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*Indian Food-stuffs*. SALIMUZZAMAN SIDDIQUI AND RAFAT HUSSAIN SIDDIQUI: *The Alkaloids of Rauwolfia Serpentina, Sect. Part II. Studies in the Ajmaline Series*. H. M. MAPARA: *A Note on the Influence of Acidity of Agar on the Liesegang Rings of Lead Chromate and Lead Iodide*. PRIYADARANJAN RAY AND ANIL KUMAR MAZUMDAR: *Hydrazinates of Metallic Thiosulphates*. J. C. GHOSH AND SUKUMAR SEN: *On the Synthesis of Higher Paraffins from Water Gas. The Use of Promoters for Activating Iron-copper Catalyst*. S. M. ABDULLAH: *Addition of Compounds containing Reactive Methylene Group with Phenylglyketone*.

## Reviews.

HANDBUCH DER RADIOLOGIE. Herausgegeben von Prof. Dr. Eric Marx. Band 6: Quanten-mechanik der Materie und Strahlung. Zweite Auflage der "Theorien der Radiologie." Teil 1: Atome und Elektronen. Pp. 466. Price 43-R.M. (Leipzig: Akademische Verlagsgesellschaft. m.b.H., 1934.)

The first part of this volume is devoted to the quantum mechanics of electrons and atoms and is divided into four chapters dealing respectively with the general theory, excitation and ionisation, electron theory of metals and nuclear physics. The third chapter is the shortest in the book covering about 50 pages and the last chapter is the largest with about 200 pages. While the scope of this Handbook is naturally more limited than the well-known *Handbuch der Physik* of Geiger and Scheel, it possesses all the advantages that a condensed account can give.

*Chapter I*:—This chapter contains all the essentials, from the point of view of a Physicist, of the theoretical portion of quantum mechanics. The knowledge of mathematics assumed on the part of the reader is not very great, such topics like the theory of groups, Hilbert space and matrices not being treated in any detail. A striking omission is an account of quantum statistics which is of the highest importance in special branches, specially the electron theory of metals. This chapter contains an article on mathematical preliminaries which is as devoted entirely to eigenfunctions and is as sweet as it is short. A very welcome feature of this article is the inclusion of Perron's theorem on the nodal points (lines or surfaces) of a wave function. The best part of the chapter is § 8 which gives a masterly ex-

position of Dirac's theory of the electron in the short space of twelve pages.

*Chapter II*:—This chapter contains a very full account of the experimental results relating to excitation and ionisation. To realise the vast amount of experimental work done in this branch one need only compare this chapter with the well-known book of Franck and Jordan on the excitation of quantum jumps by collision. One would however have wished to see in this chapter a little of the theory of the subject developed succinctly, at least the theory of collisions. Also the account given of thermal effects is rather inadequate. On pp. 223 and 225 the name of Saha is curiously written as "Megh nad Saha". The word "neutron" appears on p. 194, but a perusal of the article in question shows that the authors are using it in the sense of the neutral H-atom. It must however be pointed out that such a comprehensive treatment of the subject collected in one place is perhaps difficult to find elsewhere and this is specially true of photo-ionisation in the Röntgen region and excitation and ionisation of atoms in solid bodies.

*Chapter III*:—The theoretical aspect of the electron theory of metals can be formulated, thanks to the Fermi-Dirac statistics, in such a logical way that it is possible to present a connected account of the subject in a short compass. The distinguished author of this chapter, who is a recognised authority in the field, has made use of this fact in presenting what is easily one of the most readable accounts of the subject. After preliminary theoretical considerations, the Fermi-Dirac statistics is explained and direct applications are made to the passage of electrons through metallic surfaces, optical and X-rays properties of metals and to

conductors, semi-conductors and insulators. The theory of conductivity has one complete section devoted to it wherein all the related phenomena are briefly discussed. The complete omission of supra-conductivity in this chapter can certainly be justified on logical grounds since the extant electron theory of metals does not apply to the interaction of conduction electrons; but at least a mention of the theoretical difficulties and experimental results would have been very welcome indeed. The author departs from the usual practice in calling the Fermi-Dirac statistics merely Fermi-Statistics.

*Chapter IV* :—No branch of physics, not excluding theoretical quantum mechanics, has made and is making such rapid progress as nuclear physics. Experimental results follow one another with lightning rapidity; it thus happens that this chapter written in 1932 has no mention of the positron or the hydrogen isotope. A logical treatment of the subject is also out of question since even Dirac's relativistic theory of the electron is not adequate to treat problems of nuclear structure. Considering these handicaps, it must be said that the author's treatment of the problems of nuclear physics is really an achievement. The account is no mere catalogue of experimental results; quantum mechanics is freely applied in the discussion wherever possible and the difficulties presented clearly. In particular, the inadequacy of Dirac's theory is very well brought forth in the last section of the chapter. This judicious intermingling of experimental and theoretical results throughout the chapter makes it of the highest value to every worker in the subject. The neutron, however, is not given a theoretical background the reason being, perhaps, that Heisenberg's papers on the subject had not yet been published by the time this book went to press. Very full references are given to original papers without any unnecessary attempt at a complete bibliography. A curious error noticed is that in the *Namenverzeichnis*, p. 458 the name of Mott is given as Moté!

B. S. M.

HANDBUCH DER RADIOLOGY. Teil 2: Molekule, Pp. viii + 604. 56 gold marks.

This Handbook has been specially assigned for the quantum mechanics of a molecule. It contains authoritative articles on Band Spectra and Structure of Molecules by R. de L. Kronig, Electrical Properties of

Molecules by P. Debye and H. Sack, Rayleigh Scattering and Raman Effect by G. Placzek, Molecular Theory of Magnetism by F. Bloch and Quantum Theory and Homopolar Binding by W. Heitler.

R. de L. Kronig has dealt first with the rotation vibration spectrum of a diatomic molecule, the vibration structure of the electron bands and the multiplicity of the electron states. He has also given the general treatment of a diatomic molecule and the symmetry properties of the energy levels. The explanation of the phenomenon of predissociation has been offered in a separate section. R. de L. Kronig's article is quite simple and clear though he has expressed his ideas in a concise manner.

P. Debye and H. Sack commencing with an account of the Clausius-Mosotti law and the Lorenz-Lorentz law, have presented a clear account of the theory of electrical polarisation and its dependence on temperature followed up by the idea of dipoles in molecules. They have devoted a section on dipole moment and chemical structure of molecules explaining how the vector conception of dipoles are helpful to determine the structure of molecules. Then follows a chapter on dispersion phenomena in gases and liquids. The last chapter in the article deals with the phenomena arising from the electrical asymmetry in molecules such as the Kerr Effect. They have also dealt with the relation between the Kerr constants and the structure of molecules.

G. Placzek has done a very good service to scientists in giving a fairly comprehensive account of the theory of the Rayleigh Scattering and the Raman Effect. First deriving the Rayleigh formula for the scattering of light, he has presented an account of Dirac's theory of the scattering of radiation with a general discussion of the scattering formula and a discussion of the same for freely oriented systems. Next he has presented the foundations of the polarisability theory whose conception explains the origin of the Raman lines. In particular, one needs to know the symmetry properties connected with a given polyatomic molecule to find which of the normal modes of vibration would be active in the Raman Effect and what would be the intensities of the Raman-radiations scattered by a molecule relative to the incident radiation. G. Placzek has therefore devoted a separate section for the symmetry properties and then he deals with the relation between those properties and

the selection rules for the Raman transitions. As some examples, he has given the applications of the theory to some well-known molecules and has suggested that the infra-red spectrum and the Raman spectrum of gaseous benzene are of the highest interest. After these simple cases, he has also given a treatment of the splitting up of the Raman lines in  $\text{CO}_2$ ,  $\text{CS}_2$ ,  $\text{CCl}_4$  and  $\text{NH}_3$ . Afterwards the theory of the rotational Raman lines has been dealt with reproducing two beautiful photographs of the rotational Raman spectra of nitrogen and ammonia, the first one taken by F. Rasetti and the other taken by E. Amaldi and himself. He closes his article with a section on empirical data connected with the calculation of the polarisability, etc. This article would have been more comprehensive and complete if he had devoted a separate section on the theory of the vibrations of various point systems under internal forces as this subject is very intimately connected with the explanation of the Raman spectra of molecules.

F. Bloch opens his article with the general facts of magnetism with an account of the thermodynamic relations and magneto-caloric effect. Then he gives the theory of the diamagnetism of atoms and molecules both from the classical and the quantum mechanical standpoints, and the diamagnetism of metals. In the section on paramagnetism, he gives the classical Langevin theory, the spin of the electron, the paramagnetism of atoms and molecules and that of the free electrons. In the section on ferromagnetism he deals with its characteristic properties, Weiss's hypothesis of molecular fields and Heisenberg's theory of ferromagnetism and the theory of ferromagnetism at high temperatures. He closes his article by sections on magnetic anisotropy, magnetostriction, "remanenz" and hysteresis.

W. Heitler has treated first with the nature of valence forces with an account of the interaction of two hydrogen atoms and a helium atom and a hydrogen atom. Then the relation between the Periodic classification and the Pauli Principle, the general theory of the interaction of atoms followed up by the details of the perturbation calculus and lastly the theory of the directed valence in polyatomic molecules have been treated in various sections.

Every article in this volume has been written with very great regard to high standard, clarity and conciseness. It is not

too much to say that this volume will be exceedingly helpful both to the physicists and the physical chemists.

N. S. N.

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GENERAL ASTRONOMY. By Dr. H. Spencer Jones, F.R.S., Astronomer Royal. (Messrs. Edward Arnold & Co., Ltd., London, W.I.) Pp. 437. Price 12s. 6d.

The first edition of this interesting work appeared about twelve years ago and attracted considerable attention on account of the clear and lucid presentation it contained of a wide range of subjects in a manner suitable to the layman as well as to the serious student. In the years that have elapsed since then, the progress of astronomy has by no means been slow; the author has taken the opportunity in the second edition to incorporate the recent developments in the science and to completely rewrite some of the chapters that required more than ordinary revision and the result is, we have before us a well-written and comprehensive treatise which will indeed occupy a middle place between the large number of popular text-books and the strictly technical literature of the subject.

The work of revision has been thoroughly carried out and an attempt has been made not only to describe the extensive advances in our knowledge of the sidereal universe, but also to include in the earlier chapters additional matter dealing with the bodies of the solar system derived from recent researches. Some small errors in the former edition appear to have been rectified. A good deal of new material has been introduced in the section on stars which now occupies five chapters of the book. Some of the problems that have been receiving special attention during recent years such as rotation of stars, theory of novae, galactic rotation and expansion of the Universe are treated in a clear and concise manner. There has been a considerable re-arrangement in the subject-matter according to the trend of modern ideas; the galactic and extragalactic systems are dealt with in different chapters while the last chapter gives an account of the theories relating to the constitution of stars and their evolution.

A distinctive feature of this book is that mathematics has been carefully excluded; only the elementary formulae required for the elucidation of the text are given so that the treatment may be intelligible to all classes of readers. In the limited space

available, the author has succeeded in giving a comprehensive survey of a large and growing subject and there can be little doubt, that in extent and completeness the book forms a compendium of great value. The style is readable and the explanations though brief on some points can be easily understood by the lay reader. To the serious student the book is valuable as providing an authoritative account of the principal features of modern astronomy. It may perhaps be suggested that a bibliography giving a list of references would be useful to those interested who desire to study the subject further.

The illustrations have been carefully selected and it is gratifying to note that with all these improvements the price has been substantially reduced. The treatise may be recommended as a text-book to be used by students taking a course of astronomy in Indian Universities.

T. P. B.

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**THERMIONIC EMISSION.** By Arnold L. Reiman, pp. xi + 324. (Chapman and Hall, London.) Price 21s.

It is doubtful if there is any single invention of the present century which is so useful and universal in application as the Thermionic Valve. It has entered every conceivable industry, it is a powerful tool in the hands of the experimental physicist, and is the very back-bone of Modern Broadcasting, which is providing such wonderful entertainment and education to the people throughout the world. Whether it is the simple triode or the pentode, or even the more complicated heptode that one meets occasionally, it is the simple phenomenon of thermionic emission that is responsible for its success. Ever since the momentous discovery by Thomas Edison in America, and its application to the construction of the first Thermionic Valve by Sir J. A. Fleming in England, it has formed the subject of close study by the practical physicist providing a great bulk of experimental data helpful to the theoretical physicist, particularly in the replacement of the classical, by the quantum statistics in the theory of electrons in metals, and also to the thermionic problem in wave-mechanical theory of the transmission of electrons through potential barriers.

There have been, no doubt, several books on the subject by Richardson and others, most of them fail to render a comprehensive

account of the older and the more recent developments from the modern point of view, nor do they provide the many important data made available by new experimental methods and vacuum technique. The book under review fulfils this need. Mr. Rayner being among the research staff in the G. E. C. Laboratories, has first-hand information about the actual conditions of valve manufacture and has something interesting and important to say in the chapter dealing with the emission of electrons from contaminated cathodes, alloys and the oxides of Thorium and Tungsten. The book is roughly divided into four main sections; after a short introduction, survey of the whole field is given in the first chapter. In this is also discussed at some length the more important points like the work function, Richardson's emission formulæ, the Schottky effect, etc. The next few chapters are perhaps the very cream of the text. The admirably exhaustive discussion of the emission of electrons from clean metals, contaminated metals and oxide cathodes are really very stimulating, and will be of immense interest to the Radio Engineer. A chapter is also devoted to the discussion of the modern theory of electron emission and the emission of ions from electrolytes and from metals.

The inclusion of a few chapters on the experimental technique involved in certain operations would have proved to be most salutary to the interest of those who are practically minded. But even this omission is excusable since the slight digression would have involved a break in the continuity of thought so essential to the proper understanding of the subject.

Finally, the exhaustive bibliography appended at the end of each chapter is of incalculable value to the serious student in making available the original papers on the subject. The get-up of the book is of a high order, the diagrams and the illustrations are apt and help to elucidate the text and the book is sure to commend itself to the physicist and the Radio Engineer in whose shelf it will occupy the place of a handy, up-to-date book of reference.

C. C.

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**THE MYSTERIES OF THE ATOM.** By H. A. Wilson. (Chapman and Hall, Ltd., London, 1934.) Pp. x + 146. Price 10s. 6d.

It is one thing to write a text-book or a treatise on a subject meant for students

immediately interested in the particular subject, but quite a different thing to write an account of a supremely intricate and fundamental subject, as for instance, the structure of the atom, so as to make it understandable by readers with very little scientific training. Professor Wilson has set for himself the latter task and in the volume before us an attempt has been made to give a plain account of the modern notions concerning the ultimate particles constituting the universe.

The collapse of the classical laws governing the motion of particles as postulated by Newton, leading to a purely mechanical conception of the universe and the rise of the modern physics concerning the ultimate particles, resulting from the brilliant discoveries of J. J. Thomson, Rutherford, Röntgen, Heisenberg, Schrödinger, Dirac and others are treated in non-mathematical language, without entering into technical details. The experiments are described in simple language, the theory and calculations being consigned to the Appendices. Chapters IX and X dealing with the theories of relativity make heavy reading for the uninitiated, and may be omitted. The book fulfils a real want and the lay public who are interested in the modern developments but find in the many modern books only a mathematical treatment of the subject can profitably turn to this book where they will find matter which will amply repay study. The printing and get-up of the book are excellent.

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**PHYSICO-CHEMICAL PRACTICAL EXERCISES.** By William Norman Rae and Joseph Reilley. (Methuen & Co., Ltd., London, 1934.) Pp. iv + 276. Price 7s. 6d.

This book which has been brought out by the authors of the now famous work, *Physico-Chemical Methods*, covers the practical course for the B.Sc. Honours. It is comprehensive and thorough and the authors will undoubtedly win the gratitude of many appreciative students who will find in this book solutions for just those difficulties for which they consult the book. The exercises selected are those, which the authors have tried out and which in their experience have proved to be necessary for the students preparing for the Degree examinations. Theoretical principles have been given wherever necessary and the student will find this as also the worked examples very useful. We are confident

that the book fulfils a real purpose and are sure that students of chemical science will find it worth while to add this volume to their libraries.

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**LES RADIOCOLLOIDES.** By M. Haissinsky (Hermann et Cie, Paris, 1934.) Pp. 9. Francs.

In 1912 Paneth discovered that polonium and radium B exhibited colloidal properties in the state of aqueous solutions of neutral, feebly acidic or ammoniacal. Radium B, an isotope of lead, behaved like lead in ammoniacal solutions. The size of the particles in the solutions, calculated from the velocity of diffusion came out as  $10^{-5}$  to  $0.5 \mu$ , and thus explained the invisibility of the particles in an ultra-microscope. The real nature of these particles has, however, been a problem and two different views have been held, the one that they are radio-active compounds in true colloidal state, and the other that they are formed by the adsorption of their ions and molecules on the foreign colloids present in the same mediums.

M. Haissinsky, of the Institut du Radium, Paris, has sifted out in this monograph the evidences so far advanced for the colloidal view, and has come to the conclusion that the properties of radio colloids are due to the formation of true colloidal compounds and that any foreign substances present play only a secondary rôle. There yet remains the difficulty that the observed solubility of the hydroxides of lead and bismuth do not support the colloidal view. According to Haissinsky, however, the solubility measurements of very slightly soluble salts are of little significance, and cannot be directly applied to such solutions as the radio colloids.

M. A.

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**AN INTRODUCTION TO PRACTICAL ORGANIC CHEMISTRY.** By W. A. Waters. (Eyre Arnold & Co., Ltd., London, 1934.) Pp. ix + 92. Price 3s. 6d.

The book covers an elementary course of practical instruction in organic chemistry useful for the B.Sc. students. It is divided into three parts, Part I dealing with the technique employed in organic chemistry starts from first principles and will probably be of some use to all those who start a course of organic chemistry—student of medical colleges, etc. The next part deals with preparative organic chemistry—reactions of groups and the last part with

elementary principles of qualitative organic analysis.

There are several excellent books on practical organic chemistry and the reviewer finds hardly any purpose served in adding to their list a very elementary book which does not involve any original treatment of the subject. The student will, however, find in it some useful "tips", for his laboratory work.

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CHEMISTRY IN COMMERCE. Volumes I & II. Each Volume issued in eight weekly parts. General Editor: Edward Molloy. Vol. I, pp. 392. Vol. II, pp. 393-775 (George Newnes, Ltd., 1935.) Price 8s. per Volume.

One of the excerpts of the late Mr. S. M. Gluckstein was "A course of chemistry, it seems to me, is in itself an almost commercial education, encouraging as it does, patience, skill in observation, . . . . qualities, all of which are essential in modern commerce," words whose truth has been widely recognised, particularly in the post-war world.

In industrial works, chemists of all grades of equipment are met with—undergraduates, graduates and chemists with research qualifications. Besides these there are those who intend taking up chemistry as a profession; and all of them require to be informed how the works chemist utilises chemistry in controlling the processes and why the chemist has been considered a directing force in industry. The four volumes (to be issued in 32 weekly parts) which Messrs. Newnes have planned, attempt to provide this information, not merely by descriptive text, but also by action photographs.

The volumes are issued under the able editorship of Mr. Edward Molloy, and represent a co-operative effort, the various sections having been contributed by the chief chemists of some of the largest firms in England, who by virtue of their profession, are most qualified to describe how chemical principles are applied in actual practice.

The Editor has set himself an ambitious plan and judging from the volumes before us, a reasonable amount of success has been attained. The work is planned to show how the principles of chemistry find application in industrial processes and as it is made intensively practical, one who is interested in practising chemistry as a profession cannot fail to find in it a wealth of material which will be of immense utility to him. Notes on practical use of instruments like

the spectrographs, microscopes, refractometers, polarimeters, viscosimeters, etc., are to be found in the volumes and also short discourses on the determination of moisture content; oxidation and reduction and some of their applications in industry; colour, its determination and measurement; Vitamin A; synthetic dyestuffs; etc. The work is profusely illustrated but one may doubt if all of them are necessary at all. To choose a few at random, figures No. 10 on p. 85, 7 on p. 162, 3 on p. 248, 4 and 5 on p. 287 and 8 on p. 373, do not appear to carry conviction. Fig. 6 on p. 106 and Fig. 14 on p. 110 do not appear to be different as also Figs. 5 on p. 105 and 13 on p. 109. The name of Alfred Nobel is not to be found at all in the first chapter on Founders of Chemistry. But these are all very minor omissions. Viewed as a whole the work contains a wealth of material and deserves to be read by every one interested in Chemistry.

The work must have a special appeal to India where a number of industries are rising and there is a crying need for vigorous chemical control of the processes. There is need for being armoured with every weapon of the modern industrial armoury, if India has to make for herself a place in the Industrial World. In this respect India has to learn a lesson from Japan where the Industrial Works not only employ chemists, but also stimulate the employment of chemists. Let us hope that those interested in the development of industries in India, will keep themselves alive to this fact; when they require information on the scientific requirements of industries, they can turn to these volumes, where, we trust, their requirements will be satisfied.

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THE PHYSIOLOGY OF HUMAN PERSPIRATION. By Yas Kuno, Professor of Physiology, Manchuria Medical College, Mukden. (London, J. and A. Churchill, Ltd., 1934.) Pp. 268 with 38 illustrations. Price 12s. 6d.

This is a concise but critical exposition of the present state of our knowledge concerning the physiology of human perspiration. The book which is the result of nearly ten years collaboration is rightly dedicated to the colleagues of the author. Much of the matter discussed in the book has been published originally in Japanese; and Prof. Kuno has surveyed the vast literature (both Japanese and Foreign) on the subject and formed a synthesis of his study and

experimental observation. The book comprises eleven Chapters. In the first chapter the morphology and innervation of the sweat glands are described. Chapter II contains a clear account of the methods which Prof. Kuno and his collaborators have employed in the laboratory for the measurement of "perspiration" and a simple but acknowledged yet to be imperfect portable apparatus for use by the Physicians is also described. Chapter III deals with a discussion of the descriptive terms employed and of various factors influencing "sensible" and "insensible" perspiration. Chapter IV contains an account of thermal sweating, a subject on which there appears to be no previous description of authentic nature. This chapter is of considerable importance. In the fifth chapter an interesting account of the features of mental sweating with special reference to the causes of such sweating is given. Further the special characteristics of the perspiration of the palm and the sole on the one hand and the other of the axilla are described. In the sixth chapter the effect of mental stress on the perspiration at varying temperatures is discussed and the question concerning the intrinsic causes of variation in the "palmar sweating" and suppression of general sweating is declared to be obscure at present. The results of a systematic investigation of the features of the sweating due to muscular exercise are embodied in chapter VII and the conclusion that "no process other than the effort necessary for performing muscular exercise can therefore be considered as the cause of this sweating" is reached. The asphyxial conditions during very strenuous muscular exercise would however be an additional cause of the sweating on the general surface of the body. In chapter VIII the physiological necessity for supplying in time water and sodium chloride lost by perspiration is described. The importance of adding minute quantities of salt to the water that workers in over-heated

places drink is discussed. Chapter IX is concerned with an account of variations in the ability to perspire due to alterations in the surrounding temperature and to abnormal conditions of the body itself. Individual variations in the ability to perspire with reference to mountain climbing, forced marches of soldiers, etc., are observed. Further the possibility of "training of the sweat glands" is noted. The influence exerted by the osmotic pressure of blood in regulating the sweating process is impressively dealt with, and the injection of hypertonic salt solution has been suggested as worthy of trial in cases of hyperhidrosis. In chapter X a systematic account of the processes involved in the production and inhibition of sweating is offered. Besides noting the variations in the excitability of the individual sweat glands and the periodic discharge of sweat from individual glands, the oxygen consumption of actively secreting glands is dealt with. Chapter XI details the physiological significance of sweating. According to the author, in the human individual the sweat gland of the general body surface plays a very important rôle in temperature regulation, whilst those on the sole and the palm assist by their perpetual secretion in protecting the skin and by sweating facilitate physical work. The sweat from the human axilla disseminates the axillary scent which seems to have a sexual significance. Further, the function of the sweat glands in the elimination of lactic acid during muscular exercise, and the consequent regulation of the H-ion concentration of the blood is discussed. There is an extensive and useful bibliography, and the book is well indexed. The general get-up of the volume is excellent like all other books published by J. and A. Churchill Ltd. The volume deserves a place on the book shelf of every advanced student, teacher and researcher engaged in the study of Physiology.

A. S. R.

### Errata.

\* 1935, 3, 347-348 (Cf. The Theory of Liquids).

(1) In every instance for the suffix ' $m\mu$ ' read ( $m.p.$ )

\* Through oversight the proofs were not sent to the author.

(2) In equations (4), (6) and (8) for ' $\gamma$ ' read ' $\nu$ '

(3) In equation (6) and (7) for ' $M$ ' read ' $m$ '.

(4) Foot-note 2, for 477, read 497.

(5) In equation (10) for  $\sigma \frac{m-1}{m.\mu}$  read  $(\sigma_{m.p})^{m-1}$