron is to be associated with a *rotation about a time-axis* is highly suggestive and gains extra significance if taken in conjunction with Kramers' recent derivation of electron spin from purely classical relativistic considerations.

A very suggestive and original book on relativity. Finally no reviewer can be said to have done his job properly if he does not pick holes and so here it is: on p. 62, first sentence, it is wrongly stated that $\sqrt{-1}$ is an *irrational* quantity!

B. S. MADHAVA RAO.

The Work of the Sanitary Engineer. By Arthur J. Martin, Major, R.A.M.C., T.F. (Retired), M.Inst.C.E., F.R.San.I. Demy 8 vo. (Macdonald and Evans, 1935). Pp. 488. 81 illustrations. Price 16s. net.

Any one who has had experience of writing a book on a technical subject, and is therefore aware of the toilsome effort required to marshal and verify references and condense the necessary information, cannot but admire the industry and ability which Mr. Martin has brought to the completion of his task. Mr. Martin's book is moreover no mere compilation from existing publications. It is continually brightened by short illustrations from his own exceptionally varied experience as a Consulting Engineer in many parts of the world, and the criticisms which he permits himself on matters on which opinions may differ are always helpful and based for the most part on first-hand knowledge.

The book is divided into six parts:— I. Sanitary Administration. II. Water Supply. III. Drainage and Sewerage. IV. Sewage Disposal. V. Collection and Disposal of Refuse. VI. Flood Prevention, Land Drainage and Coast Protection.

Part I on Sanitary Administration contains much carefully compiled information of value to the young engineer especially, on such matters as the different bodies concerned with Local Government and Expenditure, Engineering Societies and

