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## REVIEWS

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**Supersonic Flow and Shock Waves.** By R. Courant and K. O. Friedrichs. (Interscience Publishers, Inc., New York), 1948. Pp. 464. Price \$ 7.00.

The theory of Supersonic flow and Shock waves is a very fascinating subject of recent development and research. A great deal of experimental work and theoretical investigation in this field may be found spread over a wide range of journals and technical reports, but till quite recently, there were very few books giving a connected mathematical theory of the subject.

The book under review is written by eminent theoretical physicists, who have themselves made important contributions to the principal mathematical methods required in such investigations as well as to the many specific topics such as flow through nozzles, the theory of deflagrations and detonations, formation and decay of shock waves and the interaction of shock and rarefaction waves. The book itself is a revised and enlarged form of an earlier report on the same subject.

The equations for flow problems in the dynamics of compressible fluids are formed with the help of the usual conservative laws of mass, momentum and energy. The changes of thermodynamic state are assumed to be adiabatic except at singularities, where modifications under suitable hypotheses are made. The general equations turn out to be non-linear in character and the aim of the mathematical theory is to solve such equations under given or appropriately formulated boundary and initial conditions. At present, only problems of special types are amenable to exhaustive mathematical treatment. While giving a thorough account of such problems, the book clearly reveals the imperfect state of the present theory and the need for further investigation relating to several aspects of flow problems.

The book consists of six chapters. The first two chapters furnish the necessary mathematical and physical background and a comprehensive treatment of one- and two-dimensional problems is given in Chapters III and IV respectively. Chapters V and VI deal qualitatively with three-dimensional problems under simplifying assumptions.

An outline of the contents of the book now follows,

In the first chapter the necessary thermodynamic notions are given in a suitable mathematical form and the general differential equations of flow are derived. The wave motion in shallow water which is analogous to the non-linear motion of gases is studied in the Appendix. In Chapter II the theory of characteristic curves and characteristics, the theory of simple waves and the method of hodograph transformation are described. The Appendix to this chapter deals with differential equations for functions of more than two independent variables. An exhaustive treatment of one-dimensional flow problems covering several aspects is presented in Chapter III. Rarefaction and compression waves, the formation of an envelope in a compression wave, shock discontinuities resulting from compressive motion are described. Shock wave theory is developed as an irreversible thermodynamical process caused by friction and heat conduction. Shock conditions are derived in several forms. Hugoniot function and Prandtl's relation for shock transition in polytropic gases are obtained. A qualitative description of elementary interactions is included. Collision of two simple waves is treated on the basis of Riemann's theory as well as by the more suitable method using finite differences. Chapman Jouguet reaction processes and hypothesis and Jouguet's rule are considered in some detail. The chapter ends with an Appendix on wave propagation in elastic-plastic material. In Chapter IV the hodograph method of solving special isentropic irrotational steady two-dimensional flow problems is used. Explicit formulæ for Mach lines, angles and cross lines are derived. The analysis of oblique shocks is carried out with the help of the shock polars. The interaction between shock fronts and production of regular shock and Mach reflections, the interaction of a shock and a simple wave are considered. Linearized perturbation methods for determining the flow around profiles are explained. Chapter V is devoted to a qualitative description of flow through nozzles and jets. In Chapter VI cylindrically symmetric steady flow against slender profiles, steady conical flow and non-steady flow with spherical symmetry are discussed.

The book is written in a clear and elegant style. It is profusely illustrated. The biblio-

graphy is extensive. There is a good subject index. The book is very stimulating and deserves to be widely used and appreciated.

T. VENKATARAYUDU.

**Fundamentals of Physical Science.** By Konard B. Krauskopf. (McGraw Hill Book Company, Inc. New York), 1948. Pp. 676.

The volume under review is a revised edition of the book which was first published in 1941. Many changes have been made in the present edition, namely, a complete rewriting of the chapter on atomic nucleus, addition of a section on the uncertainty principle, introduction of Bronsted's theory in the discussion of acids and bases and increased emphasis on air mass analysis in weather forecasting. A few sections of the first edition have been omitted or shortened because they did not contribute directly to the central theme of the book.

The author states in the Preface that the book is primarily meant for College students who wish to have a general knowledge of the physical sciences rather than a detailed knowledge of any one science. The four sciences of astronomy, physics, chemistry and geology, have been condensed in the book which runs to 650 pages only. It is therefore not surprising to find that many fascinating topics had to be omitted in each one of them while many others had to be touched only lightly. In presenting the subject, emphasis is placed less on the specific accomplishments of science than on how these accomplishments are made possible. The different sciences are not treated separately, as the author wants to emphasise the unity of physical science as a field of knowledge rather than to stress its arbitrary divisions.

The book is divided into six parts, the division being based broadly on the different sciences dealt with in them. They are as follows:—(i) Astronomy and General Mechanics, (ii) General Physics and Early Chemistry, (iii) Modern Physics, (iv) Chemistry, (v) Geology and (vi) Astronomy and Frontiers of Physical Science.

Part I in which is treated the subject of astronomy with special reference to the solar system begins with a description of the efforts of early philosophers to gain an idea of the general structure of the Universe. This is followed by a detailed account of the accepted picture of the sun's family and the origin of the solar system. Fundamental problems connected with gravitational force and motion which are intimately related to the

subject of astronomy are discussed in some detail and quite a few chapters have been entirely devoted for the same in Part I. These are followed by a chapter on energy which is included in Part II. The two succeeding chapters in Part II deal respectively with the three different states of matter, and the kinetic theory of gases. The progress of chemical knowledge during the 19th century is traced in the last five chapters in Part II. The third part is devoted entirely to cataloguing the many developments in physics which took place during the past fifty years, a topic which may be appropriately called modern physics. Many important branches of modern physics, *viz.*, x-rays, radio-activity, radiation, quantum theory, spectroscopy and nuclear physics, are very briefly referred to. In Part IV the author surveys a wide variety of chemical processes. The chemistry of carbon and silicon compounds and the colloidal state of matter have also been discussed in some detail. Part V is devoted to a discussion of the geological materials that are found on the earth and of the natural processes by which these materials are altered. The sixth and the last part is again devoted to the fascinating subject of astronomy. The universe beyond the earth is described here with special reference to the stars and galaxies.

The book is written in a simple style and is well illustrated. Mathematics has been very sparingly used. By stressing the methods of scientific reasoning rather than the results, the book attempts to give to its readers a truer picture of the relationship of science to modern life and thought, better appreciation of the limitations as also the extraordinary power of the scientific method. Nevertheless, as the book covers a very wide field of knowledge, the reviewer feels that it may not be of much use to students undergoing a specific course in any one of the branches of physical science treated therein. It will, however, serve as a useful book for general reading.

R. S. K.

**Outlines of Physical Chemistry.** By Farrington Daniels. (John Wiley & Sons, Inc., New York; Chapman & Hall, London), 1948. Pp. viii + 713. \$5.00.

The teachers and the students of physical chemistry would receive with interest the publication of Professor Daniel's work. It is a completely revised form of the Getman and Daniel's older work which was regarded as one of the standard text-books on the subject in

America for more than thirty years, its last edition having been published in 1943.

In the preparation of the book under review the author has taken into consideration not only the immediate needs of the student preparing for the examination, but his greater requirements also, namely laying a sound foundation of the subject which may enable him later to devote his mind to its more complex aspects with a thorough understanding, an object very much to the heart of the teacher and the researcher alike.

In its twenty-one chapters, besides the usual subject-matter, the book deals with physical properties and molecular structure, heat work and heat capacity, phase diagram, quantum theory and atomic and nuclear structure—topics which give a sufficiently modern approach to a field wherein every new advance in the knowledge of physical and chemical sciences has left its indelible mark.

A large number of problems at the end of each chapter would undoubtedly provide the reader an insight into the laws governing molecular processes which have their importance not only in the field of pure and applied chemistry but also in apparently diverse fields such as engineering and biology.

A number of mathematical derivations which the author thinks could be 'taken for granted' by the 'hurried student', have been relegated to the appendix. At least some of these in the writer's view could have been incorporated in the text. Such are the evaluation of the constants in van der Waal's equation, calculation of distances between the planes in a crystal, the Carnot cycle, the rate equation, specific diffusion rate and the Bohr equation for the energy of an electron in an elliptical orbit.

Reference should be made to the careful selection of various diagrams and reproductions from photographs. These are always much to the point and references to them in the text have been made in bold types. This is a helpful feature which it should be always advisable to follow. The more uncommon and interesting among them are, atomic and molecular models giving correct interatomic distances and angles (this figure could have been made twice the size, with advantage), Hougen and Watson's chart for the calculation of pressure, volume and temperature of a gas at high pressure values, space models of several three component systems, Maxwell distribution of velocities of nitrogen pentoxide molecules showing the percentage of activated

molecules at different temperatures, representation of relation between activation energy forward and reverse reactions and the heat of reaction, chart for specific reaction rates at different temperatures for different activation energies and differential ('chromatographic') adsorption and elution of rare earths.

The 'Outline' thus provides from every point of view a desirable text-book which is eminently suited for adoption by our Universities.

B. K. VAIDY

Technique of Organic Chemistry. Vol. 2 (Interscience Publishers, New York), 1948. Pp. 219. \$5.00.

This is the second volume of the very valuable series on the Technique of Organic Chemistry, edited by Dr. Arnold Weissberger of the Eastman Kodak Research Laboratories. The first volume which was in two parts dealt with the Physical Methods of Organic Chemistry, and the present volume comprises chapters on Catalytic Reactions by V. I. Komarevskiy and C. H. Riesz, Photochemical Reactions by W. Albert Noyes, Jr. and V. Boekelheide, and Electrolytic Reactions by Sherlock Swann. The theoretical background, procedure and apparatus employed in carrying out the reactions, their scope and limitations, a general bibliography and numerous references to specific topics are included in each chapter. The book is a link between the organic chemist and the chemical engineer, and will probably be of the utmost assistance to research workers in both these fields who are concerned with catalytic, photochemical and electrolytic reactions and processes.

The chapter on catalysis contains useful practical details for the preparation of catalysts of different types (Raney nickel, copper-nickel and vanadium pentoxide being no omissions), and an excellent account of procedure and laboratory apparatus for various catalytic reactions by batch and continuous methods and at pressures ranging from sub-atmospheric to several hundred atmospheres. High pressure technique is treated with a wealth of detail which will be invaluable to the organic chemist who desires to investigate high pressure reactions in general. The emphasis throughout is on apparatus and technique, and there are few references to individual substances prepared by catalytic reactions.

The chapters on photochemical and electrolytic reactions follow a somewhat different

The treatment of technique and apparatus is less detailed, and more attention is devoted to the chemistry of the reactions. The types of photochemical reactions are classified and preparatory details are given for several compounds (e.g., benzopinacol, *p*-bromobenzyl bromide, di-*n*-propyl sulphide). The technically important photochemical rearrangement of ergosterol to calciferol receives, however, only very brief consideration. Chain reactions influenced by light such as photochlorination are described with citations of many examples, and the utility of photochemistry in organic synthesis is fully demonstrated. The chapter on electrolytic reactions covers the ground very thoroughly, and numerous examples of reactions of synthetic value are quoted. The advantages of electrochemical synthesis are set out and should serve as a stimulus for the wider use of electrochemical methods for the preparation of organic compounds as part of the programme of practical work in an Honours course in chemistry.

The indexing is unsatisfactory. Thus hydrogenation and reduction are not mentioned, although examples are given in connection with the preparation of catalysts.

K. V.

**The Manufacture of Iron and Steel.** By G. Reginald Bashforth, F.I.M. (Chapman & Hall), 1948. Pp. viii+228. Price 21sh.

The author has neatly covered in fair detail practically all the aspects of Iron production. The volume under review should therefore prove extremely useful to Metallurgy students. A typical feature of the book is the latest reference appended throughout the pages in support of the voluminous data condensed in the text.

The contents are neatly laid out and well balanced. Reference to Bihar and C. P. Hæmatites iron ore belts has not been made in relation to India's iron ore deposits although Mysore Magnetites deposits have been referred to. It may be pointed out the Bihar and Bengal iron ores of India form one of the richest iron ore deposits of the world. Further chapters deal effectively with the technical processes involved in Iron and Ferro-alloy's production.

The language of the book is precise and the information contained should prove useful both to the students as well as to a large measure to industrialists for reference study. The technical details of the processes involved

are quite comprehensive. The pages on electric reduction of pig iron, however, lack adequate reference to the Swedish processes and their results. This may be ascribed to lack of space.

The book is a very useful addition to the metallurgical texts on Iron Production.

B. R. NIJHAWAN.

**Chromosome Numbers of Northern Plant Species.** By Åskell Löve and Doris Löve. (University Institute of Applied Sciences, Department of Agriculture, Reports, Series B, No. 3, Reykjavik), 1948.

The impact of other botanical sciences on plant systematics has been felt gradually since the beginning of this century. Plant geography has been one of these which has been of much help to taxonomy. The rapid development of genetics and cytology has thrown considerable light on speciation in plants and animals and the aid of these allied sciences appears to be very necessary if real differences between species have to be correctly established by taxonomists. The future taxonomist will, therefore, largely depend on results of cytogenetic investigations in the creation of new species or the delimitation of existing species. Information so far obtained by cytogenetic investigations on the interrelationship of species has been of considerable importance and it points to the future possibilities of gaining more information. There is thus both a scope and a necessity for undertaking work on the study of the interrelationship of taxonomic species from a cytogenetic angle. In this regard the publications of lists of chromosome numbers of plants has to some extent been of help to systematists among others.

The book under review lists the chromosome numbers of the plants of the Scandinavian countries and includes the higher flowering plants, gymnosperms and the pteridophytes. In a previous publication by the same authors the chromosome numbers of the flora of the four Scandinavian countries, viz., Denmark, Finland, Norway and Sweden were recorded but in the present publication the previous information has been amplified by the inclusion of the flora of the Færoes and Iceland. As the authors point out, "the present list is not only a list of chromosome numbers of the species met with in the area but is also a complete list of the floras of the six Northern countries". Thus the publication is of use to geneticists, cytologists and taxonomists.

On page 11 is given an interesting table

which furnishes information on the total number of species present in the six northern countries and the percentage of these cytologically determined. It is observed that a very high percentage varying from over 50 to 90 per cent. of the species of pteridophytes, gymnosperms and angiosperms have been cytologically studied. Another interesting information given is that more than fifty per cent. of the angiosperms of these areas are polyploids.

It would be of considerable help if similar lists of chromosome numbers of the flora of other geographical regions of the world, which would include the known floras of the area, are published.

The publication is most appropriately dedicated to Tischler who was the first to publish a list of chromosome numbers of plants. A key to the use of the publication, an index to synonyms, a bibliography and an index to genera are useful additions furnished.

L. S. S. KUMAR.

**Dictionary of Genetics.** Compiled by R. L. Knight. Vol. 2 of *Lotsaya—A Biological Miscellany*. (The *Chronica Botanica* Company, U.S.A.; Macmillan & Co., Ltd., Calcutta), 1948. Pp. ix+183. Price \$4.50.

Under the editorship of Dr. Frans Verdoorn, the second volume of the series *Lotsaya—Biological Miscellany* has been issued. This volume is a *Dictionary of Genetics* prepared by Dr. Knight, Cotton Geneticist, Sudan.

The *Dictionary* is a comprehensive one, for, terms used in allied subjects, cytology, animal breeding and evolution, have been included. There has been no narrow adherence to these subjects alone, and terms used in animal embryology, and cytologically important chemical terms are included, making a total of about 3,000 entries. This is followed by brief appendices dealing with the formulæ of biometry important in genetics and plant breeding with six relevant tables.

There is a need for a dictionary of this type and in the Preface, the present confusion in terminology is pointed out. This book can be claimed to be a pioneer in this field, for generally the lists compiled by other geneticists have been brief appendices to a text. Dr. Knight has made good use of their compilation. For some of the important terms the definition is given and its author's name cited.

This *Dictionary* is not one which gives an explanation of new terms to a beginner, but one which tries to define the meanings with

a view to greater precision in their use. A criticism of the definitions is difficult, as the terms are closely bound up with concepts and interpretations in this controversial subject. As an example the following may be pointed out. *Strepsitene* is termed a misnomer, according to Dr. Darlington, while *chromonemata* is defined as by Nebel, and Darlington's view is not presented. No simple solution is offered to the difficulty pointed out in the Preface that new words are being coined by research workers for which often the old ones will do, or which could be better constructed and defined. The remedy presumably is for the biologists to bestow greater care on the current usage. For this purpose, this *Dictionary* is a help and the author has done a service to geneticists.

C. G.

**Biological Reactions caused by Electric Currents and by X-Rays.** J. Th. Bander Werff, M.D., D.Sc. (Published by Elsevier Publishing Company, Inc., New York, Amsterdam, London and Brussels), 1948. Pp. xii+230. Price 30sh.

Biology is a science much younger than physics; therefore mathematico-theoretical developments in it have been until recently entirely lacking. During the last decade or two, considerable progress has been made towards the logical understanding of many observations which were known but ill understood. Using mathematical analysis and methods borrowed from mathematical physics, the science of mathematical biophysics plays the same role with respect to experimental biology and medicine as mathematical physics does with respect to experimental physics.

Such a book as the above is therefore welcome. It contains a theoretical study of the phenomena of excitation in the nerve by different electric currents and of the biological reactions in tissues caused by x-rays, both based upon a common principle. It is assumed that these cause changes in assimilation and dissimilation processes of metabolism, as a result of some disturbances. However, little further advance is to be expected unless more is known of these metabolic processes of life.

The theory described above has been useful in indicating the possibilities and limitations of x-ray therapy. Its most important result has been to unite the two fields in which so many investigators have spent their energy for so many years.

INDERJIT SINGH.

*The Science of Animal Life.* By A. M. Winchester. (Van Nostrand Co., New York; Macmillan & Co., London), 1948. Pp. xii+437. Price \$4.50.

There is a general feeling among students that far too many technical terms abound in a study of biological sciences, a part of which at least one has to remember in pursuing a course in them. In order that the beginner may not be spirited away from a study of zoology, Winchester, in the book before us, has tried to avoid as far as possible the use of technical terms explaining, however, their meaning fully wherever they have been employed inevitably. Further, in order to evoke the maximum amount of interest in the student, he has portrayed the subject in an interesting manner.

There are 31 chapters including invertebrates, chordates, and general principles like genetics and embryology, and the book concludes with a glossary and an index. About half the book is devoted for the consideration of the invertebrates while the other half deals with chordates and general principles.

While perusing the book, it is noticed that in fig. 21.3 (p. 238) the olfactory and optic regions are labelled 'nasal foramen' and 'optic foramen' respectively; these terms are inappropriate. Again, in the description of the frog's brain, it is not stated to which part of the original segmentation the diencephalon belongs. The figure of the alimentary system (p. 249) gives a wrong idea with regard to the hepatic duct which is shown independently of the pancreas.

Under aquatic vertebrates, the cyclostomes, elasmobranchs and other fishes are treated. The derivation of the term 'teleostei' is misleading. It not only means 'perfect' but also 'end'; in defining 'teleostomi', it may not be justifiable to describe them as 'perfect mouthed' fishes as the author has done, but as fishes having mouth at one end. Undoubtedly the term 'teleostei' would mean fishes which are completely bony. Similarly, in the glossary, the term 'telolecithal' (p. 427) is explained as an egg showing uneven yolk distribution! Under reptilia, the figure (25.5, p. 284) representing the development of an embryo of a reptile or a bird, definitely conveys a wrong idea to the student; the allantois is drawn as a double-walled bag completely enclosing the embryo.

In describing the snakes, the author has indulged in not a little folklore and on page 296, it is most amusing to read 'Unfortunately

the majority of the people hold them in superstitious reverence and they do not kill them for fear that they may be the reincarnation of their late grandmother or other relatives'.

In the chapter on mammals, the fig. 27.1 (p. 325) is drawn to show the developing embryo of a mammal. In this it has failed, for the figure is not of a generalised type and further, the legend reads, that "the allantois has been replaced by the placenta" which is not at all correct.

There are a few printer's devils: 'righ' for 'high' (p. 262), 'Lepisosteus' for 'Lepidosteus' (p. 274) and 'an an exception', for 'an exception' (p. 326).

For a serious student of zoology, the book provides little food for thought, while it may satisfy the requirements of a beginner for whom the figures have been drawn, sacrificing the details. One must congratulate the author on the excellent photographs enlivening the book.

L. S. R.

#### Storing and Drying Grain—FAO Agricultural Studies No. 6.

Studies of methods used in Canada, the United States and the United Kingdom in drying grain before storage, have been released by the Food and Agricultural Organisation as a stimulus to the spread of information on protection of stored grain from insect and fungal attack. Great stress has been laid on the proper conditioning and storage of grain as the most important factors in preventing losses due to insects and fungi, at an international meeting on infestation of food stuffs held in London in 1947 where the loss was estimated at 33 million tons enough food to keep 150 million people alive for a year.

The methods used in these three highly industrialised countries, while far from ideal to all the countries, will, doubtless, be of help and interest to the other parts of the world.

Canada is very favourably placed in the matter of storing and handling grain because of the low temperature prevailing there throughout most of the year. The United States of America enjoys higher average temperatures and the humidity is also higher in many sections. Grain therefore faces greater danger from infestation and loss there than in Canada; the moisture content of the grain must necessarily be lower for safe storage; the diversity of the crops grown in U.S.A. also makes the problem more difficult.

The United Kingdom is faced with the two-

fold problem of handling and storing imported as well as home-produced grain.

In Canada and U.S.A. the extent to which Science is applied to the handling of cereal crops in the field, is most unusual to other parts of the world. The extensive use of the combine harvester in these two countries, while effecting great savings in labour, has created new storage problems, since, harvesting by combine, ordinarily leaves no time for the grain to dry out between cutting and threshing; also the cutting of the green weeds with the grain, frequently results in the transfer of moisture from immature weed seeds to the drier grain kernels. The United Kingdom into which the combine harvester is now being rapidly introduced, has now to meet the increased demand for new methods and machines to cope with the new problems of grain storage.

The existing methods of handling, drying and storing grain described in the studies released by the FAO of the United Nations, are many and varied. Strict regulations concerning grain drying in the matter of the moisture content of different grain to be stored and maximum temperature of the hot air in drying grain artificially which are laid down and

enforced are described. Results of experiments on the factors such as—effects of drying conditions on grain temperature and quality and the factor of different initial moistures—and minimum time required for safe drying under desirable and effective temperature are given in detail. The important part played by proper ventilation in safe storage in different kinds of bins is pointed out clearly and natural ventilation as well as that obtained by means of forced air are also dealt with. Useful information on Farm grain driers—Commercial grain driers—and grain drying in elevators—is provided. The national grain Silos in the United Kingdom established during the war as a contribution towards solving the problem of grain drying and bulk storage arising from the introduction of the combine harvester and the great expansion of wheat acreage, are pointed out as a great feature of the country, serving a useful purpose in setting high standards of drying and handling and in dealing with the wettest part of the crop in each year, since, without their being in operation, most of the grain handled by the ordinary and general silos in the country, would have been probably spoiled.

B. K. M.

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## SCIENCE NOTES AND NEWS

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### Fishery Research\*

Fishery Research is the investigation of problems connected with the production and proper utilization of the fish and other wealth from the waters. The first care of Fishery Research is that the areas concerned shall be fished right up to their fishable limit, but without harming the stock for future years. The investigations are therefore to be directed towards finding out not only the total productivity of the areas but also the correct type of fishing gear and the rate and frequency of fishing, as well as the details regarding the ecology, life-histories and the economic value of the different species of fish themselves. Such investigations provide the basis to evolve stocking policies and regulations for proper fishery management. The other part of Fishery Research aims at

finding out suitable methods to preserve, cure, transport and store the fish and fishery products to ensure the best possible quality.

These investigations require the establishment of well-equipped and well-staffed biological and technological laboratories and seagoing research vessels. Large sums of money are being spent in this direction in all the advanced countries of the world. Japan, for instance, had more than 120 fishery research stations before the war; Russia has fifteen large fishery research vessels to-day; and the United States of America have added just last year a 525 ton vessel fitted with all the latest equipment, to their large research fleet.

In Indian seas, fishing is done only in the inshore regions which form a fraction of the 74 million acres of the continental shelf. Trawling experiments conducted off the coasts of Bombay, Bengal, Madras and Ceylon indicate greater possibilities for fishing the richer beds, but more

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\* Abstract of a Radio Talk, A.I.R., March 1949, by Mr. K. Chidambaram, M.A., F.Z.S., Assistant Director of Fisheries, Madras.