

Reviews.

Theorie der Endlichen und Unendlichen Graphen (Kombinatorische Topologie der Streckenkomplexe). Dénes König. Band XVI, Mathematik in Monographien und Lehrbüchern. (Akademische Verlagsgesellschaft, Leipzig, 1936.) Pp. 248. Price 18 M.

From the view-point of Klein's classification of geometries, Topology or Geometry of Position must be considered as the invariant theory of groups of the most general continuous one-to-one transformations. If mathematics is understood in a narrow sense, as the study of certain kinds of numbers, then topology equally with the Theory of Aggregates and Theory of Groups, forms part of the pre-mathematical foundations of mathematics. While the theory of Aggregates has applications to the *analysis* of the continuum-concept, topology has a more direct appeal to the imagination as it deals with continua in the large and concerns itself with the idiosyncrasies of their behaviour and with their classification; the general method of effecting the classification is by the theory of homology groups of Poincaré, whose name stands foremost among the founders of topology. Though Topology and the Theory of Aggregates are both closely related to aspects of function theory, they are too abstract and difficult to be included in the college-course of mathematics—particularly as they both bristle with unsolved problems.

For the beginner, it is perhaps the theory of linear graphs which furnishes the best introduction to topology; even though this theory is not representative of the general methods and procedure of the Geometry of Position to the same extent as surface-topology, it is sufficiently indicative of the type of problems, and concepts with which the subject is concerned. After Sainte-Laguë's *Les Réseaux* published in 1924, the present book appears to be the first systematic treatise devoted to linear graphs. In writing this book the author has aimed not only at an orderly exposition, but also at a comprehensive digest of graph-theory with full bibliographical references; he has also treated or mentioned all the known applications of the theory. The more difficult parts of the theory of graphs, namely the properties of infinite graphs and problems relating to factorisation of graphs, including Petersen's Theorem are well

treated, and the book is a worthy addition to the series in which it has been included.

It is not perhaps generally realised that there is a rich variety of recreational and other applications depending on the theory of graphs. The first topological publication was Euler's in 1736; it arose out of the problem of passing through the seven bridges of Königsberg each only once. Euler's Theorem that *all the vertices of a connected linear graph can be described in a closed circuit, if and only if the number of edges abutting on each vertex is even*, disposed of the Königsberg problem as insoluble. Similarly the problem of finding one's way out of a labyrinth or into the centre of a labyrinth is equivalent to the problem of finding a path between two vertices of a graph known to be connected. Kirchhoff's results relating to the distribution of electric current in a network of conductors are closely related to the fundamental theorems of linear graph theory. "Axiomatik" or the study of the logical relations between the propositions constituting any "doctrine" can be brought under the scheme of the linear graph—as also the relations between the operators of any group—in particular, also the unsolved four-colour problem. It is the same with many solitary games—for instance, the game of traversing all the squares of a chessboard with the Knight. Cayley and Sylvester, pioneers of graph theory studied it in connection with the hydrocarbons and other compounds of organic chemistry—the atoms constituting the vertices and the valency-bonds the edges of the associated linear graph. The closing part of the book contains interesting applications of graph theory to determinants, which are due to the author himself.

Except in certain portions relating to infinite graphs, the mathematical knowledge requisite for understanding the book is of a fairly elementary kind. This should make the book accessible to a wider class of readers than those who are interested in graphs only as an introduction to advanced topology.

R. V.

Integralgeometrie. Von W. Blaschke [Actualités Scientifiques et Industrielles.] (Hermann & Cie, Paris, 1935). Pp. 22. Price 7 Francs.

In this little tract containing 18 pages of matter, Prof. Blaschke establishes certain

invariant expressions pertaining to what he calls *Integral Geometry*, a subject whose origin is traced to the well-known "Buffon's Needle Problem" in the theory of probabilities.

Consider in Euclidean space E_n a system of r mutually orthogonal unit vectors a^i ($i = 1, 2, \dots, r$) in a sub-space E_r ($0 \leq r < n$) formed by taking suitable points x^i . Let b^i ($i = 1, 2, \dots, s$; $s = n - r$) be other orthogonal vectors which with a^i form a normal orthogonal system with determinant equal to ± 1 . Consider

$$p^{ik} = + \sum_t \dot{a}_t^i b_t^i = - \sum_t a_t^i \dot{b}_t^k$$

where the dots denote differentiation. Let

$$\pi \prod_{\substack{i=1, \dots, r \\ k=1, \dots, s}} p^{ik} = F_r$$

where in order to render the sign of F_r definite, the factors p^{ik} are supposed to be written in the dictionary order. Let

$$v^i = \sum_t b_t^i \dot{x}_t$$

and

$$G_r = \pi \prod_{j=1, \dots, s} v^j \cdot F_r.$$

Then G_r is defined as the "density" (*Dichte*) for the space E_r in E_n , and is proved to be invariant for all Euclidean movements in E_n .

Again, let $\prod_{i=1}^n \dot{x}_i = G_0$ and $\prod_{i < k} p^{ik} = S$.

Then $T = G_0 S$ is the "Kinematische Mass" of E_n , and is an invariant.

These ideas are also worked out for non-Euclidean Geometry.

Prof. Blaschke closes with a reference to the work of L. A. Santaló which shows that this subject has some useful applications. In E_2 , let K_1 and K_2 be two closed convex regions of which K_1 is fixed and K_2 variable. Let $K = K_1 \cdot K_2$ be the common part between K_1 and K_2 . Let T be the "Kinematic density" of K_2 , f and u the area and perimeter of K , and n the number of intersections of the bounding curves of K_1 and K_2 . Then Santaló's results are

$$\int f T = 2\pi f_1 f_2$$

$$\int u T = 2\pi (f_1 u_2 + f_2 u_1)$$

$$\int n T = 4u_1 u_2$$

where u_i, f_i refer to the perimeter and area of K_i .

The last of these formulæ leads to an improvement of a well-known inequality known as the isoperimetric property of the circle. For an oval of perimeter u and area f , we have

$$\frac{u^2}{4\pi} - f = f_4 + 2f_6 + 3f_8 + \dots$$

where the areas f_i are generated by means of circles of the same perimeter intersecting the oval in exactly i points.

The subject of "Integral Geometry" is further treated in the following papers:

(1) W. Blaschke, *Integralgeometrie 2*, *Berichten der rumänischen Math. Gessellschaft*, 1935.

(2) O. Varga, *Integralgeometrie 3*, *Math. Zeitschrift*, 1935.

(3) L. A. Santaló, *Geometria Integral 4*, *Abhandlungen des Math. Seminars, Hamburg*, 11 (1935).

C. N. S.

Astronomy—A Text-Book for University and College Students. By Robert H. Baker, Ph.D. (Macmillan & Co., 2nd Edition, 1935.) Pp. 522. 16s. net.

This second edition of a well-known text-book on Astronomy is a vast improvement on the first edition and includes the most recent developments of the subject. It bears a great resemblance to that well-known classic, Russell-Dugan-Stewart's *Astronomy* being written almost on the same model but in a less comprehensive manner. In some ways it even goes beyond Russell-Dugan-Stewart inasmuch as brief but clear accounts are given of the doctrine of the expanding Universe, the rotation of the galaxy and recent theories of stellar constitution.

The book is profusely illustrated and easily the best text-book of Astronomy in this respect. Second only to the illustrations are the very valuable innumerable tables interspersed throughout the book. The author's presentation of the subject is logical and clear and all through the extremely wide ground covered, it is hard to point out an instance where the author's treatment would tend to suggest that he was not master of the topic he was dealing with. All these go to make this book one of the very best works on Astronomy ever written.

Examined as a text-book, it is really a rich treasure house for picking up questions to be set in an examination paper. It is

equally enchanting as a book to teach from, permitting as it does a lot of scope to the teacher in choosing the topics for instruction.

For its printing and get-up and the excellence of its contents, the price of 16s. is really very reasonable. We refuse to find fault with this book.

B. S. M.

Foundations of Physics. By R. B. Lindsay and H. Margenau. (New York: John Wiley & Sons; London: Chapman and Hall, Ltd., 1936.) Pp. 537. Price 22s. 6d.

Theoretical physics has taken such enormous and rapid strides in recent years that it has not merely enlarged its own sphere considerably but has made severe inroads into other fields of intellectual activity. The application of mathematical rigour to physical problems has yielded such fruitful results that to-day certain mathematical methods have become uniquely appropriate for particular physical theories.

In the wake of such a remarkable progress, there have appeared excellent treatises on various special developments in the realm of physical thought. However, comparatively few books have been published which present to all those interested, a careful analysis and detailed description of the ultimate theories on which the superstructure of modern physics is built. Lindsay and Margenau have done therefore a real service to the student of physical science by the publication of the book under review.

In the first three chapters, the authors present a critical summary of the meaning of a physical theory, the fundamental concepts of space and time in physics and the foundations of mechanics. In Chapter III on the foundations of mechanics, appropriate treatment is accorded to the principles of D'Alembert and of Hamilton. The chapter on probability (one wishes for a more detailed treatment under this head) is bound to serve as a clear introduction to the subject. After presenting a detailed account of the statistical methods of Gibbs and of Darwin and Fowler, the authors examine the concept of continuum in physics and the electromagnetic field theories. The special and general theories of relativity are next treated in fairly simple mathematical language and finally the foundations of quantum mechanics are examined appropriately at considerable length. The chapter on quantum mechanics is of special interest since the development of the subject is extremely logical and well

balanced. After setting forth the axiomatic foundation of quantum mechanics, the authors examine at length the celebrated equation of Schrödinger and the formal structure of matrix mechanics. A clear account is given of the theory of electron spin and Pauli's exclusion principle. The statistical mechanics of Darwin and Fowler are reconsidered from the point of view of quantum mechanical axioms and the reader is naturally led to the elucidation of Maxwell-Boltzmann, Fermi-Dirac and Einstein-Bose statistics. Dirac's theory of the electron is next presented and one cannot help agreeing with the authors that the trend of recent discoveries appears to recede from uniformity and simplicity of explanation. We shall rest on the assurance that the list of discoveries is far from complete and when these are made the lengthening chain will close itself into a ring.

The book closes with a short chapter on the problem of causality under which plain heading a general survey is made of the various theories developed in the earlier chapters.

It will be seen from the foregoing survey that the authors have covered a wide range of subjects all of which serve as foundations to modern physics. They have been successful in their aim, namely, to steer a middle course between a dogmatic treatment of selected theories on one side and a cursory presentation of diverse aspects of modern theories without decisive analysis on the other. Although the book is not intended to be a text-book, certain chapters are of special interest to the advanced students of Indian Universities since they give definite and clear pictures of special theories. The authors are to be congratulated on an elegant presentation of the fundamental concepts of modern physical thought and the book is bound to appeal to a wide circle of readers including philosophers and mathematicians as well as physicists.

S. R. R.

Introduction to Atomic Spectra. By H. E. White. "International Scientific Series." (McGraw Hill Publishing Company, Ltd., London, 1935.) Pp. xii + 458. Price 30s. net.

This book, by Prof. White, in the well-known "International Scientific Series" of the McGraw Hill Publishing Company, has been written with the following objectives in view: "First, to start as nearly as possible

at the beginning of each subject; second, to develop each new concept so that the student with a working knowledge of elementary physics and elementary calculus should have little difficulty in following; and third, clearly to illustrate each chapter as far as possible with diagrams and photographs of spectra." Each of the twenty-one chapters in the book reveals that the author has eminently succeeded in achieving the above three objects he had in undertaking the work.

The first chapter gives a useful historical introduction leading up to the early Bohr theory of the hydrogen atom which is treated in full in the second chapter. The third chapter deals with Sommerfeld's extension of Bohr's theory to elliptic orbits and the explanation of the fine structure in the lines of hydrogen and helium as a result of the Relativity correction. Chapter IV discusses Schrödinger's wave equation and the new explanation of the atomic hydrogen spectrum. There is in this chapter a beautiful photographic representation of the electron cloud for various states of the hydrogen atom as made from a spinning mechanical model. In the following chapters are treated usual topics that ought to find a place in any modern book on atomic spectra. The last chapter gives a concise account of the very important subject of the breadth of spectral lines, a topic that generally finds hardly any place in the ordinary run of text-books. Throughout, the treatment is characterised by clarity and fullness. The earnest student ought to find no difficulty in mastering the subject with the aid of this book. The tables at the end, giving the relative intensities of lines in a multiplet for various cases, are very useful to the practical spectroscopist.

The publishers must be congratulated on the excellent get-up of the book. We have no hesitation in recommending the book to University Honours students.

B. V.

The Optical Basis of the Theory of Valency. By R. De L. Kronig, Ph.D. (Cambridge University Press, 1935.) Pp. 237. Price 16 *sh.*

The new book of Professor Kronig is a general introduction to the theory of atomic and molecular spectra. It begins with chapters on X-ray and line spectra and then gives a more detailed account of Band and Raman Spectra of diatomic and polyatomic

molecules and of optical methods to determine their energies of dissociation. Apparently the book is meant more for the physicist working in other fields, because those details, which are interesting for the specialist, are not dealt with. Thus a very clear and comprehensive description has been given of the conceptions, which form the basis of the theory of valency. In the sections on the vibrations of polyatomic molecules the author has succeeded in giving a particularly clear account of some rather intricate details, and the chapter on pre-dissociation, to which his own original investigations have contributed so much, naturally forms delightful reading.

If we may venture to criticise one point, it would rather be the title of the book. In reality, the author has made very short work of the theory of valency, and has not gone beyond a very brief description of the contents of the main original papers of some of the investigators like Hund, Mulliken, etc. If he has done so because the theory of valency at the present moment is rather an accumulation of hypotheses and the author wanted to remain in the field of proved and acknowledged theories, this is a very reasonable point of view. But then it should have been made clear, that many of the rules mentioned, are assumptions without experimental proof. As an example, we may mention the identification of non-promoted and bonding electrons, based on earlier correlations of molecular and atomic levels, more and more contradicted by recent experimental results, which in reality is introduced into the theory as a hypothesis.* This, however, is a minor point in such a general introduction and this very clearly written book may be highly recommended.

R. SAMUEL.

Physics. By Erich Hausman and Edgar P. Slack. (Chapman & Hall, London, 1936.) Pp. viii + 776. Price 20*sh.*

The number of text-books in "Physics" must be very large. Starting from the old Ganot and Deschanel series, one passes through Glazebrook and the more recent writers like Crowther and Smith. A progressive science like physics must certainly afford ample scope for writers of text-books, but that they should find so much to write about on the same old fundamental laws in

* See article on Band Spectra. By Prof. R. Samuel. (This number—p. 830.)

the form of an elementary text-book is at times somewhat puzzling. Each writer, of course, believes in his method of presenting the subject to the standard aimed. Some succeed, where others fail.

Text-book writers like examiners have, however, a very important responsibility. They guide the progress of the subject in the country where the book is adopted as the text-book. If they strike a mathematical vein the mathematical aspects get emphasised and the young minds pinning their faith on text-books and examinations regard the mathematical as the correct aspect to attend to. On the other hand, if the experimental and applied aspects are emphasised the book almost loses its appeal to the old-fashioned teachers and examiners who regard the mathematical and the mysterious as the correct and becoming style for physics. This may in some measure be due to the difficulty which the old school of physicists find in following much of the new applied and experimental developments in physics which have a difficult technique of their own. This danger is particularly great in physics which has both these aspects equally important and rarely is one to be found who could do justice to both aspects adequately and equally.

However, it must be granted that it is a great mistake to over-emphasise the mathematical aspect, at any rate, in junior text-books intended for beginners. This is exactly what has happened in the past and in recent years it is so refreshing to come across a different class of books like Saunders: *Survey of Physics* and Davies and Black: *New Practical Physics* which emphasize the experimental and applied aspects. The present book under review by Hausman and Slack is from this point of view a very welcome addition to the group of text-books of physics specially suitable to correct the theoretical tendencies of the Indian youth. Gyroscopic Compasses, the Hydrostatic thrust on a dam, the calculation of the forces on a roof truss and a variety of such interesting applied aspects receive adequate consideration by simple numerical examples and beautiful illustrations. Omissions are not absent. An applied item of great importance like the horizontal pendulum and seismograph finds no mention. However, it must be granted that it is physically impossible to cover all the items without increasing the size of the volume to unwieldy proportions. On the whole it is a very

excellent book particularly suitable for adoption in the B.Sc. classes of Indian Universities.

H. PARAMESWARAN.

The Chemistry of Milk. By W. L. Davies. (Chapman & Hall, London, 1936.) Pp. xii + 522. Price 25s. net.

The present volume on the chemistry of milk constitutes the tenth of a series of monographs on applied chemistry and is one which will be welcomed not only by students of dairy science but also by dairy technologists, nutrition chemists, physiologists, public analysts and members of the medical profession.

The volume is divided into five parts, each of them being devoted to a consideration of some special aspect of milk chemistry. The variation in the composition of milk in relation to breeds, individuals, age, period of lactation, climate, kind and quality of feed and disease and other abnormal conditions, has been discussed in considerable detail. The data and graphs presented in this connection should prove most useful to public analysts who have the difficult task of fixing legal limits of composition.

Chapter V deals with milk fats, their variation in composition with breed, feed, indoor feeding and spring pasture. Attention is drawn to the variation in percentage of the unsaturated fatty acids, whose indispensability in the nutrition of animals has recently been established. The discussion on the auto-oxidation of butter-fat and the factors which lead to the rancidity of butter and "fishiness" of milk powders which is included in this chapter, will be of great interest to dairy technologists.

The author has drawn attention to the presence of sugars in human milk other than lactose, a fact which will have to be taken into account by those interested in infant nutrition.

The sixth chapter is concerned with proteins and other nitrogenous constituents of milk which also occur in other physiological fluids like blood and urine. It would be interesting to elucidate the interrelationship between the proteins and the residual nitrogen. The author has dealt with the question of the structure and composition of casein as revealed by physical, physico-chemical and immunological reactions. A considerable amount of work on the enzymatic digestion of casein has been

carried out in recent years and a review of this work would form a most useful addition to this interesting and important chapter. Gróh's recent work on the fractionation of casein does not find mention here.

Attention is drawn to the very interesting similarity in composition between caseins and vitellins, pointing to a similarity in the physiological requirements of the young chick and the mammal.

Comparatively little attention has been paid to the study of lactalbumins and lactoglobulins of milks, and these should form a field of future research, particularly those from the human and ass's milk which are rich in their lactalbumin contents.

That milk proteins exhibit a powerful tendency to aggregate under a variety of conditions to which milk is ordinarily subjected, freezing, heating, pasteurising, etc., is a circumstance which requires careful investigation from the point of view of nutrition.

The mineral constituents of milk and their importance from the nutritional and technical points of view are discussed in the ninth chapter. Bunge has shown that there exists in the case of cat, dog and rabbit, an analogy between the fully grown foetus and the composition of the ash of the maternal milk; the author has however shown that this fact applies only to mammals with a comparatively short pre-natal life, and which have, therefore, to depend on milk for the complete development of their complement of ash. Special emphasis is laid upon the different forms of phosphorus present in milk and how they are affected by variations of season. The chloride and lactose contents of milk have some analytical interest since the lactose-chloride number has been suggested as an index of abnormality in milk.

An entire chapter is devoted to a discussion of the enzymes of milk, which, being a physiological secretion, contains a number of enzymes. Abnormalities due to diseases which afflict the animal are unmistakably reflected in the enzyme content of their milks, the contents of amylase and peroxidase being the two which are most affected. The physiological significance of these enzymes and their rôle in the nutrition of the young, are still matters of controversy and offer useful lines of enquiry.

Colloid and physical chemistry of milk in relation to some of the technological processes in the dairy industry, forms the subject-

matter of the third section of the volume. The range of variation of the freezing point of milk is given for a large number of samples from various authorities, data which are of great value to public analysts who have to deal with adulteration of milk.

Dairy technologists will be particularly interested in the fourth part of this volume which deals with the chemistry of milk processing. Of universal interest is the chapter on milk and metals, which gains great importance in view of the recent recognition of the cumulative effect of the metals on the health of human beings.

The last two chapters on the vitamins and the nutritive value of milk, will have a general appeal. The important function of colostrum in the immunisation of the offspring, the special rôle of lactose in enhancing the assimilation of calcium and phosphorus and securing their retention in the body in higher percentages, the high supplemental value of the milk proteins with regard to the cereal proteins, are a few of the important points to which attention is drawn.

Interesting experiments on the response of school children to milk in their diet are cited. Increased vitality and vigour, superior intelligence and wider scholarship, greater alertness and quicker perception, characterised the group of school children who were given milk. Authorities who are entrusted with the care of the public health of the country will find a considerable amount of valuable information in the later portions of the volume.

KAMALA BHAGVAT.

The Economics of Diet—Address to the British Association, September 1935. By John Boyd Orr.

Food, Health and Income—Report on a Survey of Adequacy of Diet in Relation to Income. By John Boyd Orr. (Macmillan & Co., London, 1936.) Pp. 71. 2s. 6d.

These two works are a valuable contribution to the science of nutrition in its broader aspects. Sir John Orr compares the food supply of the United Kingdom with the "optimum" nutritive requirements of the population as defined by modern research; he produces evidence to show that about half the population is living on a "sub-optimum" diet and is consequently not reaching the highest possible levels of health and development; finally, he outlines the changes in agricultural policy and production

which would be necessary if the whole population were to consume an "optimum" diet.

Consumption of various foods per head per day was worked out on the basis of agricultural and import statistics, etc. Since 1909 there has been an increase in the national consumption of animal fat, eggs, fruit, and fresh vegetables—a change in the right direction. But only a very rough picture of the dietary habits of a nation can be obtained by dividing total food supply by number of inhabitants. A further necessary step is to discover how food expenditure is directed in different sections of population at various income levels.

In the present enquiry the population was divided into 6 income groups, ranging from 10s. to over 45s. per head per week. By means of the study of family budgets, and diet surveys, expenditure per head on food in the various groups was assessed; it ranged from 4s. to 14s. per head per week. At the same time, by similar methods, an estimate of the actual *direction* of food expenditure in each group was made. It was found that the quality of the diet, reckoned in terms of protein, fat, mineral salts and vitamins, was closely dependent on expenditure; consumption of almost all the most valuable "protective" foods, *e.g.*, milk, butter, cheese, meat, fresh eggs, fruit and vegetables, rose with increasing income. The only foodstuffs which are recorded as having been consumed in greater amounts in the poorer groups, are condensed milk and margarine.

The author marshals evidence to show that in the nation as a whole, the level of health and physique declines with decreasing income and decreasingly satisfactory diet. Certain nutritional diseases—*e.g.*, nutritional anæmia—are most common among the poorer classes. Tuberculosis has a similar class incidence. The remarkable manner in which the addition of "extra" milk to the diet of children of the poorer classes accelerates growth, and improves general health, is evidence that ordinary diets of such children are "sub-optimum".

If the diet of the whole population were to be brought up to the level of that of its best fed sections, this would mean a great increase in the consumption of certain foods—notably milk, butter, eggs, fruit and vegetables. The production of greater quantities of such foods—which are mainly perishable foods suitable for home consumption—lies within the scope of agriculture in

the United Kingdom itself; further, the development of agriculture in this direction would not necessarily involve reduction in food imports. While the agricultural industry could thus be greatly stimulated by an increased consumption of "protective" foods on the part of the poorer classes, such consumption would, at the same time, raise national health standards.

Studies of this kind provide a scientific basis for enlightened national food policies, which take into consideration both the prosperity of the farmer and the health of the community.

W. R. A.

Letters from India. By Victor Jacquemont. Translated by Catherine Alison Phillips. (Macmillan & Co., Ltd., London, 1936.) Pp. xxxii + 372. Price 21 *sh.*

That the French excel other nations in the field of letter-writing is well-nigh universally recognised. The publication for the second time of the translations of the correspondence of Victor Jacquemont, a century after its first appearance in print, will surely be considered by many people as a literary event of the first order. It would scarcely be an exaggeration to say that no finer letters from India exist. The easy grace of the composition, combined with sparkling wit, keen observation and delicate humour, entitle the book to the highest place among the published correspondence in any language.

Victor Jacquemont was entrusted by the *Jardin des Plantes* with a roving commission to collect rare specimens of plants and animals in India. Jacquemont's original idea was to explore the entire Indus valley between Multan and Kabulistan. This was abandoned after some deliberation and finally he decided to proceed from Pondicherry to Calcutta, making his way to the Sikh territory of the Punjab. He crossed the Deccan plateau by way of the Narbada valley to Bombay. Had Heaven spared him, this unique tramp would have continued further south, but his untimely death in 1832 cut this short.

As a travelling naturalist of the *Jardin des Plantes* and a man of good family and high talents, Jacquemont won an immediate welcome in the best society in India. He was introduced in an informal way to the Governor-General, Lord Bentinck, and his personal charm soon captivated both Lord and Lady Bentinck, whose friendship

stood him in good stead during his travels. The young foreigner, having political ambitions and endowed with acute powers of observation, supplemented his scientific mission by a critical analysis of the East India Company's Government, the social condition of the land, and he has handed down to succeeding generations a singularly vivid picture of India of a hundred years ago, and of its people, both European and Indian, who were carrying on her administration.

To the British and the Indian reader it is not the style alone but the subject-matter also that makes an instant appeal. The letters are full of reflections upon native rule and the problems "of governing semi-civilised and barbarous races" which are of permanent value to those concerned with questions which "arise when western ideas come in contact with eastern ways of life". There are numerous instances where Jacquemont speaks severely of the extravagant ways of early nineteenth century English life in India. Though many of his criticisms are undoubtedly justified, he has not failed to do justice to the benefits which English rule has conferred on India.

Of particular significance is his account of the Punjab and Kashmir under Sikh domination. The lively pen-portraits of the "Lion of the Punjab" and of other native potentates are valuable historical documents. Jacquemont's interpretation of the many problems of Indian administration by Europeans and his comments thereon are equally applicable to problems arising under similar situations even at the present day.

The student of Indian history will find his delineations of the interesting persons he came in contact with, invaluable. Lord William Bentinck, Ranjit Singh, Shah Shuja, Lord Clare and the eccentric William Frazer, all live before us in his letters. To the general reader Jacquemont will appeal most strongly by the wit and pathos of his letters. His estimation of his literary powers though modest, was nevertheless not inconsiderable. It is to be greatly lamented that he did not live to publish the "three or four volumes" he had intended to bring forth.

It is said that Jacquemont was an artist of no mean talent. But whether in the art of drawing or in that of letter-writing, the same simplicity and economy of means characterise his productions. His letters are diversified by a variety of moods,

ranging from the low tones and melancholy strain of his early letters to the exuberant imagery with which he presents his adventures in Tibet and Kashmir. Jacquemont's short life of thirty-one years produced far more than his necessarily limited contributions to natural history. As an artist and a letter-writer and as a keen observer of Indian conditions at an interesting epoch his memory deserves to be kept ever-green.

The excellence of this volume is in no small measure due to the perfect rendering into English of the original French by Mrs. Catherine Phillips. The maps and the index appended at the end enhance the usefulness of the book to the serious reader who wishes to form an exact picture of the travels of the author.

To read Victor Jacquemont's letters provides all the elements of liberal education.
C. N. R. RAU.

Intermediate Botany. By L. J. F. Brimble. (Macmillan & Co., Ltd., London, 1936.) Pp. 562. Price 8s. 6d.

This is an elementary text-book of botany designed to cover the courses of High schools and Intermediate examinations in Science, Arts, Agriculture, Medicine, etc. of the English Universities. The book is naturally more comprehensive and deals with many such aspects of botany which are not generally found in elementary text-books.

There are altogether thirty chapters with practical exercises at the end of each and a selection of important questions in the appendix. A small section on historical survey gives a short account of the development of more important branches of botany and a page devoted to the history of economic botany furnishes the reader with names of various centres of botanical research within the British Empire. The portions on morphology, histology, general biology, fossil plants, diseases of plants (including virus diseases), vitamins, etc., are very nicely dealt with and the treatment accorded to each is quite adequate for a book of this category.

The special feature of the book, however, is the treatment of the ecological, physiological and physico-chemical aspect of plant-life and relatively greater space has been devoted to these subjects. The student will find these portions stimulating.

The author has succeeded in presenting

within a reasonable compass a fairly complete picture of the different aspects of botany. The simple, lucid style, the avoidance of all but the most essential technical terms and the many, well-chosen, useful illustrations, most of which are drawn by the author himself, contribute to make the book both attractive and interesting. Further, the brief presentation of the more recent developments adds greatly to the value of the book.

There are a few minor errors particularly in the taxonomical portion of the book. They are no doubt due to oversight and it is hoped will be corrected in the next edition.

P. 510. Eicher instead of Eichler.

P. 322: Floral formula of pea (*Pisum sativum*) is given as $K_5C_5A(10)G(2)$; compare the same given in pages 321 and 512: $K(5)C_5A(9)+1G1$.

The instruction (p. 321) that "an inferior ovary is represented by a line over the sign for the gynæcium and a superior ovary by a line beneath" is not followed in the floral formula given in the same page; the lines are below the numbers. There is also a lack of uniformity in this respect as is apparent from pp. 321 and 322 and elsewhere.

No mention is made of the importance of the position of the mother axis in the instructions for "representation of floral structure" (p. 320) neither is it shown in the diagrams given in p. 321, although the mother axis is indicated in the same floral diagrams given elsewhere. Due to the absence of the mother axis, the floral diagram of the wall-flower (p. 321) conveys a wrong meaning.

The language of the book in certain places is rather loose and is likely to be confusing to the beginner for whom the book is meant.

P. 510. "All the orders may be subdivided finally into monocotyledons and dicotyledons" is, strictly speaking, incorrect. The term "sub-divided" is hardly applicable in this case.

P. 500. "The classification of Angiosperms naturally is based on the more variable characteristics." The author intends to convey the idea that the classification is based on those organs which show the greatest evolutionary change. That is, of course, shown more profoundly by the floral organs than by the vegetative organs such as roots. But as expressed by the

author it is very likely to be misunderstood by the students.

Pp. 500-501. The statements that "the classification of plants to-day follows closely on that made by the great Swedish botanist Carl von Linnæus" and "the classification of Linnæus is still the basis of present-day classification though much modified" will be difficult to justify. Linnæus suggested the sexual system of classification. It was totally artificial, being based on the number or some other characteristic of the stamen. Linnæus himself was alive to this fact and attempted to classify the plants according to their true affinities into a natural system but did not live to complete it. In the evolution of the natural system of classification the contribution of Linnæus is only indirect. As regards the date of the publication of the Linnæan system of classification it was published for the first time in 1735 in his *Systema Naturæ*. In 1753 in his *Species Plantarum* Linnæus described all the species known at the time.

P. 23. Bacteria are regarded as a subgroup of fungi. But the modern tendency is to give bacteria and fungi an equal status.

The book, on the whole, fulfils certain needs of the student and as such is a very welcome addition to its predecessors. It is conceived on a slightly different plan. There is a certain freshness in the treatment of the subject which makes the book rather interesting. The book is easy reading and stimulating and although mainly intended for students, the layman interested in botany will also find it quite enjoyable.

S. D. G.

Damage by Frost at New Forest, Dehra Dun during the Period 1930 to 1934 (Forest Bulletin No. 91). By Bachaspati Nautiyal. (Manager of Publications, Delhi, 1935.) Pp. 18. Price As. 12 or 1s.

Frost injury to Forest crop in India is so rare in the greater part of India that Mr. Nautiyal's paper has an element of uniqueness. The incidence of Frost damage is, apparently, so erratic that it is not always possible "even with considerable past experience, to predict with any degree of certainty the locality, frequency and severity of Frost."

Mr. Nautiyal's main conclusion from his experiments is that protection against Frost is better effected by shading the crop with a cover during nights only than by having cover both night and day. In the latter

case, there was presumably a great reduction in the soil temperature "as the surface was never warmed up by the sun, whilst evaporation continued its cooling effect increased by the occasional irrigation." A series of soil temperature measurements recorded by Mr. Nautiyal at depths of 3 and 12 inches below the surface gave results in accordance with this conclusion.

The reviewer can confirm this conclusion by his observations on the Beech (*Fagus sylvatica*) in central Europe. As a rule, experience with these Forests indicates that the immediate causative factor in Frost damage is not so much the element of temperature as of *dryness*. It is to be hoped that Mr. Nautiyal will continue his researches in this direction also.

The Author says (p. 5) that the "same Centigrade thermometer was used in recording temperatures". Since there was a set of six readings for each measurement, and since, obviously, there must be the lapse of an interval for the thermometer to correctly record the temperatures, the method admits of a small error in that the temperatures are not taken at exactly the same time. This, of course, could easily be avoided by having six calibrated thermometers to simultaneously take the readings. The record of 40° F. (p. 2) is rather discordant in a scientific paper wherein all other temperatures are reckoned on the Centigrade scale.

The Bulletin is illustrated by four plates of telling photographs.

EMMENNAR.

Francis Amory Septennial Prize.

IN compliance with the requirements of a gift under the will of the late Francis Amory of Beverly, Massachusetts, the American Academy of Arts and Sciences announces the offer of a septennial prize for outstanding work with reference to the alleviation or cure of diseases affecting the human genital organs, to be known as the Francis Amory Septennial Prize. The gift provides a fund from which the income may be awarded for conspicuously meritorious contributions to the field of knowledge "during the said septennial period next preceding any award thereof, through experiment, study or otherwise...in the diseases of the human sexual generative organs in general." The prize may be awarded to any individual or individuals for work of 'extraordinary or exceptional merit' in this field.

In case there is work of a quality to warrant it, the first award will be made in 1940. The total amount of the award will exceed ten thousand dollars, and may be given in one or more awards. It rests solely within the discretion of the Academy whether an award shall be made at the end of any given seven-year period and also whether on any occasion the prize shall be awarded to more than a single individual.

While there will be no formal nominations, and no formal essays or treatises will be required, the Committee invites suggestions which should be made to the Amory Fund Committee, c/o the American Academy of Arts and Sciences, 28, Newbury Street, Boston, Massachusetts, U.S.A. (*Research and Progress*, 1936, 2, 126.)